WASTE MANAGEMENT

GO GREEN, BEAT PLASTIC POLLUTION AND WASTE MISMANAGEMENT

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ENVIS, The Ministry of Environment, Forets and Cliamate Change, GoI

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ENVironmental Information System[ENVIS]
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Proposed Certificate Courses/Training programmes under GSDP for Master Trainers (MTs)/ Specialists to commence in July, 2018

Sl No.	Title of Certificate Course with required Minimum Qualification	ENVIS Hubs/RPs and Institutions/Entities concerned	Prospective Employment Opportunities in
1.	Value addition & marketing of NTFPs (Plant Origin) (a) Lantana Furniture and Crafts (b) Coconut Shells & Fibre Handicrafts (c) Bamboo Crafts (d) NTFP Products / Medicinal Plants {(a, b, c) No minimum qualification, (d) Class 12th Pass}	1. AFRI, Jodhpur (d) 2. BNHS, Mumbai (c) 3. CSF, AVV, Coimbatore (a,d) 4. DoE&F, Itanagar (c,d) 5. DoE&F, Kavaratti (b) 6. FRI, Dehradun (c,d) 7. F&ED, Ranchi (c) 8. HFRI, Shimla (c) 9. IPIRTI, Bengaluru (c) 10. IWST, Bengaluru (d) 11. KSCSTE, TVM (c) 12. RFRI, Jorhat (c) 13. TFRI, Jabalpur (d)	Self-employment / Master Trainer
2.	Community based conservation of Mangroves Ecosystem {Class 10th Dropout}	1. CASMB, Parangipettai, Tamil Nadu 2. GEC, Gandhinagar 3. BSI, Pune	Govt./Nurseries/Forest Departments
3.	Value addition & marketing of NTFPs (Animal Origin) (a) Wild Bee Keeping and Processing (b) Lac & Tassar Cultivation {Class 10th Pass}	1. ASTEC, Guwahati (a) 2. IFP, Ranchi (b)	Self-employment / Master Trainer
4.	Nature Conservation & Livelihood: (a) River based - Ganga Prahari (b) Nature Interpretation (c) Eco-tourism (d) Scuba Diving for marine life conservation # {Class 10th pass}	1. WII, Dehradun (a, b) (b) 2. DoE&F, Kavaratti (d) 3. GBPNIHESD, Almora 4. SCSTS, Gangtok (c)	Self-employment / Master Trainer
5.	Quality Planting Material Producer {Class 10th pass}	IFGTB, Coimbatore	Self-employment / Master Trainer
6.	Sustain and Enhance Technical Knowledge in Solar Energy Systems {Class 12th dropout}	1. EPTRI, Hyderabad 2. TERI, Patna 3. Department of Environment – Chandigarh 4. DoEERS, J&K	Self-employment / Private Firms / Govt. bodies
7.	Propagation and Management of Bamboo {Class 12th Pass}	1. FRI, Dehradun 2. HFRI, Shimla 3. IFP, Ranchi 4. IWST, Bengaluru 5. KSCSTE, Thiruvananthapuram 6. RFRI, Jorhat 7. TFRI, Jabalpur 8. F&ED, Ranchi	Self-employment / Nurseries / Botanical Gardens / Master Trainer
8.	Management of Small Botanical Gardens {Class 12th Pass}	1. CPREEC, Chennai 2. FRI, Dehradun 3. F&ED, Ranchi 4. AFRI, Jodhpur 5. TFRI, Jabalpur 6. KSCSTE, Thiruvananthapuram	Self-employment/Nurseries/ Botanical Gardens/Households/ Corporates/ Govt./University campuses
9.	Plantation Techniques and Utilization of Renewable Energy in Arid Zone {Class 12th pass}	ICAR-CAZRI, Jodhpur	Self Employment / Research Institutions related to the theme
10.	Forest Fire Management {Class 12th pass}	DMI, Bhopal	Forest Departments
11.	River Dolphin Conservation {Class 12th pass}	ZSI, Patna	ZSI / Research Institutions related to the theme
12.	Forest Entomology & Pest Control {Graduate}	1. FRI, Dehradun 2. KSCSTE, Thiruvananthapuram 3. TFRI, Jabalpur	Pest Control Agencies/ Companies/ Forest Departments/ Research Institutions
13.	Valuation of Ecosystem Services and Green GDP {Graduate}	1. BNHS, Mumbai 2. EPTRI, Hyderabad 3. IISc, Bengaluru 4. KSCSTE, Thiruvananthapuram	GRIDSS/ Research Institutions etc.
14.	Water Budgeting & Auditing {Graduate}	1. ADRI, Patna 2. EPTRI, Hyderabad	Urban local bodies/ Panchayats in rural areas/ Industries/ Water treatment plants/ Research Institutions etc.
15.	Paralegal Practices : (a) Forestry Acts and Policy (b) Environmental Laws {Graduate}	1. ICFRE, Dehradun (a) 2. NEHU, Shillong (b) 3. NLSIU, Bengaluru (b)	Facilitation Centres in State Forest Departments/ Law Firms
16.	ETP/STP/CETP Operation and Maintenance {Science Graduate}	1. CECB, Raipur 2. CSIR-NEERI, Nagpur 3. EPTRI, Hyderabad 4. GCPC, Gandhinagar	ETP/STP/CETP Plants in industries/Municipal Corporations/ Councils/Boards
17.	Pollution Monitoring : Air and Water Pollution {Science Graduate/ Diploma in Engg.} Soil Pollution {Science Graduate/ Diploma in Engg.}	1. ADRI, Patna 2. CPCB, Delhi 3. EPTRI, Hyderabad 4. IIT-ISM, Dhanbad 5. IITM, Pune 6. MPCB, Aizawl 7. NPCB, Dimapur 8. Puducherry PCC 9. TSPCB, Agartala 10. UEPPCB, Dehradun 11. CPCB-RD, Bhopal 12. CPCB-RD, Bengaluru 13. CPCB-RD, Kolkata 14. CPCB-RD, Lucknow 15. CPCB-RD, Shillong 16. CPCB-RD, Vadodara 17. NBRI, Lucknow	CPCB/SPCB/ Municipal Corporations/ Councils
18.	Laboratory Technicians / Technical Assistants for electrical testing for environmental criteria {ITI (Electrician/Wireman)/ Diploma/Degree (Electrician/Wireman)}	CERC, Gujarat	Private firms/Govt. certifying institutions/bodies
19.	Emission Inventory {Graduate / Post Graduate / Engineering background}	IITM, Pune	CPCB/SPCB/ Municipal Corporations/ Councils
20.	Para-Taxonomy [including Peoples Bio-diversity Register (PBR)] {Science Graduate only (with Bio Science)}	1. ASTEC, Guwahati 2. BNHS, Mumbai 3. BSI, Kolkata 4. BSI, Allahabad 5. BSI, Coimbatore 6. BSI, Dehradun 7. BSI, Gangtok 8. BSI, Itanagar 9. BSI, Jodhpur 10. BSI, Port Blair 11. BSI, Pune 12. CASMB, Parangipettai, Tamil Nadu 13. CES, Bhubaneswar 14. DESKU, Nadia, W. B. 15. DoE, Imphal 16. DoE&F, Itanagar 17. EPTRI, Hyderabad 18. GBPNIHESD, Almora 19. GEC, Gandhinagar 20. HIMCOSTE, Shimla 21. IOM, Chennai 22. SACON, Coimbatore 23. ZSI, Kolkata 24. ZSI, Dehradun 25. ZSI, Itanagar 26. ZSI, Jodhpur 27. ZSI, Kozhikode 28. ZSI, Port Blair 29. ZSI, Pune	GRIDSS / BSI / ZSI / FRI / ICFRE / SACON / Zoos / wildlife sanctuaries/ national parks / biosphere reserves / Botanical Gardens/ Bird Sanctuaries/ Nurseries/ wetland sites/WCCB Regional Offices/ State Biodiversity Boards/ Biodiversity Management Committees
21.	Bird Identification and basic ornithology {Class 10th Dropout}	1. BNHS, Mumbai 2. SACON, Coimbatore	
22.	Bird Migration and Migration study techniques {Graduate with basic knowledge of birds}	BNHS, Mumbai	
23.	Wildlife Management using Geospatial Techniques {Science Graduate}	WWF, Delhi	
24.	Monitoring Ecosystem Health using Invertebrates {Science Graduate (Zoology / life sciences)}	ZSI, Chennai	ZSI / Research Institutions related to the theme
25.	Plant Tissue Culture Techniques and its Applications {Science Graduate}	1. BSI, Dehradun 2. BSI, Shillong 3. BSI, Yercaud 4. DESKU, Nadia, W. Bengal 5. EPTRI, Hyderabad 6. KSCSTE, TVM 7. TFRI, Jabalpur	Research Institutions related to the theme
26.	Waste Management: (Solid Waste, Biomedical Waste, Plastic Waste, E-Waste, Construction and Demolition Waste) {Science Graduate}	1. AFRI, Jodhpur 2. CPREEC, Chennai 3. CSIR-NEERI, Nagpur 4. DESKU, Nadia, W.Bengal 5. DzUM, Chennai 6. EPTRI, Hyderabad 7. FRI, Dehradun 8. F&ED, Ranchi 9. IISc, Bengaluru 10. KSCSTE, TVM 11. NEHU, Shillong 12. TCE, Madurai 13. TFRI, Jabalpur 14. TSPCB, Agartala	Municipal Corporations/ Councils
27.	Laboratory Assistant for Eco-friendly Food testing Laboratory {Science Graduate}	1. CERC, Gujarat 2. NIOH, Gujarat	Eco-friendly Food Testing Labs
28.	Cleaner Production Assessment {Science Graduate}	GCPC, Gujarat	Industries
29.	Greenbelt Development for Industries {Science Graduate}	NBRI, Lucknow	Self-employment / Private Firms / Govt. bodies
30.	City Environmental Surveyor {Science Graduate/ B.Tech (Env. Engg.) / B.Planing}	SPA, Delhi	Environmental Cell in States/ UTs/Development Authorities/ Municipal Corporations/ Councils

Importance of Skilling India's Youth

India's youthful manpower, a result of the demographic dividend,need to be provided with skills and ability to tackle global challenges. The more we give importance to skill development the more competent youth will be. It is important to predict the possibilities of the future, and prepare for them today itself. We have to make India the skill capital of the world.

- Shri Narendra Modi,
Prime Minister of India

To protect the environmental right of our future generations, all of us have a green social responsibility. The fast evolving and emerging technologies in dynamic world to combat the menace of environmental degradation need to be complemented by specially trained and skilled manpower in various field at all levels. Imparting skill sets for greener transformation will generate employment opportunities and strengthen our resolve to conserve and preserve the priceless environment."

- Dr. Harsh Vardhan, Minister,
Environment, Forest and Climate Change

India's youth needed to be empowered with skill development with focussed training in their areas of interest. For instance, there is need for skill development at the grassroots to meet the challenges of hospitality and tourism industry in order to better harness India's tourism potential.

- Dr. Mahesh Sharma, Minister of State,
Environment, Forest and Climate Change

Green Skill Development Programme

The Ministry of Environment, Forest & Climate Change (MoEF&CC) has been implementing a Central Sector Scheme titled ENVIS since 1982-83. ENVIS, by providing scientific, technical and semi- technical information on various environmental issues, has served in facilitating policy formulation and environment management at all levels of Government as well as in decision–making aimed at environment protection and its improvement for sustaining good quality of life for all living beings. ENVIS is a decentralized network of 66 centres of which 31 Centres dealing with "State of the Environment and Related Issues" are hosted by State Government /UT Administrations, called ENVIS Hubs and remaining 35 Centres are hosted by environment-related governmental and non-governmental organisations/ institutes of professional excellence, with varied thematic mandates pertaining to environment, called the ENVIS Resource Partners (RPs).

Utilising the vast network and expertise of ENVIS Hubs/RPs, the Ministry for the first time, has taken up an initiative for skill development in the environment and forest sector to enable India's youth to get gainful employment and/or self employment, called the **Green Skill Development Programme (GSDP).** The programme endeavours to develop green skilled workers having technical knowledge and commitment to sustainable development, which will help in the attainment of the Nationally Determined Contributions (NDCs), Sustainable Development Goals (SDGs), National Biodiversity Targets (NBTs), as well as Waste Management Rules (2016).

1. Background: India being the second most populous country in the world is bestowed with a large working population. India has advantage of reaping this demographic dividend. However, high drop-out rates from school coupled with poor vocational skills may hinder in reaping this dividend. There exists a demand-supply gap of skill sets, both cognitive and practical, at various levels in the Environment/ Forest fields in India.

Green skilling is crucial for making a transition from energy and emissions – intensive economy to cleaner and greener production and service patterns. It also prepares people for green jobs that contribute to preserving or restoring the quality of the environment, while improving human well-being and social equity. Hence activities under GSDP include process-based green skills such as, monitoring and managing activities such as waste, energy efficiency, impact minimization and assessment, etc. Facilitating the employment/self-employment of the skilled manpower is major goal of GSDP.

Realizing the demand for green skilled youth, the Green Skill Development Programme (GSDP) has been conceptualised and developed in MoEF&CC in consultation with the National Skill Development Agency (NSDA), the nodal agency for synergizing skill development initiatives in the country, under the Ministry of Skill Development & Entrepreneurship (MSDE). All skilling modules would be NSQF compliant. For more information on National Skill Qualification Framework (NSQF) and Common Norms please follow the link: http://www.nsda.gov.in/nsqf.html

2. Present Status: The first GSDP course was formulated for skilling Biodiversity Conservationists (**Basic Course: 3 months-Completed**) and Para-taxonomists (**Advanced Course: 3 months - Ongoing)** and is running on pilot basis in **ten** select districts (covering nine bio-geographic regions). The pilot course has received positive feedback from all stakeholders. For more information on Training Module and Success stories please follow the link: https://goo.gl/PzUTvy

3. Way Forward: With the success of the pilot programme, the next step is to take the skilling programme to an all India level and for all the courses to commence in July, 2018.

List of courses currently offered along with the prospective employment opportunities and ENVIS Hubs/RPs and Institutions/ Entities imparting the courses is given overleaf. The list is not finite and will be increased depending on the demand for the same.

Master Trainers/Specialists:

The list of the courses indicated above would be carried out by the respective ENVIS Hubs/RPs and Institutions/Entities. To expand the skill development programme at a larger scale, there is a requirement to train a pool of **Master Trainers/ Specialists** who can further train youth across the country. Hence, the Ministry would initially create a pool of master trainers in each of the above mentioned courses. As per the requirement of the skilling programme, Graduates in Science/Arts and even drop-outs would be trained to become master trainers.

These courses would commence from July, 2018 across India. These Master Trainers/Specialists would in turn then help in training participants in various States/UTs. These Master Trainers would form the backbone of the entire programme in the years to come. The frequency of conducting each programme in a year would depend on the total duration of each course which would vary from course to course and accordingly the number of skilled persons would increase. Duration of these courses ranges from 80 to 560 hours.

Project Mode: Skilling in Air/Water/Soil Pollution monitoring and management of STP / ETP / CETP operation and maintenance and waste management will be undertaken in project mode in specific stretches of rivers.

Collaborations:

The Ministry has held deliberations with various stakeholders and welcomes any collaboration/ participation/ partnership in the programme from national and international organisations/ institutes/ agencies etc. to build a strong network which can be utilised for green skilling under GSDP for sustainable conservation and management of our natural resources.

For any queries/feedback please feel free to contact us at:

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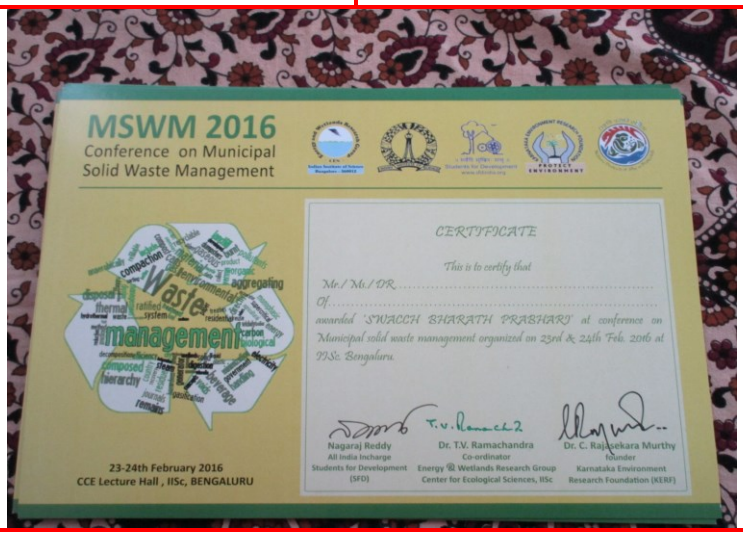

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Waste Management

Course Overview:

Geographic Information System:	**Remote Sensing**:
▪ GIS: Introduction Real World to GIS Data modeling ▪ Geodesy and Map projections ▪ Demo of Vector & Rastor Analysis ▪ Maps and Map projections ▪ Open source GIS: Overview Global positing system and GNSS	▪ Remote Sensing Concepts ▪ Digital Images ▪ Image Classification ▪ Remote Sensing Data and DBMS ▪ Digital Image Processing ▪ Remote Sensing Applications in EIA
▪ Open Source geospatial technology and their role in the conservation of Biodiversity of Western Ghats; Hands on Mobile apps in the field database generation ▪ Resolutions and Satellites: Detailed specifics on different resolutions, satellites, orbits ▪ Grass intro+ Working including extraction of stream layers, dem, land cover and land use ▪ QGIS – Hands on sessions	
1. Municipal Solid Waste Management: An Introduction. 2. MSWM In India: Issues and approaches 3. Generation and Characteristics of Waste. 4. Waste Collection, Storage and Transport. 5. Waste Disposal. 6. Waste Processing Techniques. 7. Source Reduction, Product Recovery and Recycling. 8. Recovery of Biological Conversion Products: Compost and Biogas. 9. Incineration and Energy Recovery. 10. Hazardous Waste: Management and Treatment. 11. Integrated Waste Management (IWM). 12. Geographic Information System (GIS) and Remote Sensing data in planning and management of MSW. 13. Constitution and Demolition Waste 14. Biomedical Waste Management 15. E Waste Management	

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Waste Management

SAHYADRI: ENVIS Centre on Western Ghats Biodiversity and Ecology

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Web: http://ces.iisc.ernet.in/energy, http://ces.iisc.ernet.in/biodiversity
Open Source GIS: http://ces.iisc.ernet.in/grass

GIS: Introduction

Many of our decisions depend on the details of our immediate surrounding, and require information about specific places on the Earth's surface. In this regard, recent developments in information technologies have opened a vast potential in communication, analysis of spatial and temporal data. Data representing the real world can be stored and processed so that they can be presented later in a simplified form to suite specific needs. Such information is called geographical because it helps us to distinguish one place from another and to make decisions for one place that are appropriate for that location. Geographical information allows us to apply general principles to the specific conditions of each location, allows us to track what is happening at any place, and helps us to understand how one place differs from another. Spatial information is essential for effective planning and decision-making at regional, national and global levels. The geographical information in the form of maps (based on field surveys), photos taken from aircraft (aerial photography), and images collected from the space borne platforms (satellite) can be represented in digital form, this opens an enormous range of possibilities for communication, analysis, modeling, and accurate decision making, but a degree of approximation.

GIS can be defined as computerized information storage processing and retrieval system that has hardware, software specially designed to cope with geographically referenced spatial data. Collective name for such system is geographical information systems, (GISs). Processing geographical information include:

- Techniques to input geographical information, converting the information to digital form
- Technique for sorting such information in a compact format on computer disks, and other digital storage media
- Methods for automated analysis for geographical data, to search for the patterns, combine different kinds of data, make measurements find optimum sites or routes, and a host of other tasks

- Methods to predict the out come of various scenarios, such as the effects of climate change on vegetation
- Techniques for display of data in the form of maps, images and other kinds of display
- Capabilities for output of results in the form of numbers and tables.

Elements of GIS: Components of geographical data are ***Spatial and Attribute Database, Cartographic Display System, Map Digitizing System, Database Management System, Geographic Analysis System, Statistical analysis system and Decision support system.*** The linkages among these components is illustrated in Figure 1.1.

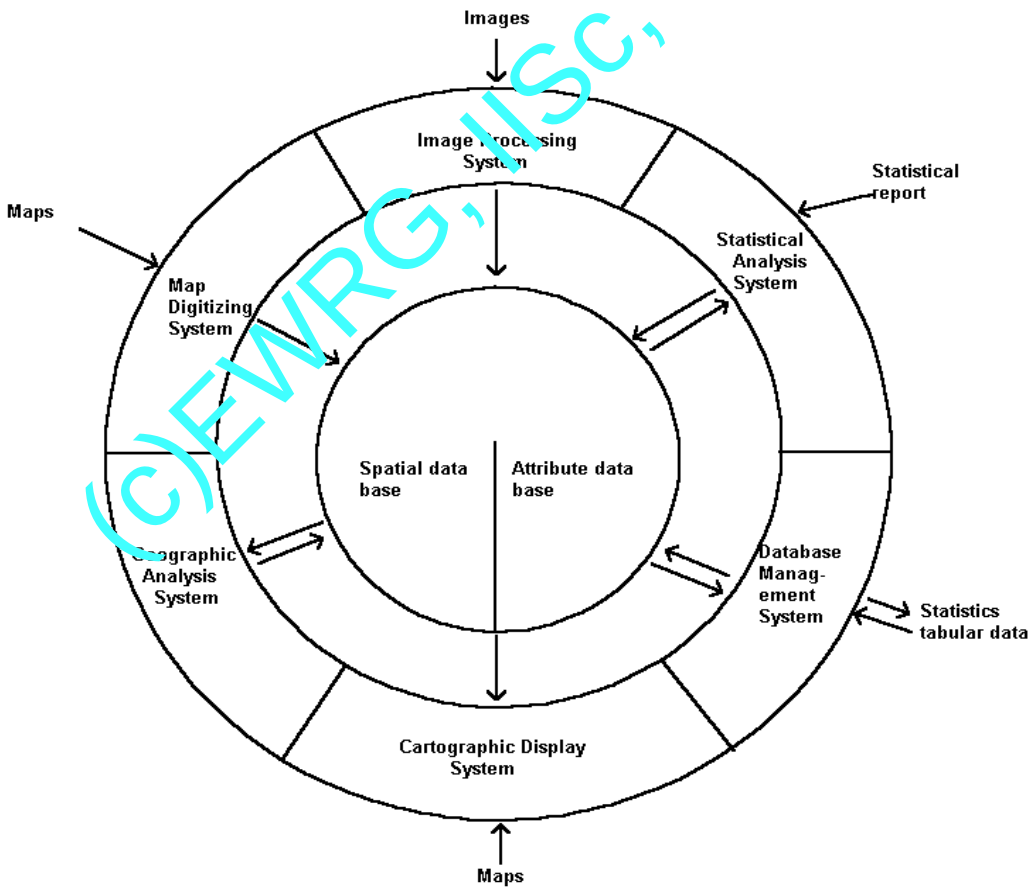


Figure 1.1: Components of GIS.

i). ***Spatial and Attribute Database:*** Central to the system is the database – a collection of maps and associated information in digital form. Since the database is concerned with earth surface features, it is seen to comprise of two elements – a spatial database describing the geology (shape and position) of the earth surface features, and an attribute database describing the characteristics or quantities of these features. Thus, for example, we might have a property parcel defined in the spatial database and qualities such as its land use, owner, property valuation, etc. in the attribute database.

ii). ***Cartographic Display System:*** Surrounding the central database, we have a series of software components. The most basic of these is the cartographic display system. The cartographic display system allows one to take selected elements of the database and produce map output on the screen or some hardcopy device such as printer or plotter.

iii). ***Map Digitizing System:*** After cartographic display, the next most essential element is a Map Digitization System. With a map digitizing system, one can take existing paper maps and convert them into digital form, thus further developing the database. In the most common method of digitizing, one attaches the paper map to a digitizing tablet or board and then traces the features of interest with a stylus according to the procedures required for digitizing. Many maps digitizing system also allows for some editing of the digitized data. Scanners can also be used to digitize data such as aerial photographs. The results is a graphic image, rather than the outlines of features that are created with a variety of standard graphics file formats for export. These files are then imported into the GIS. Computer assisted design (CAD) and Coordinate Geometry (COGO) are two examples of software systems that provide the ability to add digitized map information to the database, in addition to providing cartographic display capabilities.

iv). ***Database Management System***: The next logical component in a GIS is Database Management System (DBMS), which is used to input, manage and analyze attribute information along with then spatial data. GIS thus typically incorporates a variety of utilities to manage the spatial and attribute components of the geographic data. DBMS aids to enter attribute data, such as tabular information and statistics, and

subsequently extract specialized tabulations and statistical summaries to provide new tabular reports. The DBMS provides the ability to analyze attribute data. Many map analysis have no true spatial component, and for these a DBMS will often function quite well. For example, we might inquire of the system to find all property parcels where the head of the household is single but with one or more child dependents, and to produce a spatial map. Software that provides cartographic display, map digitizing, and database query capabilities are often referred to as Automated Mapping and Facilities Management (AM/FM) system.

v). ***Geographic Analysis System:*** Up to this point, we have described a very powerful set of capabilities that the GIS offer, the ability to digitize spatial data and attach attribute to the features stored; to analyze these data based on those attribute; and to map to the result. But on inclusion geographic analysis system, we extend the capabilities of the traditional database query to include the ability to analyze data based on their location. Perhaps the simplest example of this is to consider what happens when we are concerned with the joint occurrence of features with different geographies. For example, suppose we want to find all areas of residential land on bedrock types associated with high levels of radon gas. A traditional DBMS cannot solve this problem because bedrock types and landuse divisions simply do not share the same geography. Traditional database query is fine as long as we are taking about attributes belonging to the same features. But when the features are different, it cannot cope. For this we need a GIS. In fact, it is this ability to compare different feature based on their common geographic occurrence that is the hallmark of GIS. This analysis is accomplished by the process of overlay, thus named because it is identical in character to overlaying transparent maps of the two entity groups on top of one another. Like the DBMS, the Geographic Analysis System as highlighted in Figure 1.1 has a two-way interaction with the database; the process is distinctly analytical in character. Thus while it may access data from the database, it may equally contribute the results of that analysis as a new addition to the database. For example we might look for joint occurrence of lands on steep slopes with erodable soil under agriculture and call the results based on existing data and set of specific relations. Thus the

analytic capabilities of the Geographic Analysis System and the DBMS play a vital role in extending the database through the addition of knowledge of relationships between features.

vi). ***Image Processing System:*** In addition to these essential GIS elements, remotely sensed image and specialized statistical analysis are also important. This we will discuss in the subsequent sections.

vii). ***Statistical analysis system:*** GIS incorporates a series of specialized routines for analyzing the statistical description of spatial data and for inferences drawn from statistical procedures.

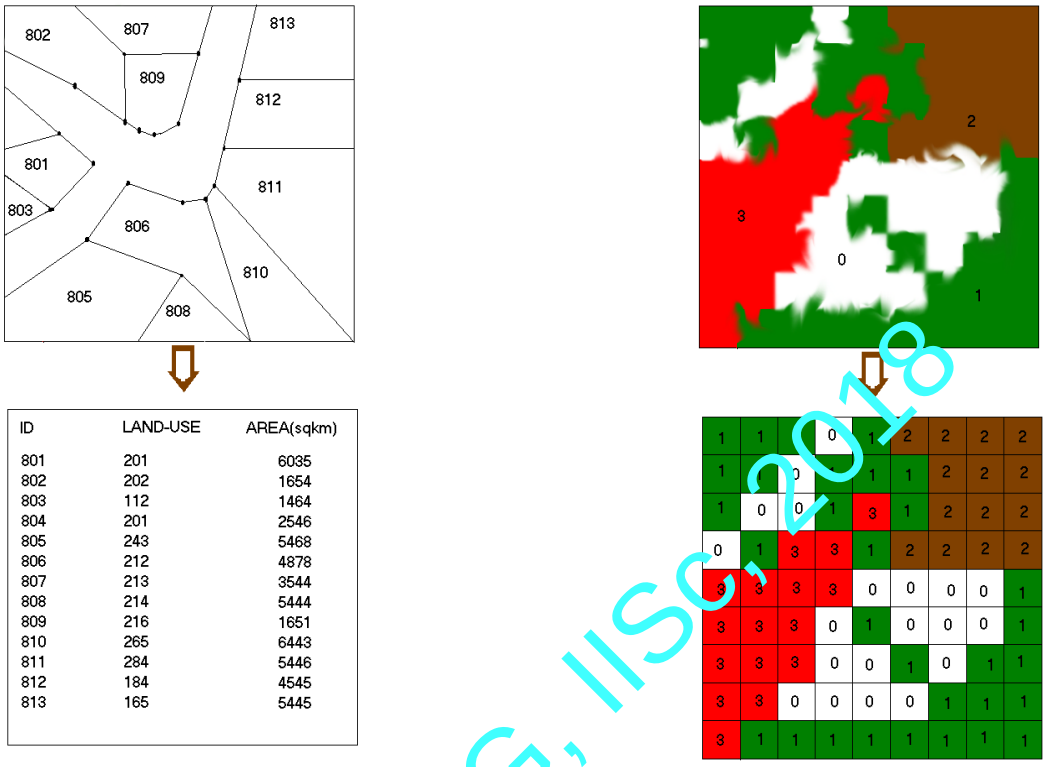
viii). ***Decision support system (DSS):*** Decision support constitutes a vital function of a GIS. It helps in the construction of multi-criteria suitability maps, and address allocation decisions when there is multiple objectives involved while accounting for error in the process. Used in conjunction with the other components of the system, DSS provides a powerful tool in decision-making for resource allocation.

Map Data Representation

A Geographic Information System stores two types of data that are found on a map—the geographic definitions of earth surface features and the attributes or qualities that those features possess. Most systems use nearly one or a combination of both the fundamental map representation techniques: vector and raster.

Vector: This refers to the spatial data represented in the form of point, line or polygon depending on the feature of interest (and scale). With vector representation, the boundaries or the course of the features are defined by a series of points that, when joined with straight lines, form the graphic representation of that feature. The points themselves are encoded with a pair of numbers giving the X and Y coordinates in systems such as latitude/ longitude, etc. The attributes of features are then stored in the database management system (DBMS). For example, a vector map of property parcels might be tied to an attribute database of information containing the address, owner's name,

property valuation and land use. The link between these two data files can be a simple identifier number that is given to each feature in the map (Figure: 1.2).



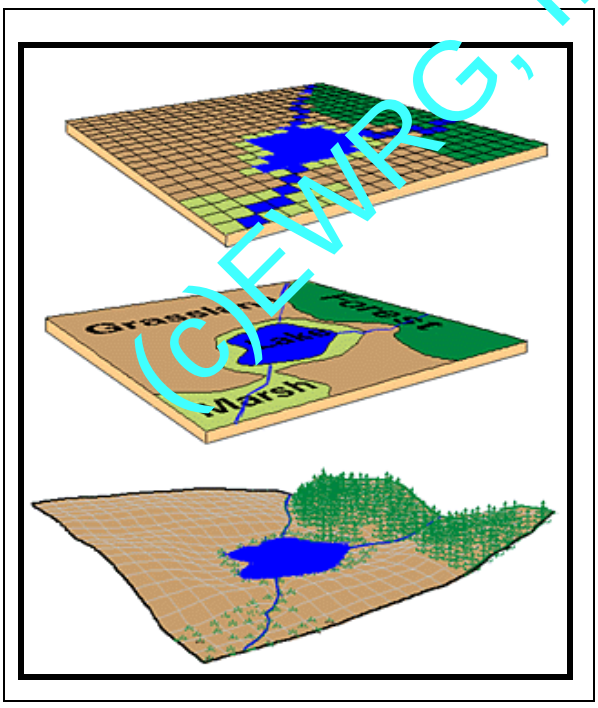
Vector Raster

Figure1.2

Raster: In this case, the graphic representation of features and the attributes they possess are merged into unified data files. In fact, we typically do not define features at all. Rather, the study area is subdivided into a fine mesh of grid cells in which we record the condition or attribute of the earth's surface at that point (Figure 1.2). Each cell has a numeric value (often referred as digital number or spectral signature), representing a feature identifier, a qualitative attribute code or a quantitative attribute value. For example, a cell could have the value "6" to indicate that it belongs to District 6 (a feature identifier), or that it is covered by soil type 6 (a qualitative attribute), or that it is 6 meters above sea level (a quantitative value). Although the data we store in these grid cells do not necessarily refer to phenomena that can be seen in the environment, the data grids themselves can be thought of as images or layers, each depicting one type of information over the mapped region. This information can be made visible through the use of a raster

display. In a raster display, such as the screen on your computer, there is also a grid of small cells called pixels (or picture elements). The word pixel is a contraction of the term picture element. Pixels vary in their color, shape or gray tone depending on features in the object. To make an image, the cell values in the data grid are used to regulate directly the graphic appearance of their corresponding pixels. Thus in a raster system, the data directly controls the visible form we see.

Raster versus Vector: Raster systems are typically data intensive since they must record data at every cell location regardless of whether that cell holds information that is of interest or not. However, the advantage is that geographical space is uniformly defined in a simple and predictable fashion. As a result, raster systems have substantially more analytical power than their vector counterparts in the analysis of continuous space and are thus ideally suited to the study of data that are continuously changing over space such as terrain, vegetation biomass, rainfall and the like. The second advantage of raster is that its structure closely matches the architecture of digital computers.



As a result, raster systems tend to be very rapid in the evaluation of problems that involve various mathematical combinations of the data in multiple layers. Hence they are excellent for evaluating environmental models such as soil erosion potential and forest

management suitability. In addition, since satellite imagery employs a raster structure, most raster systems can easily incorporate these data, and some provide full image processing capabilities.

While raster systems are predominantly analysis oriented, vector systems tend to be more database management oriented. Vector systems are quite efficient in their storage of map data because they only store the boundaries of features and not that which is inside those boundaries. Because the graphic representation of features is directly linked to the attribute database, vector systems usually allow one to roam around the graphic display with a mouse and query the attributes associated with a displayed feature, such as the distance between points or along lines, the areas of regions defined on the screen, and so on. In addition, they can produce simple thematic maps of database queries.

Compared to their raster counterparts, vector systems do not have as extensive a range of capabilities for analyses over continuous space. They do, however, excel at problems concerning movements over a network and can undertake the most fundamental of GIS operations that will be sketched out below. For many, it is simple database management functions and excellent mapping capabilities that make vector systems attractive. Because of the close affinity between the logic of vector representation and traditional map production, a pen plotter can be driven to produce a map that is in distinguishable from that produce by traditional means. As a result, vector systems are very popular in municipal applications where issues of engineering map production and database management predominate.

Geographic database concepts: Regardless of the logic used for spatial representation, raster and vector, we begin to see that a geographic database as a complete database for a given region and is organized in a fashion similar to a collection of maps. Vector systems come closest to this logic with what are known as coverages. Map like collection that contain the geographic definition of a set of features and their associated attributes tables. However, they differ from maps in two ways. First, each will typically contain information on only a single feature types, such property parcels, soil polygons, and the like. Second, they may contain a whole series of attributes that pertain to those features,

such as a set of census information for city blocks.

Raster system also uses this map like logic, but usually divide data sets into unitary layers. A layer contains all the data for a single attribute. Thus one might have a soil layer, a road layer and a land-use layer.

There are subtle differences, for all intents and purposes, raster layer and vector coverage can be thought of as simply different manifestations of the same concepts as the organization of the database into elementary map-like themes. Layers and coverage differ from traditional paper maps, however, in an important way. When a map is digitized, scale differences are removed. The digital data may be displayed or plotted at any scale. More importantly, digital data layers that were derived from maps of different scale, but covering the same geographic area, may be combined.

GIS provide utilities for changing the projection and reference system of digital layers. This allows multiple layers, digitized from maps having various projections and reference system, to be converted to a common system.

With the ability to manage differences of scale, projection and reference system, layers can be merged with ease, eliminating a problem that has traditionally hampered planning activities with maps. It is important to note, however, that the issue of resolution of the information in the data layers remains. Although features digitized from a poster sized world map could be combined in a GIS with features digitized from very large-scale local map, such as a city street map, this would normally not be done. The level of accuracy and detail of the digital data can be as good as that of the original maps.

Georeferencing: All spatial data files in GIS are georeferenced. Georeferencing refers to the location of a layer or coverage in the space as a definition by a known coordinate referring system. With raster images, a common form of georeferencing is to indicate the reference system, the reference units and the coordinate positions of the left, right, top, and bottom edges of the image. The same is true of the vector data files, although the left, right, top and bottom edges now refer to what is commonly called the bounding rectangle

of the coverage; rectangle which defines the limit of the mapped area (corners of a feature). This information is particularly important in an integrated GIS since it allows raster and vector files to be related to one another in a reliable and meaningful way. It is also vital for the referencing of the data values to actual positions on the ground.

GIS Applicability: The society is so complex, and their activities so interwoven, that no problem can be considered in isolation or with out regard for the full range of its interconnections. For example, a new housing development will affect the local school system. The volume of city traffic put constraints on the maintenance of buried pipe networks, affecting health. The action needed to solve such a problem are best taken on the basis of standardized information that can be combined in many ways to serve many users. GISs have this capability.

Environmental and resource management: Decision making is becoming increasing complex as dwindling natural resources and more demanding economic priorities diminish the chances of today's decision being right tomorrow. Furthermore, environmental awareness is constantly increasing among the general public, particularly among the younger generation. To help us map and monitor changes, and plan appropriate responses that take account of the complex interactions of the Earth system, many countries now have comprehensive programs to capture and archive information on the existing natural resources and known sources of pollution, using technologies such as satellite remote sensing and GIS. The data may be used both to expose conflicts and to examine environmental impacts and even simulate the causes and the alternative will become possible.

Planning and development: The planning and development of new housing, roads, and industrial facilities require data on the terrain and other geographical information. Development often involves building on marginal terrain, increasing the density of the building in the areas already built up, or both. Yet the new structures must fit with in the existing technical infrastructure; here computerization is a great aid. One of the benefits GIS holds for such projects is a minimalization of disruption to the existing infrastructure.

Escalating construction costs have made the optimizing of building and road location extremely important. Minimizing blasting and earthmoving are significant aspect of minimizing costs. Flexibility is vital: plans should be amenable to rapid changes as decisions are made. The influence of special interest groups and individual citizens require that initial plans be presented effectively and in a manner that is easily understood. Simplified, visualized plans are instrumental in conveying both the content of the scheme and the nature of any likely impact on those concerned.

Management and public services: In modern societies, decisions should be made quickly, using reliable data, even though there may be many differing viewpoints to consider and large amount of information to process. Today, the impact of development decisions is ever greater, involving conflicts between society and individuals, or between development and preservation. Information must therefore be readily available to decision makers; the majority of such information is likely to be geographical in nature, and best handled using GIS.

Overviews of administrative units and properties are crucial in the development of both virgin terrain and built-up area, in both developed and developing nations. In many countries, property registration is extensive: even in smaller states, 2 to 3 million properties maybe involved. Moreover, property is also an economic factor in taxation and security for loans; so comprehensive overviews are essential to a well-ordered society. Computerized registers based on GIS technology are now well established in many countries.

Land transportation: In many countries, the greater part of transportation has shifted from rail to road, at the same time, the use of private vehicle has greatly increased. These developments have created traffic problems, which cause loss of time and money. Large goods are now transported by road. In most countries the annual costs of traffic accidents have become extremely high. The automobile industry is now investing heavily in the development of driver information system, and several systems are now in the market. In principle, all of them involve simple GIS function with digital maps and supplementary information.

Chapter 2: Maps

Map is a picture of a place as our eyes see it or best-known models of real world. Maps have been used for thousands of years to represent information about the real world. Their conception and design has developed into a science with a high degree of sophistication. Maps have proven to be extremely useful for many applications in various domains.

A disadvantage of maps is that they are restricted to two-dimensional static representation, and that they always are displayed in a given scale. The map scale determines the spatial resolution of the graphic feature representation. The smaller the scales, the less detail a map can show. The accuracy of the base data, on the other hand, puts limits to the scale in which a map can sensibly drawn. The selection of proper map is one of the first and most important steps in map design.

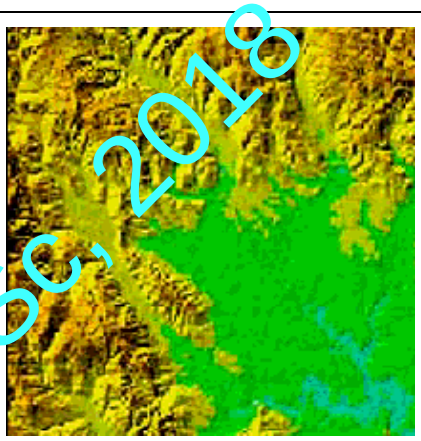
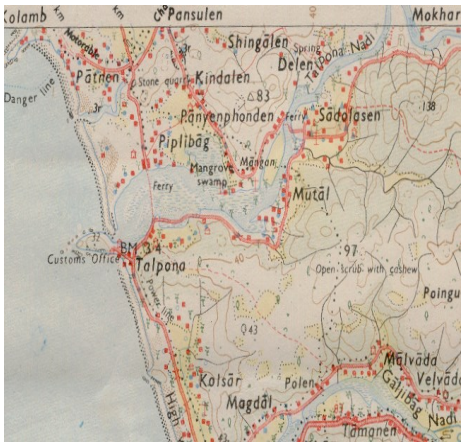
A map is always a graphic representation at certain level of detail, which is determined by the scale. Map sheets have physical boundaries, and features spanning two map sheets have to cut into pieces.

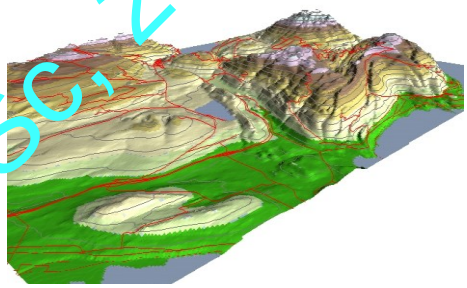
Cartography as the science and art of map making functions as an interpreter translating real world phenomena into correct, clear and understandable representation for our use. Maps also become a data source for other maps.

Maps are made for many reasons and, therefore they vary in content and context. Different maps show different information. Different symbols are used to represent the features of the environment on a map. They are explained in the legend for each map.

Some examples

A photograph: A photograph shows a place as our eyes see it. However, the area that is viewed on the ground is limited. It is often difficult to see a substantial landscape in a single photography.

Aerial photography: A photography taken from an aircraft is known as an aerial photo (fig 2.1). These photograph are normally. Taken to prepare maps of an area. Aerial photographs give a 'birds-eye' view of the earth's surface. Features on earth look different from above; consequently, field experience is needed to make correct interpretation of these photographs.	
Shade relief map A shaded relief map (fig 2.2) shows how an area looks when sunlight is shining on it from a particular direction. It gives an impression of the nature of the terrain. We can visualize whether an area is plain or rugged by these maps.	
Topographical map: A topographical map (fig 2.3) shows the shape of the earth's surface by contour lines. Contours are the imaginary lines that join points of equal elevation on the surface of land above or below a reference surface such as mean sea level. These maps include symbols that represent features such as street, buildings, rivers, and forests. Topographic maps are used by most applications as the base map on which other feature or phenomena are referenced.	

Road/ tourist map Road maps (fig 2.4) show people the route for traveling from one place to another. They show some physical features such as cities and towns. Normally, tourist maps emphasize the location of monuments and tourist spots.	
3-D map 3-D maps (fig 2.5) show a phenomenon in three dimensions. They help us visualize an area as continuous surface that rise and fall showing the high and low values of the phenomenon.	

Use of maps: Maps give us a better understanding of a place. The information they contain depends on the type of maps are used to obtain answers to the following fundamental questions.

- ***Where: Locations and Navigation:*** We try to locate ourselves with respect to rivers, mountains, buildings, trees and other landmarks to make references to where we stand. Similarly, we also think of places in terms of other places and try to find the shortest rout to reach the destination. For example, you know where you live relative to your friend's houses, your school and the supermarket you visit and even the shortest as well as least congested route. Since these features are depicted on a map with their positions relative to each other, we can locate ourselves by relating these features on the map and these features in our

surroundings. To know where we stand maps even provide us with the information on latitude and longitude, the coordinate system to measure all places on the earth.

- ***Information****:* Apart from road maps and topographic maps that help us locate ourselves and navigate, there are many other types of maps, which are made for conveying information on a specific topic. These are known as thematic maps. They are made for a purpose. Maps of rainfall, temperature, population density, etc are thematic maps that give us information on a theme in the area concerned.

Map reading

Reading a map means interpreting the colors, lines and other symbols. Features are shown as points, lines or areas depending upon their size and extent. Besides recognizing the features, knowing their location and distances accurately is also important. Map symbols and map scales provide this information.

Point features*:* Point features or geographically defined occurrences are features whose location can be represented by a single x, y or x, y, z location. Points have no linear or areas dimensions but simply define the location of a physical feature (control point: monument, sign, utility pole) or an occurrence (e.g. accident).

Line feature*:* Lines represent feature that have a linear extent but no area dimensions. Centerlines of roads, water mains and sewer mains are examples of line features.

Area features*:* Area features, also called polygons, have a defined two-dimensional extent and are delimited by a boundary lines that encompass an area. For example: district, soil type, agro climatic zones etc.

Three-dimensional surfaces*:*Some geographic phenomena are best suited to represent in three-dimensional form covering an area. The most frequent example is surface terrain often represented by contour lines that have an elevation value. This concept can be applied to other spatially continuous data as well. For instance, population

density or income levels could be mapped as a third dimension to support demographic analysis or water consumption statistics.

***Scale**:* Map scale describes the relation between mapped size and actual size. It is expressed as a relationship between linear distances on the map and corresponding ground analysis.

Representative Fraction (RF). This is pure fraction that represents the ration of map distance to ground distance without specifying any measurement unit. RF value of 1: 25000 implies that 1 cm in the map is equivalent to 25000 cm (250 m s) in the real world.

Large-scale maps cover small areas and usually include a greater level of detail than small-scale maps that depict larger areas in lesser details. The following general scale categories apply.

Map numbering: The map numbering system used in India are:

- The international system (CIM)
- India and Adjacent countries (IAC) system.

The International System: This system is used for international map on 1:1 million scale. Each sheet covers an area of 4^0 latitude by 6^0 longitude. The geographical position of the sheet is defined by two letters and a number. The first letter is N or S depending on whether the sheet is north or south of the equator. Next letter after the N or S indicates latitude of sheet alphabetically with the capital letters in succession of each 4^0 band. Numbering starts from 180^0 longitude and goes from west to east, the number changing after 6^0 longitude. Each 1:1milionsheet is sub divided into 24 sheets each covering an area of 1^0 by 1^0. The numbering of the sheets starts alphabetically from northwest corner and proceeds from west to east. Number of north west corner sheet is A and that of south east corner sheet is x. the sheet covering latitude each 20^0 to 21^0 N and 80^0 to 81^0 will be numbered as NF 44 C.

India and Adjacent countries system: IAC system is the system followed by the Survey of India maps. Each sheet is bound by 4^0 latitude and 4^0 longitude, which is 1:1 million scale. The sheets numbered from North to South and starts with 40^0 N latitude and 42^0 E longitude. Sheets falling in the sea are not numbered. Sheets covering India are numbered from 39 to 58. The 1/M sheets are further sub-divided into 16 equal parts of 1^0 x1^0. The sheets are in 1:25000 scale. These sheets are numbered from A to P and each grid is called by the sheet number followed by the alphabet i.e. for the 1/M sheet 48, sixteen components are 48A to 48P.

A	E	I	M
B	F	J	N
C	G	K	O
D	H	L	P

48 - 4^0 x 4^0 on 1:1M scale

Shaded cell shows 48 J of scale 1: 250000.

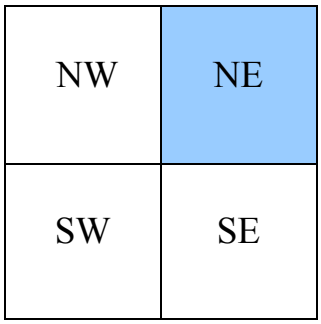
The 1^0 x 1^0 map (degree sheet) is again subdivided into sixteen equal parts - each of fifteen minutes of latitude and longitude in extent. These sheets are numbered from 1 to 16 (e.g.: 48J/1, 48J/2 to 48J/16) and on the scale 1: 50000 scale maps.

1	5	9	13
2	6	10	14
3	7	11	15
4	8	12	16

48 - 1^0 x 1^0 on 1: 250000 scale

Shaded cell shows 48 J/12 of scale 1:50000 scale

The 1:50000 sheet is further divided into four equal parts of 7.5' latitude x 7.5' longitude. The sheets are numbered A/1/NW, A/1/NE, A/1/SW, A/2/SE and scale is 1:25000.



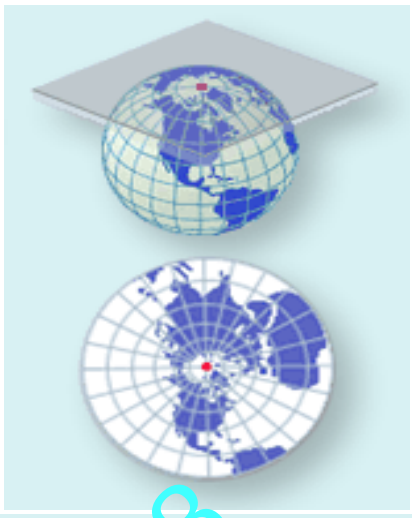
48 - 15' x 15' on 1: 50000 scale

Shaded cell shows 48 J/12/NE of scale 1:25000 scale

Symbols: The meaning of each symbol used in a map is described in the map's legend. However, many symbols in topographic maps have become conventional and can be interpreted without looking at the legend. For example, an area feature shown in green is vegetation, blue water, gray or red built-up etc.

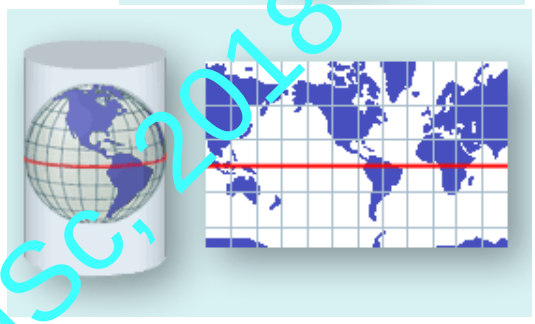
Map projection: As we know earth is not a perfect sphere, but more like an ellipsoid with flattering at the poles. The shape of the Earth is there fore expressed by the shape of the ellipsoid. For geodetic calculation an ellipsoid called datum is used. The common datum for a country or area requires that there are specific coordinates for the datum origin, while this has to have height in relation to a given sea level (e.g. WGS84).

Geo-referenced data may be drawn on a map only when referenced to a plane surface, not to the curved surface of the Earth. Various projections are used to represent the curved surface of the earth on the plane surface of the map. They are classified into three groups according to the underlying geometrical transformation involved: azimuthal, cylindrical, and conical. It should be remembered that all projections method, will affect distance, area, direction or shape and that these errors multiply with the increasing size of the area represented.

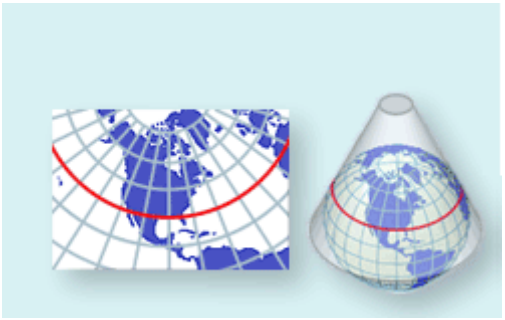


Azimutal: This projection the points from the earths surface are projected to a plane, which is to it. This projection does not take into account the curvature of earth and hence can be used for the mapping of small areas only.

Cylindrical projection: The earth is projected on a cylindrical developing surface which can be flattened to form a map. Depending on the orientation of the axis of cylinder with the axis of the earth, a number of projections are possible. Transverse Mercator projection based on cylindrical projection, which is one of the widely used projection.



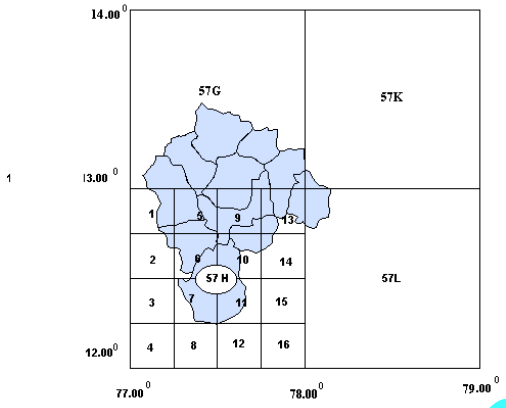
Conical projections: In this projection the globe is projected on a conical surface. Polyconic and Lambert conformal projections are extensively used in map preparation.

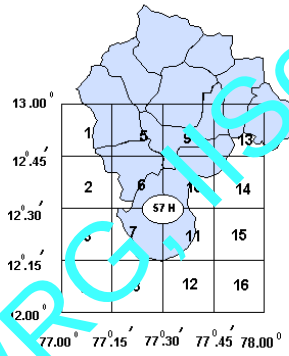


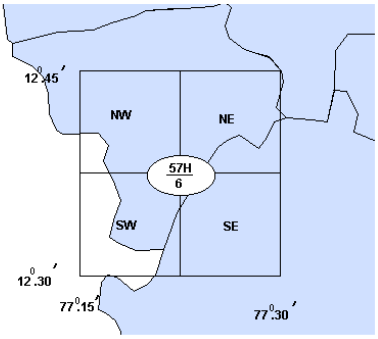
Coordinate system: The geographic coordinates on the surface of the Earth are latitude, measured in degrees north or south of the equator, and longitude, measured in degrees east or west of Greenwich. Positions in latitude and longitude are only relative; distances and areas must be calculated using spherical geometry and the Earth's radii to the points in question. In applications, latitude and longitude are usually used in describing major land areas.

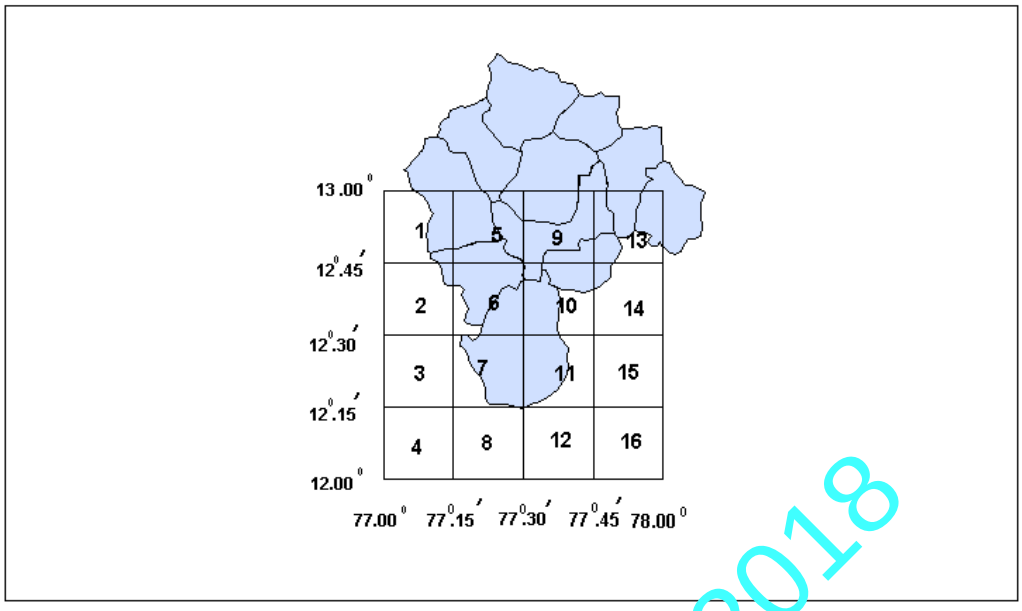
The GISs have facilities for transforming data from one coordinate system to another, based on common points in the two systems. When the common point is unknown, the parameters for the datum, project method, and coordinate system should be ascertained.

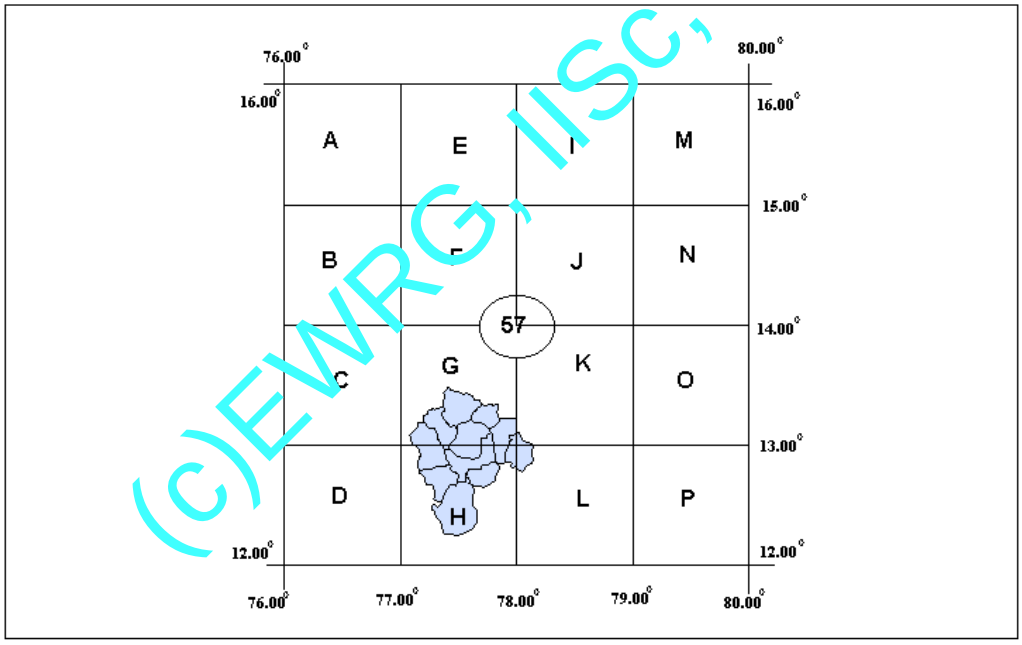
The best-known coordinate system is the UTM Gird (Universal Transverse Mercator Grid). UTM covers the entire surface of the Earth surface with the help of 60 zones or axes, each with a width of 6^0.

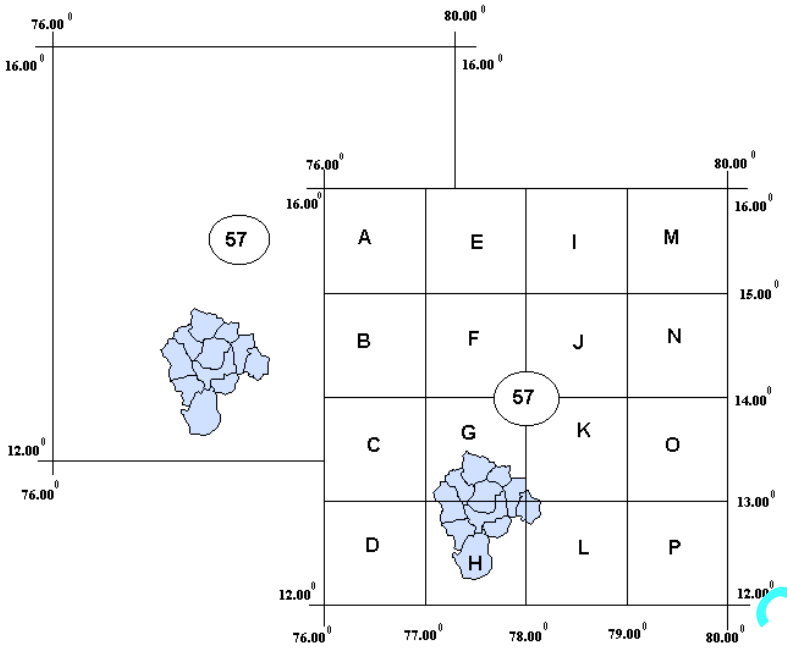






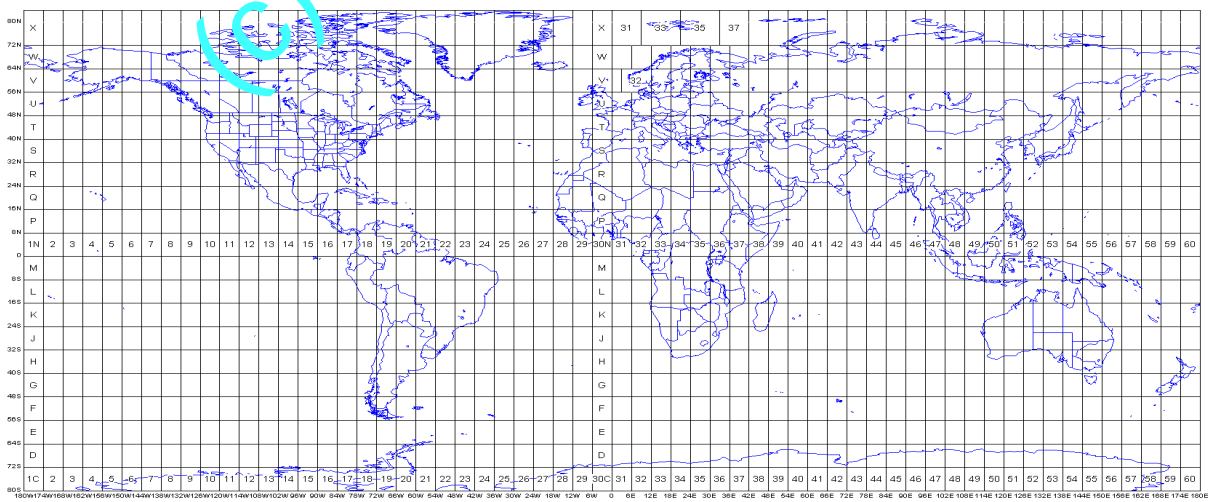






Relevance to GIS

Maps are a common source of input data for a GIS. In GIS often-input maps will be in different projections, requiring transformation of one or all maps to make coordinates compatible. Thus, mathematical functions of projections are needed in a GIS. GIS are used for projects of global or regional scales so consideration of the effect of the earth's curvature is necessary. Monitor screens are analogous to a flat sheet of paper thus; need to provide transformations from the curved surface to the plane for displaying data.



Chapter 3: Introduction to Remote Sensing and Image Processing

Of all the various data sources used in GIS, one of the most important is undoubtedly that provided by remote sensing. Through the use of satellites, we now have a continuing program of data acquisition for the entire world with time frames ranging from a couple of weeks to a matter of hours. Very importantly, we also now have access to remotely sensed images in digital form, allowing rapid integration of the results of remote sensing analysis into a GIS

Because of the extreme importance of remote sensing as a data input to GIS, it has become necessary for GIS analysts (particularly those involved in natural resource applications) to gain a strong familiarity with Image processing system (IPS). Consequently, this chapter gives an overview of this important technology and its integration with GIS.

Definition

Remote sensing can be defined as any process whereby information is gathered about an object, area or phenomenon without being in contact with it. Our eyes are an excellent example of a remote sensing device. We are able to gather information about our surroundings by gauging the amount and nature of the reflectance of visible light energy from some external source (such as sun or a light bulb) as it reflects off objects in our field of view. Contrast with this thermometer, which must be in contact with the phenomenon it measures, and this is not a remote sensing device.

Given this rather general definition, the term *remote sensing* has come to be associated more specifically with the gauging of interactions between earth surface materials and electromagnetic energy. However, any such attempt at a more specific definition becomes difficult, since it is not always the natural environment that is sensed (e.g., art conservation applications), the energy type is not always electromagnetic (e.g., sonar) and some procedures gauge natural energy emissions (e.g., thermal infrared) rather than interactions with energy from an independent source.

Basic Process involved-

1. Data Acquisition
2. Data Analysis

Data Acquisition -

Propagation of energy through the atmosphere

↓

Energy interaction with the earth surface

↓

Retransmission of energy through the earth's surface

↓

Sensing systems

↓

Sensing Products (pictorial/digital)

Data analysis

- Interpretation and Analysis (application in various fields such as land use, geology, hydrology, vegetation, soil)
- Reference data are used to assist in the analysis and interpretation.

Fundamental Considerations

Energy Source

Sensors can be divided into two broad groups: passive and active. Passive sensors measure ambient levels of existing sources of energy, while active ones provide their own source of energy. The majority of remote sensing is done with passive sensors, for which the sun is the major energy source. The earliest example of this is photography. With airborne cameras we have long been able to measure and record the reflection of light off earth features. While aerial photography is still a major form of remote sensing, newer solid-state technologies have extended capabilities for viewing in the visible and near-infrared wavelengths to include longer wavelength solar radiation as well. However, not all passive sensors use energy from the sun. Thermal infrared and passive microwave sensors both measure natural earth energy emissions. Thus the passive sensors are simply those that do not themselves supply the energy being detected.

By contrast, active sensors provide their own source of energy. The most familiar form of this is flash photography. However, in environmental and mapping applications, the best example is RADAR. RADAR systems emit energy in the microwave region of the electromagnetic spectrum **Fig 3.1. Th**is reflection of that energy by earth surface materials is then measured to produce an image of the area sensed.

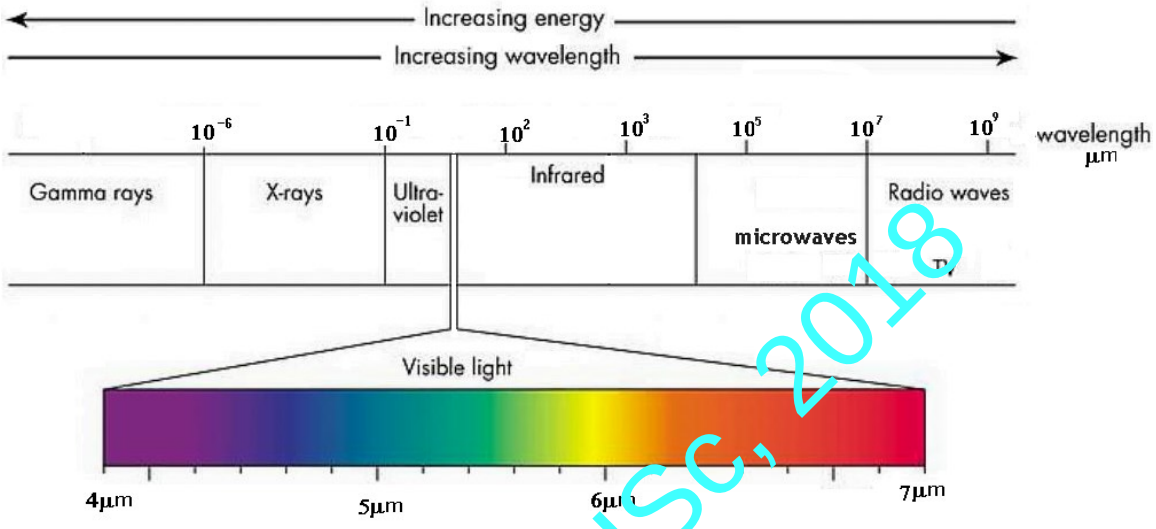


Fig 3.1: The Electromagnetic Spectrum

Wavelength

As indicated, most remote sensing devices make use of electromagnetic energy. However, the electromagnetic spectrum is very broad and not all wavelengths are equally effective for remote sensing purposes. Furthermore, not all have significant interactions with earth surface materials of interest to us. Fig 3.1 illustrates the electromagnetic spectrum. The atmosphere itself causes significant absorption and/ or scattering of the very shortest wavelengths. In addition, the glass lenses of many sensors also cause significant absorption of shorter wavelengths such as ultraviolet (UV). Even here, the blue wavelengths undergo substancial attenuation by atmospheric scattering, and are thus often left out in remotely sensed images. However, the green, red, and near-infrared (IR) wavelengths all provide good opportunities for gauging earth surface interactions without significant interference by the atmosphere. In addition, these regions provide important clues to the nature of many earth surface materials. Chlorophyll, for example, is a very strong absorber of red visible wavelengths, while the near-infrared wavelengths provide important clues to the structures of plant leaves. As a result, the bulk of remotely sensed images used in GIS-related applications are taken in these regions.

Extending into the middle and thermal infrared regions, a variety of good windows can be found. The longer of the middle infrared wavelengths have proven to be useful in a number of geological applications. The thermal regions have proven to be very useful for monitoring not only the obvious cases of the spatial distribution of heat from industrial activity, but a broad set of applications ranging from fire monitoring to animal distribution studies to soil moisture conditions.

After the thermal IR, the next area of major significance in environmental remote sensing is in the microwave region. A number of important windows exist in this region and are of particular importance for the use of active radar imaging. The texture of earth surface materials causes significant interactions with several of the microwave wavelength regions. This can thus be used as a supplement to information gained in other wavelengths, and also offers the significant advantage of being usable at night (because as an active system it is independent of solar radiation) and in regions of persistent cloud cover (since radar wavelengths are not significantly affected by clouds).

Interaction Mechanisms

When electromagnetic energy strikes a material, three types of interaction can follow: reflection, absorption, and/ or transmission (figure 3-2). Our main concern is with the reflected portion since it is usually this which is returned to the sensor system. Exactly how much is reflected will vary and will depend upon the nature of the material and where in the electromagnetic spectrum our measurement is being taken. As a result if we look at the nature of this reflected component over a range of wavelengths, we can characterise the result as a spectral response pattern.

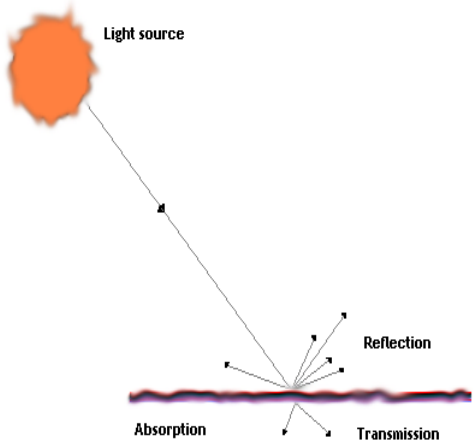


Fig 3.2: Interaction mechanism between EM energy and material.

Electromagnetic Radiation

Nuclear reactions within the sun produces spectrum of electromagnetic radiation which is transmitted through the space without major changes. Examples of electromagnetic radiation are heat, radio waves, UV rays, X-rays

Waves obeys general equation –

$$C = \nu \times \lambda$$

$C = 3 \times 10^8$ m/s

ν = frequency

λ = wavelength

Wavelength –The distance between one wave crest to the next

Frequency- Number of crests passing a fixed point at a given period of time

Amplitude-Equivalent to height of each peak

Electromagnetic waves are characterized by their wavelength location on electromagnetic spectrum. Unit of wavelength is µm.

$1\mu m = 1 \times 10^{-6}$ m

UV	Visible(µm)			0.8-0.9 (µm)	0.9-1.3 (µm)	1.3-14 (µm)	Microwaves
	0.4-0.5	0.5-0.6	0.6-0.7				
	Blue	Green	Red	Near IR	Mid IR	Far IR	

Interaction with surfaces-As electromagnetic energy reaches the earth's surface it must be reflected, absorbed or transmitted.

The proportions depends on-

- Nature of surface
- Wavelength of energy
- Angle of illumination

Reflection-When ray of light is redirected when it strikes a non transparent surface.

Transmission -When radiation passes through a substance without significant attenuation.

$$t = \frac{\text{transmitted radiation}}{\text{incident radiation}}$$

Fluorescence -When an object is illuminated with radiation at one wavelength and it emits radiation at another wavelength.

Electromagnetic waves are categorized by their wavelength location in electromagnetic spectrum. Electromagnetic radiation is composed of many discrete units called photons or quanta.

$$Q = h \nu$$

Q = energy of quantum, Joules (J)
h = Plank's constant
ν = Frequency

$$Q = h (c/ \lambda)$$

Q = 1/ λ ie, the longer the wavelength involved the lower is its energy content. All matter at temperature above absolute zero continuously emits electromagnetic radiation.

Stefen-Boltzmann Law- The amount of energy a body radiates is the function of its surface temperature.

$$M = \sigma T^4$$

M = total radiant exitance from the surface of a material
σ = Stefen-Boltzmann constant, 5.6697×10^{-8} $Wm^{-2}K^{-4}$
T = absolute temperature (K) of the emitting material

Total energy emitted from an object varies as T^4 and increase very rapidly as temperature increases.

The rate at which photons (quanta) strike a surface is called **radiant flux** (øc) measured in Watts.
Irradiance (Ee) is defined as radiant flux per unit area.

A blackbody is a hypothetical source of energy that behaves in an idealized manner. It absorbs all incident radiation, none of the radiation is reflected.

Kirchoff's Law states that-The ratio of emitted radiation to the absorbed radiation flux is same for all black bodies at the same temperature.

Wien's Displacement law- specifies relationship between wavelength of radiation emitted and temperature of a black body.

$$\lambda = 2897.8 / T$$

λ = wavelength at which temperature is maximum
T = absolute temperature (K)

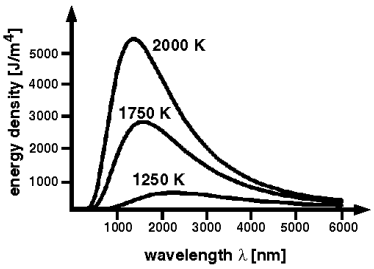


Figure 1: Spectral distribution of energy radiated from blackbodies of various temperatures. (Reference: http://itl.chem.ufl.edu/4412_aa/origins.html)

Energy interaction in the atmosphere

The net effect of atmosphere varies with the following factors-

- Path length
- Magnitude of energy signal being sensed
- Atmospheric conditions present
- Wavelength involved

Effect of atmosphere

Scattering absorption

Scattering

Reyleigh Scatter-When radiation interacts with the atmospheric molecules and other tiny molecules which are smaller in diameter than wavelength of interacting radiation then Reyleigh scatter is inversely proportional to the fourth power of the wavelength.

When sunlight interacts with the earth's atmosphere then it scatters shorter wave (blue) wavelengths more dominantly than other visible wavelengths. During sunrise and sunset sun's ray travel in a longer atmospheric path than during midday. With longer wave path the scatter of shorter wavelength is so complete that we see longer wavelengths of orange and red.

Mie Scatter-When atmospheric particle diameter is equal to the wavelength of energy being sensed. Water vapour and dust are the major causes of Mie Scatter.

Non selective Scatter-When the diameter of particles causing scatter are much larger than the wavelength of energy being sensed. Water droplets have diameter in the range 5-100µm and scatters all visible and near to mid IR wavelengths equally. In visible wavelengths equal quantities of blue, green, red light are scattered hence fog appears white.

Absorption: Absorption of radiation occurs when atmosphere prevents or strongly attenuates transmission or radiation of energy through the atmosphere. Water vapour, carbon di oxide, ozone are the most efficient absorber of solar radiation.

Ozone is formed when oxygen reacts with UV radiation. It lies 20-30 Km in the stratosphere. Carbon di oxide is important in remote sensing because it is effective in absorbing radiation in mid and far IR rays. Its strongest absorption occurs in the range 13-17.5µm. Water vapour present in the atmosphere is 0-3% by volume. Two of the most important regions are several bands between 5.5 to 7.0µm and above 27.0µm.Absorption in these region can exceed 80%if the atmosphere contains considerable amount of water vapour. The wavelength at which atmosphere is particularly transmissive of energy are referred as atmospheric windows.

Energy interactions with Earth surface features-

Applying Principle of conservation of Energy, $E_I(\lambda) = E_R(\lambda) + E_A(\lambda) + E_T(\lambda)$

E_I = incident energy; E_R = reflected energy; E_A=absorbed energy; E_T = transmitted energy

$$E_R(\lambda) = E_I(\lambda) - [E_A(\lambda) + E_T(\lambda)]$$

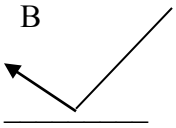
Reflected energy is equal to the energy incident on a given feature reduced by the energy that is either absorbed or transmitted by that feature.

The geometric manner in which an object reflects energy is function of surface roughness of the object.

Specular reflectors- Flat surface in which angle of reflection is equal to the angle of incidence.

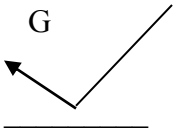
Diffuse reflectors-rough surface that reflects uniformly in all directions.

Colours



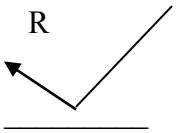
BLUE

Within the visible portion of spectrum spectral variation results in visual effect called colours. An object blue when it reflect more highly of blue portion of the spectrum.



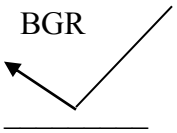
GREEN

an object green when it reflects more highly of green portion of the spectrum.



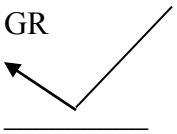
RED

an object red when it reflects more highly of red portion of the spectrum and so on.



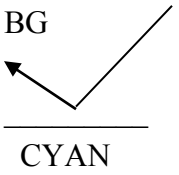
WHITE

an object white when it reflects all the Radiations (blue, green, red) incident on it.

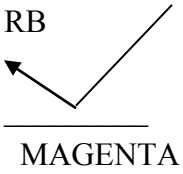


YELLOW

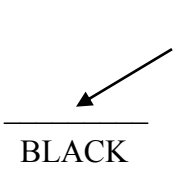
an object Yellow when it reflects green and red radiation and absorbs blue radiation.



An object is cyan in colour when it reflects blue and green and absorbs red radiation.



An object is magenta in colour when it reflects red and blue and absorbs green radiation.



An object is black in colour when it absorbs all the Primary Colours.

$$\text{Spectral reflectance} = \frac{\text{energy of wavelength reflected from an object}}{\text{energy of wavelength incident upon an object}} \times 100$$

Spectral response Patterns: A spectral response pattern is sometimes called a *signature*. It is a description (often in the form of a graph) of the degree to which energy is reflected in different regions of the spectrum. Most humans are very familiar with spectral response patterns since they are equivalent to the human concept of colour. The bright red reflectance pattern fig 3.3, for example, might be that produced by a piece of paper printed with a red ink. Here, the ink is designed to alter the white light that shines upon it and absorb the blue and green wavelengths. What is left, then, are the red wavelengths which reflect off the surface of the paper back to the sensing system (the eye). The high return of red wavelengths indicates a bright red, whereas the low return of green wavelengths in the second example suggests that it will appear quite dark.

The eye is able to sense spectral response patterns because it is truly a multi-spectral sensor (i.e., it senses in more than one place in the spectrum). Although the actual functioning of the eye is quite complex, it does in fact have three separate types of detectors that can usefully be thought of as responding to the red, green and blue wavelength regions. These are the *additive primary* colours, and the eye responds to mixtures of these three to yield a sensation of other hues. For example, the colour perceived would be a yellow as a result of *mixing* a red and green. However, it is important to recognize that this is simply our phenomenological perception of a spectral response pattern. Consider, for example, the fig 3.4. Here we have reflectance in both the blue and red regions of the visible spectrum. This is a bimodal distribution, and thus technically not a specific hue in the spectrum. However, we would perceive this to be a purple! Purple (a colour between violet and red) does not exist in nature (i.e., as a hue- a distinctive dominant wavelength). It is very real in our perception, however. Purple is simply our perception of a bimodal pattern involving a non-adjacent pair of primary hues.

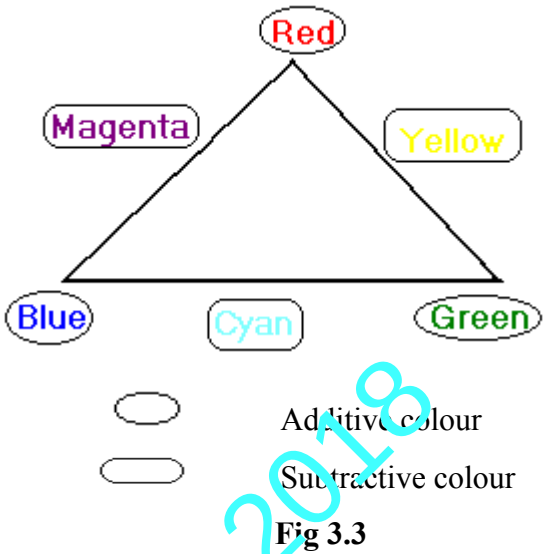


Fig 3.3

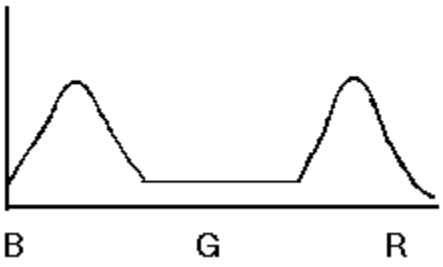


Fig 3.4: Bimodal, (colour perceived Purple).

In the early days of remote sensing, it was believed (more correctly *hoped*) that each earth surface material would have a distinctive spectral response pattern that would allow it to be reliably detected by visual or digital means. However, as our common experience with colour would suggest, in reality this is often not the case fig 3.5. For example, two species of trees may have quite a different coloration at one time of the year and quite a similar one at another.

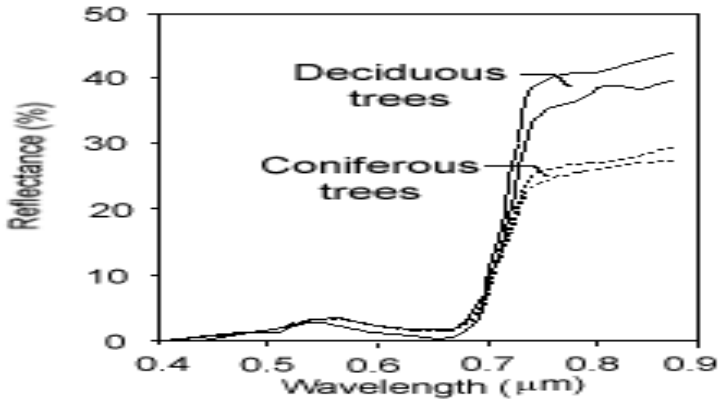


Fig 3.5: General spectral reflectance deciduous and coniferous trees

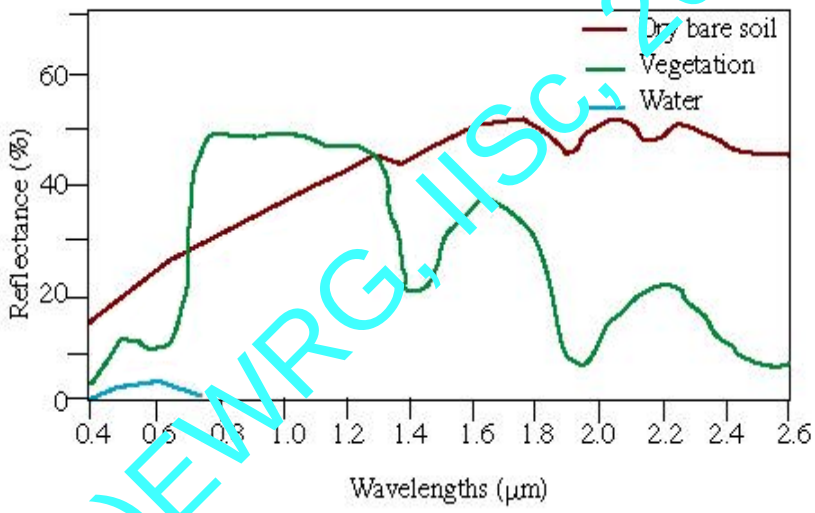


Fig 3.6: Typical spectral reflectance curve for vegetation, soil, and water.

Finding distinctive spectral response patterns is the key to most procedures for computer-assisted interpretation of remotely sensed imagery. This task is rarely trivial. Rather, the analyst must find the combination of spectral bands and the time of year at which distinctive patterns can be found for each of the information classes of interest.

For example, Fig 3.6 shows an idealized spectral response pattern for vegetation along with those of water and dry bare soil. The strong absorption by leaf pigments (particularly chlorophyll for purposes of photosynthesis) in the blue and red regions of the visible portion of the spectrum leads to the characteristic green appearance of healthy

vegetation. However, while this signature is distinctly different from most non-vegetated surfaces, it is not very capable of distinguishing between species of vegetation- most will have a similar colour of green at full maturation. In the near-infrared, however, we find a much higher return from vegetated surfaces because of scattering within the fleshy mesophyllic layer of the leaves. Plant pigments do not absorb energy in this region, and thus the scattering, combined with the multiplying effect of a full canopy of leaves, leads to high reflectance will depend highly on the internal structure of leaves (e.g., broadleaf versus needle). As a result, significant differences between species can often be detected in this region. Similarly, moving into the middle infrared region we see a significant dip in the spectral response pattern that is associated with leaf moisture. This is, again, an area where significant differences can arise between mature species. Applications looking for optimal differentiation between species, therefore, will typically involve both the near and middle infrared regions and will use imagery taken well into the development cycle.

Data acquisition and interpretation

Detection of electromagnetic energy- Photographically
Electronically

Photography-Chemical reaction on the surface of light sensitive film to detect energy variation within a scene.

Electronic sensors generate an electrical signal that corresponds to the energy variations in the original scene.

Analogue to digital conversion Process: Digital Numbers are positive integers that results from quantisizing the original electrical signal from sensor into positive integer value by a process called Analogue to digital conversion Process. The original electrical signal from sensor is continuous analogue signal. This signal is sampled at a set time interval (ΔT) and recorded numerically at each sample points (a,b,c,d). DN output are the integers ranging from 0-255. In numerical format, image data can readily be analyzed with the aid of a computer.

Reference data is used for the following purpose-

- Analysis and interpretation of remote sensed data
- To calibrate a sensor
- Verify information extracted from remote sensing data

Reference data are of two types-

1. **Time critical**-Where ground conditions changes rapidly with time such as analysis of vegetation conditions, water pollution events.
2. **Time stable**-Where materials under observation donot change appreciably with time such as geologic application.

Spectral Response Pattern- Water and vegetation might reflect equally in visible light but these features are always separable in IR radiations.

Spectral responses measured by remote sensors over various features permits the assessment of type and condition of feature and are referred as spectral signatures. The physical radiation measurement at those wavelengths is referred as spectral response. Spectral signatures are absolute and unique. Spectral response pattern may be quantitative but not unique. This variability causes various problems if the objective is to identify various earth features. Therefore it is important to identify the nature of ground area one is looking at to minimize spectral variability.

Spectro radiometer- This device measures function of wavelength of the energy coming from an object within its view.

Bidirectional reflectance Distribution Function –Mathematical description of how reflectance varies for all combinations of illuminations and viewing angles of a given wavelength.

Three models of Remote Sensing- The reflection of solar radiation from the earth's surface is recorded. Aerial camera mainly uses energy in the visible and near IR portions of the spectrum.

Passive Remote Sensing - The radiation emitted from the earth's surface is recorded. Emitted energy is the strongest in the far IR spectrum. Emitted energy from the earth's surface is mainly derived from the short wavelength energy from the sun which is absorbed by the earth's surface and reradiated at a longer wavelength. Other sources of emitted radiations are geothermal energy, heat from steam pipes, power plants.

Active Remote Sensing - Active sensors provide their own energy and therefore they are independent of terrestrial and solar radiation. Camera with a flash is an example of active remote sensing.

Ideal Remote sensing system

- Uniform energy source
- Non-interfering atmosphere-where atmosphere would not modify the energy from the source in any manner either on the way to the earth surface or coming from it.
- Energy matter interaction unique to each and every earth surface.
- Super sensor - sensor highly sensitive to all wavelength
- A real-time data processing and supply – Each data observation would be recognized as being unique to the particular terrain element from which it came. The derived data would provide insight into the physical, chemical and biological state of each feature of interest.

Photography

Basic concept of camera

- Lens to focus light on the film
- Light sensitive film to record the object
- Shutter that controls the entry of light into camera
- Camera body a light tight enclosure

Lens-It gathers light and focuses it on film. The sizes, shapes, arrangement and composition of lenses are designed to control the bending of light rays to maintain colour balance and to minimize optical distortions. Imperfection in lens shape contributes to spherical aberration, a source of error that distorts the image and causes loss of clarity.

Simple Positive lens- Equal curvature on both the sides. Light rays are refracted from both the edges to form image.

Compound lens-Formed of separate lenses of varied sizes, shapes and properties.

Optical axis-joins the centre of curvature of both sides of lens.

Image Principle Plane-Plane passing through the centre of lens.

Nodal point-where image principal plane intersects optical axis

Focal Point-Parallel light rays pass through the lens and are brought to the focus at the focal point.

Focal plane-A plane passing through the focal point parallel to the image principal plane.

Focal length-It is the distance from centre of the lens to the focal point.

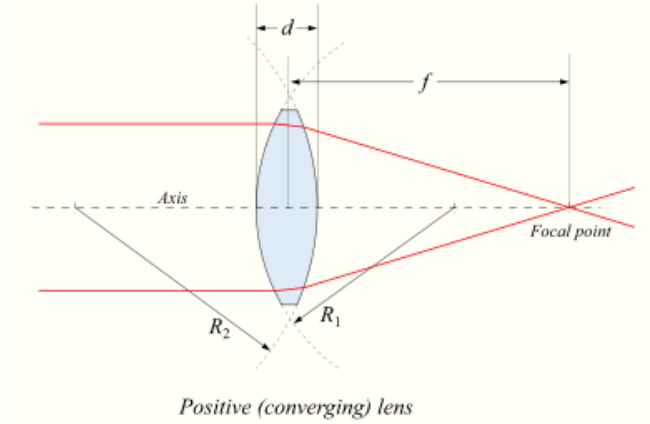


Figure 3.7: Lens. (Reference: wikipedia.org/wiki/Lens_(optics))

For aerial cameras, the scene to be photographed is at such a large distance that focus can be fixed at infinity. For a given lens the focal length is not identical for all the wavelengths. Blue is brought to the focal point at a shorter distance than Red or IR wavelength. This is the source of chromatic aberration.

Aperture Stop-It is positioned near centre of compound lens which controls the intensity of light at focal plane. Manipulation in aperture stop controls the brightness of image.

Shutter- controls the length of time the film is exposed to light.

Film magazine-Light tight container that holds the supply of a film.

Supply spool-holding several hundred feet of unexposed aerial film

Take up spool- accept exposed film

Lens cone-supports the lens and filters and holds them in correct position. Common focal length for typical aerial cameras is 150mm, 300mm, 450mm.

Kinds of cameras-

Reconnaissance camera

- Military use
- Donot have geometric accuracy
- Ability to take photograph at high speed
- Ability to take photograph in unfavourable light conditions and low speed

Strip camera

- It acquires images by moving film past a fixed slit that serves as shutter.
- The speed of the film movement as it passes through the shutter is coordinated with the speed of aircraft movement.
- High quality image from planes flying at high speed and low altitude.

Panoramic cameras

- It is designed to record a very wide field of view.
- Photograph from panoramic camera show a narrow strip of terrain that is perpendicular to the flight track from horizon to horizon.
- Serious geometric distortions
- Useful for large area they represents

Black and white aerial Films

Major components

Base- a thin (40-100µm), flexible transparent material that holds a light sensitive coating (photographic emulsion).

Emulsion-Modern emulsion consists of Silver halide (silver bromide-95% and silver iodide-5%).

Silver halide crystals are insoluble and donot adhere to the base. Silver halide crystals are hold in suspension by gelatin and are evenly spread. Gelatin is transparent, porous and absorbs light rays when light strikes the emulsion.

Physical properties of Silver halide-

- Extremely small
- irregular in shape
- sharp edges

The finer the size of the grain the finer details can be recorded. Below the emulsion is subbing layer to ensure that it adhere to the base. On the reverse side of the base there is

antihalation backing that absorbs light that passes through the emulsion and the base and prevents reflection back to the emulsion.

Process-When the shutter opens it allows the light to enter and strike the emulsion .Silver halide crystals are very small and even a small area of a film contains thousands of crystals. When light strikes a crystal then it converts small portion of crystals into metallic silver. The more intense the light striking a portion of the film the greater is the number of crystals affected.

Development-The process of bathing the exposed film in an alkaline chemical developer that reduces the silver halide grain that exposed to the light. Fixer is applied to dissolve or remove unexposed silver halide grains. After development and fixing the resulting image is a negative representation of a scene. Those areas which were brightest in the scene are represented by greatest concentration of metallic silver. Film speed is the measure of sensitivity of light. A fast film requires low intensity of light for proper exposure, slow film requires more amount of light.

Contrast-It represents a range of gray tones recorded in the film. High contrast means a scene largely in black and white with few gray tones. Low contrast indicates representation of largely gray tones with less dark and bright tones.

Spectral sensitivity records the spectral region to which a film is sensitive.

Panchromatic film-emulsion that is sensitive to radiation throughout visible spectrum.

Orthochromatic film-films with preferred sensitivity in blue and green usually with peak sensitivity in the green region.

Black and white infrared film- deep red filter that blocks visible radiation but allows IR rays to pass. Living vegetation appears many times brighter in near IR portion of spectrum.

Characteristic curve

When the original scene is bright then the negative has large amount of silver that creates dark area. Where the original scene is dark the film is clear with shades of gray due to variations in the abundance of crystals present in the film.

When light of intensity is passed through a portion of negative the brightness of light measured on the other side is a measure of darkness of that region of the film.
Darkness of the film is related to the brightness of the original scene.

E = i x t
E = effect of light upon emulsion
i=intensity
t =time

Colour reversal films

Films coated with three separate emulsions each sensitive to one of the three additive primaries. The layer between upper most blue sensitive emulsion and middle green sensitive emulsion is treated to act as yellow filter to prevent the blue light from passing through the upper layers. This filter is necessary as it is difficult to manufacture emulsions which are sensitive to red and green light without sensitizing them to blue light.

- Upon exposure blue light passes through the blue layer and exposes it. Yellow filter prevents the blue light from exposing the green sensitive emulsion and red sensitive emulsion.
- Green light passes through the blue layer and exposes the green sensitive emulsion.
- Red light passes through the emulsions to expose the red sensitive emulsion.

After Processing-

- The areas which are not exposed to blue light on blue sensitive emulsion are represented by yellow dye and those which are exposed to blue are left clear.
- The areas which are not exposed to green light on green sensitive emulsion are represented by magenta dye and those which are exposed to green are left clear.
- The areas which are not exposed to red light on red sensitive emulsion are represented by cyan dye and those which are exposed to red are left clear.

When the processed film is viewed as a transparency against a light source-

- Magenta and cyan dye combines to form blue colour.
- Yellow and cyan dye combines to give green colour.
- Yellow and magenta dye combines to give red colour.

Colour IR Films-

Yellow filter is present to prevent blue light from entering the camera. Blue sensitive layer is represented by a layer which is sensitive to a portion of near IR. After developing representation of colour is shifted one position in the spectrum. Green in the scene appears blue in the image, red appears green and objects representing near IR is depicted red.

Objects in the scene reflects	blue	green	red	IR
Colour reversal films represents object as	blue	green	red	IR
Colour IR films represents object as		blue	green	red

Green light exposes the green sensitive layer, red light expose the red sensitive layer and IR radiation exposes the IR sensitive layer.

After Processing-

- The areas which are not exposed to green light are represented by yellow dye.
- The areas which are not exposed to red light are represented by magenta dye.
- The areas which are not exposed to IR radiation are represented by cyan dye.

In the final transparency-

- Magenta and cyan dye combine to form blue colour (green area as blue)
- Yellow and cyan dye combine to give green colour (red area as green)
- Yellow and magenta dye combine to give red colour (near IR)

Geometry of Vertical aerial Photograph-
Oblique aerial Photograph-Cameras are oriented towards the side of the aircraft.
Vertical Photograph-Camera directly aimed at the earth's surface.

Image Acquisition

Fiducial Marks - appear at edges and corners of Photographs

Principal Point-The lines that connects the opposite pairs of fiducial mark intersects at one point called Principal Point.

Ground nadir-The point on the ground vertically beneath the centre of camera lens at the time photograph was taken.

Photographic nadir - Intersection of the photograph of vertical line that intersects the ground nadir and centre of the lens.

Relief displacement-Positional error in vertical aerial Photography
Amount of displacement depends upon-

- Height of object
- Distance of object from nadir

Optical distortion-error caused by inferior camera lens
Tilt- Displacement of focal length from truly horizontal position due to aircraft motion.

Coverage of Multiple Photographs-

Vertical aerial photographs are obtained by a series of parallel flight lines to get complete coverage of specific region. When it is necessary to photograph large areas, coverage is build by several strips of photography called flight line.

Stereoscopic Parallex-

- Difference in the appearance of an object due to change in perspective.
- The amount of parallex decreases as the distance increases between the source and the observer.
- Displacement due to stereo parallex is always parallel to the flight lines.
- Tops of tall objects nearer to the camera show more displacement than shorter objects which are more distant from camera.

Mosaics- A series of vertical photographs that shows adjacent regions on the ground can be joined together to form mosaics

Uncontrolled mosaic-Photographs are placed together in a manner that gives continuous coverage of an area without concern for its preservation of consistent scale and positional relationships by simply placing the photograph in the correct sequence

Controlled mosaic-Individual photographs arranged in a manner that preserves its positional relationship with the feature they represents.

Orthophotos -shows photographic details without error caused by tilt and relief displacement.

Orthophotomap – preserve consistent scale throughout the image without geometrical error.

Multispectral Remote Sensing

In the visual interpretation of remotely sensed images, a variety of image characteristics are brought into consideration: colour (or tone in the case of panchromatic images), texture, size, shape, pattern, context, and the like. However, with computer-assisted interpretation, it is most often simply colour (i.e., the spectral response pattern) that is used. It is for this reason that a strong emphasis is placed on the use of multispectral sensors (sensors that, like the eye, look at more than one place in the spectrum and thus are able to gauge spectral response patterns), and the number and specific placement of these spectral *bands*.

It can be shown through analytical techniques such as Principal Components Analysis, that in many environments, the bands that carry the greatest amount of information about the natural environment are the near-infrared and red wavelength bands. Water is strongly absorbed by infrared wavelengths and is thus highly distinctive in that region. In addition, plant species typically show their greatest differentiation here. The red area also very important because it is the primary region in which chlorophyll absorbs energy for photosynthesis. Thus it is this band which can most readily distinguish between vegetated and non-vegetated surfaces.

Given this importance of the red and near-infrared bands, it is not surprising that sensor systems designed for earth resource monitoring will invariably include these in any particular multi-spectral system. Other bands will depend upon the range of applications envisioned. Many include the green visible band since it can be used, along with the other two, to produce a traditional false colour composite - a full colour image derived from the green, red, and infrared bands (as opposed to the blue, green, and red bands of natural colour images). This format became common with the advent of colour infrared photography, and is familiar to many specialists in the remote sensing field. In addition, the combination of these three bands works well in the interpretation of the cultural landscape as well as natural and vegetated surfaces. However, it is increasingly common to include other bands that are more specifically targeted to the differentiation of surface materials.

Hyper spectral remote Sensing: In addition to traditional multispectral imagery, some new and experimental systems such as AVIRIS and MODIS are capable of capturing *hyperspectral* data. These systems cover a similar wavelength range to multispectral systems, but in much narrower bands. This dramatically increases the number of bands

(and thus precision) available for image classification (typically tens and even hundreds of very narrow bands). Moreover, hyperspectral signature libraries have been created in lab conditions and contain hundreds of signatures for different types of landcovers, including many materials and other earth materials. Thus, it should be possible to match signatures to surface materials with great precision. However, environmental conditions and natural variations in materials (which make them different from standard library materials) make this difficult. In addition, classification procedures have not been developed for hyperspectral data to the degree they have been for multispectral imagery. As a consequence, multispectral imagery still represents the major tool of remote sensing today.

Some Operational Earth Observation Systems

The systems are grouped into following categories-

- Low resolution system with spatial resolution 1Km-5Km.
- Medium resolution system with spatial resolution between 10m-100m.
- High resolution system with spatial resolution better than 10m.
- Imaging spectrometric systems with high spectral resolution.

Table 1: Evolution of various satellites.

S.No	Satellite	Sensor	Temporal resolution	Spectral resolution	Spatial resolution
1.	NOAA-17 National Oceanic and Atmospheric Administration	AVHRR-3 Advanced Very High Resolution Radiometer	2-14 times per day	0.58-0.68(1), 0.73-1.00(2), 1.58-1.64 (3A day) 3.55 -3.93 (3B night) 10.3-11.3(4) 11.5-12.5(5)	1 Km X 1Km (at nadir) 6 Km X 2Km (at limb)
2.	Landsat	MSS Multispectral scanner	18 days	0.5-0.6 0.6-0.7 0.7-0.8 0.8-1.1	79/82m 79/82m 79/82m 79/82m 79/82m
		TM The Thematic Mapper	18 days	0.45-0.52(1) 0.52-0.60(2) 0.63-0.69(3) 0.76-0.90(4)	30m 30m 30m 30m

				1.55-1.75(5) 10.4-12.5(6) 2.08-2.35(7)	30m 120m 30m
		ETM+ Enhanced Thematic Mapper	16 days	All TM bands + 0.50-0.90 (PAN)	15m(PAN) 30m (band 1-5,7) 60m (band 6)
3.	Terra	ASTER Advanced Spaceborne Thermal Emission and Reflectance Radiometer	5 days (VNIR)	VIS (BANDS 1-2), 0.56, 0.66, NIR 0.81, SWIR (4-9), 1.65, 2.17, 2.21, 2.26 2.33, 2.40, TIR (bands 10-14) 8.3, 8.65, 9.10, 10.6, 11.3	15m(VNIR) 30m (SWIR) 90m(TIR)
4.	SPOT-5 Systeme Pour l 'Observation de la Terre	2 X HRG (High resolution Geometric) and HRS High Resolution Streoscopic	2-3 days	0.50-0.59 0.61-0.68 0.78-0.89 (NIR) 1.58-1.75 (SWIR) 0.48-0.70 (PAN)	10m, 5m (PAN)
5.	Resourcesat 1	LISS 4 Linear Imaging Self Scanning	5-24 days	0.56, 0.65, 0.80	6m
6.	Ikonos	Optical Sensor Assembly(OSA)	1-3 days	0.45-0.52(1), 0.52-0.60(2), 0.63-0.69(3), 0.76-0.90(4), 0.45-0.90 (PAN)	1m (PAN) 4m (bands 1-4)
7.	EO-1 Earth Observing	CHRIS (Compact High	Less than 1 week	19 or 63 bands 410 nm-1050	18m (full spatial

		Resolution Image Spectrometer)	typically 2-3 days	nm	resolution) 36(full spectral resolution)
8.	EO-1	Hyperion	16 days	220 bands	30 m
9.	Envisat-1	ASAR	35 days	C-band, 5.331 GHz	30m-150m (depending on mode)
		MERIS	3 days	1.25 nm to 25 nm 15m bands	300m (land) 1200m(ocean)
10.	IRS (Indian Remote Sensing)-1A, 1B, 1C, 1D, P6	LISS-III, LISS-IV	24 days	0.52-0.59µm 0.62-0.68 µm 0.77-0.86µm 1.55-1.70µm 0.5-0.75 µm (Panchromatic)	23 m resolution (70m in mid IR)(LISS III), 5.8 m(LISS-IV)
		Panchromatic	5 days		5.8m
		Wide Field Sensor (WiFS)	3 days		188m
11.	Quick Bird	Panchromatic Multispectral	1-5 days	Blue (450-520 nm) Green (520-600 nm) Red (630-690 nm) Near IR (760-900nm)	60-70cm (panchromatic sensor) 2.4m-2.8m (Multispectral)
12.	Cartosat I,II	Panchromatic	4-5 days	0.50-0.85µm	2.5m, less than 1 meter

Digital data

Electronic imagery-A digital image is composed of many thousands of pixels. Each pixels representing brightness of small portion of earth's surface

Optical mechanical scanners-Physically move the mirror or lens to systematically aim the view of earth's surface. As the instrument scans the earth's surface it generates a electric current that varies in intensity as the land surface varies in brightness. Each signal is subdivide into discrete units to create discrete values for digital analysis

Charge coupled devices (CCDs)

- Light sensitive material embedded in silicon chip
- Sensitive components of CCD are manufactured as small 1µm in diameter and sensitive to visible and near IR radiation
- Detector collects photons that strikes a surface and accumulates a charge proportional to the intensity of radiation
- CCDs are compact and more efficient in detecting photons, effective even when intensities are dim.
- CCDs expose all pixels at the same instant than read these values as the next image is acquired.
- Low noise

CCD can be positioned in the focal plane of a sensor such that they view a thin rectangular strip oriented at right angle to the flight path. The forward motion of aircraft or satellite moves the field of view forward building up coverage.

Image Interpretation

Subject – Knowledge of subject of interpretation

Geographic Region – Knowledge of specific geographic region depicted on the image.

Remote Sensing System – Interpreter must understand the formation of images and function of sensor in the portrayal of landscape.

Classification- Assignment of object, area, features based on their appearance on imagery.

Detection – Determination of presence or absence of a feature

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Identification – Identity of a given feature can be specified with enough confidence.

Enumeration- Task of listing or counting discrete items present on an image.

Measurement -

- Measurement of distance and height
- Extension of volumes and areas as well.

Delineation –

Interpreter must delineate or outline regions as observed on remotely sensed data.

- Interpreter must be able to separate distinct areal units characterized by specific tones and textures.
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Elements of Image interpretation

Image tone- denotes lightness or darkness of a region within an image

For black and white images – tones may be characterized by light, medium gray, dark gray.

For colour images- tones simply refers to colours. Image tone refers ultimately to the brightness of an area of the ground.

- Hue refers to the colour on the image as defined in the intensity-hue –saturation (IHS).
- Tonal variations are an important interpretation element in an image interpretation.
- The tonal expression of object on the image is directly related to the amount of light reflected from its surface.
- Different types of rock, soil or vegetation most likely have different tones.

Image texture- Apparent roughness or smoothness of an image.

- Usually image texture is caused by pattern of highlighted and shadowed area created when an irregular surface is illuminated with an oblique angle.
- Image texture depends on the surface and the angle of illumination.

Shadow

- Provides an important clue
- Features illuminated at an angle cast a shadow that reveal characteristic of its shape and size.
- Military photo interpreters have developed techniques to use shadows to distinguish subtle difference that might not show otherwise.
- Useful in identification of man-made landscape

Pattern

- Arrangement of individual objects into distinctive recurring form that facilitate the recognition.
- Pattern can be described by terms such as concentric, radial, checkerboard, etc.
- Some land uses however have specific and characteristic pattern when observed from on aerospace data.
- Examples include the hydrological system rivers with its branches and patterns related to erosion.

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- When identification of a specific class of equipment implies that other more important items are likely to be found nearby.
- An example of association is an interpretation of a thermal power plant based on the combined recognition of high chimneys, large buildings, cooling towers, coal heaps etc.

Shape

- Obvious clues of their identity
- Individual structures have characteristic shapes.
- Height differences are important to distinguish between different vegetation types and also in geomorphological mapping. The shape of objects often helps to determine the character of the object (build up, roads and railways agricultural fields etc.).

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- Relative size of the other object in relation to the other objects on the image provides the interpreter with the notion of its scale and resolution.
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- The width of road can be estimated by comparing it to the size of the cars, which is generally known. Subsequently this width determine the road type, e.g. primary road, secondary road etc.

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- Refers to topological positions
- Sewage treatment facility is positioned near low topological sites near the steams or rivers to collect the waste water flowing from high location.
- A typical example of this interpolation element is that back swamps can be found in a flood plain but not in the centre of city area.

The global positioning system (GPS)

The Global Positioning System (GPS) is a location system based on a constellation of 24 satellites orbiting the earth at altitudes of approximately 20,200 kilometres. GPS satellites are orbited high enough to avoid the problems associated with land based systems, yet can provide accurate positioning 24 hours a day, anywhere in the world. Uncorrected positions determined from GPS satellite signals produce accuracies in the range ± 100 meters. When using a technique called differential correction, users can get positions accurate to within 5 meters or less. With some consideration for error, GPS can provide any point on earth with a unique address (its precise location). A GIS is a descriptive database of the earth (or a specific part of the earth). GPS provide location of a point (X, Y, Z), while GIS gives the information at that location.

GPS is most useful for:

- Locating new survey control stations and up grading the accuracy of the old station
- Measuring terrain features that are difficult to measure by conventional means
- Positioning of offshore oil platforms

- Updating road data with a GPS receiver in the vehicle
- Marine navigation, including integration with electronic charts
- Determining camera- carrying aircraft positions to reduce reliance on fixed marks in aerial photography
- Determination of difference in elevation.

GPS/GIS is reshaping the way users locate, organise, analyse and map the resources.

Successful application of remote sensing:

- Evaluation for the potential for addressing the problem with remote sensing techniques.
- Identification of remote sensing data acquisition procedures appropriate to the task.
- Determination of data interpretation procedures to be employed and the reference data needed.
- Identification of the criteria by which the quality of information collected can be judged.
- Clear definition of problem at hand
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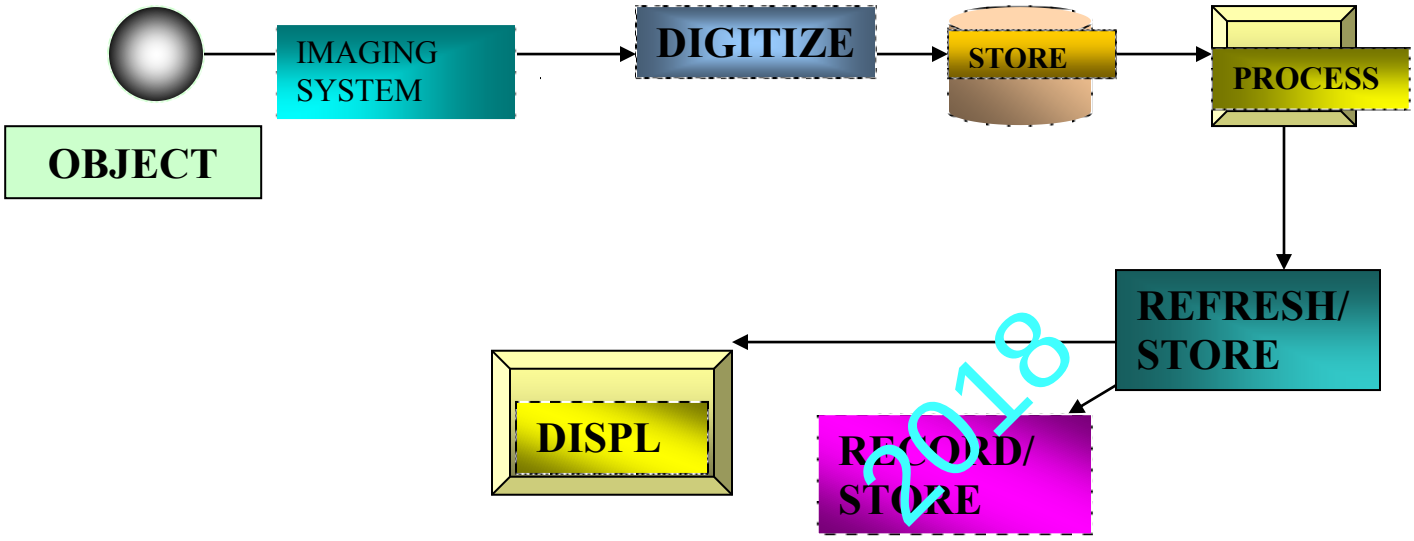
DIGITAL IMAGE PROCESSING.

As a result of solid state multispectral scanners and other raster input devices, we now have available digital raster images of spectral reflectance data. The chief advantage of having these data in digital form is that they allow us to apply computer analysis techniques to the image data- a field of study called *Digital Image Processing*.

Digital Image Processing is largely concerned with four basic operations*: image restoration, image enhancement, image classification, image transformation*. Image restoration is concerned with the correction and calibration of images in order to achieve as faithful a representation of the earth surface as possible – a fundamental consideration for all applications. Image enhancement is predominantly concerned with the modification of images to optimise their appearance to the visual system. Visual analysis is a key element, even in digital image processing, and the effects of these techniques can be dramatic. *Image classification* refers to the computer-assisted interpretation of images—an operation that is vital to GIS. Finally, *image transformation* refers to the derivation of new imagery as a result of some mathematical treatment of the raw image bonds.

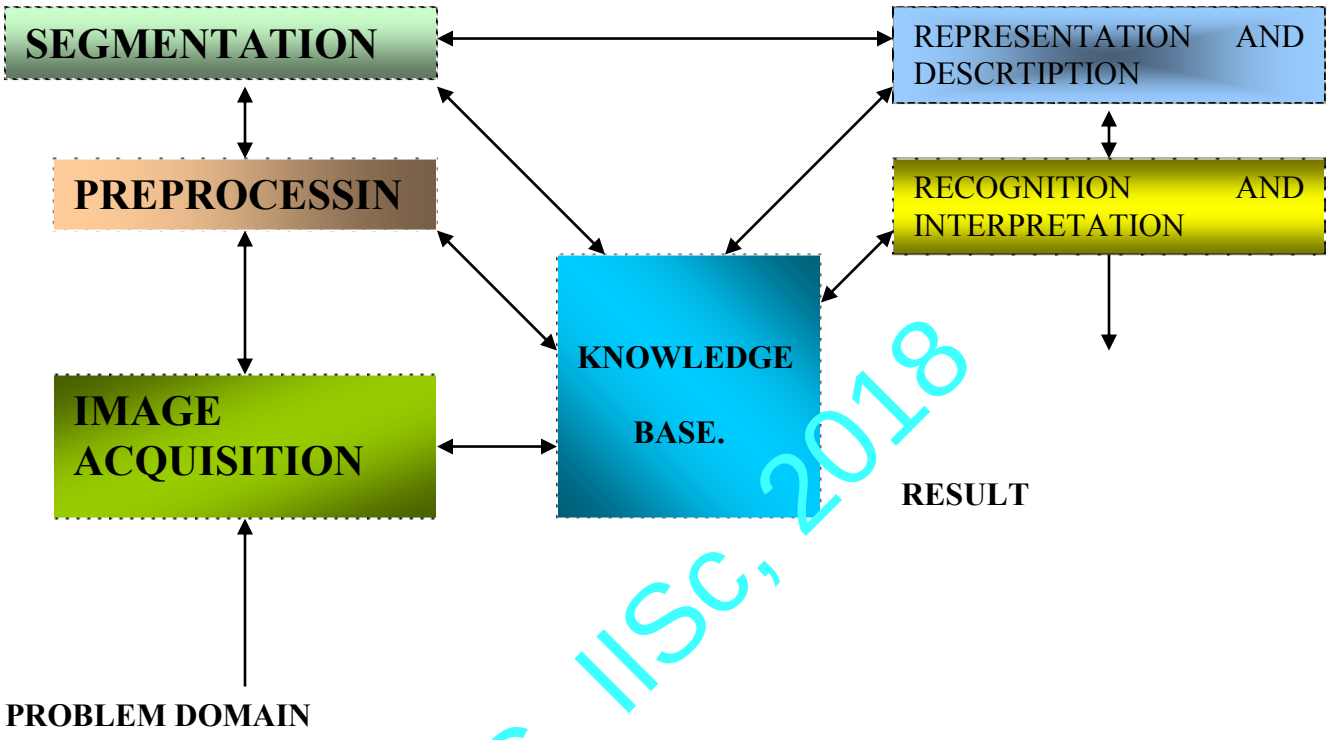
Digital image is an image f (x, y) that has been discritised both in spatial co-ordinates and brightness. So, it is considered as a matrix whose rows and column indices identify a point in the image and the corresponding matrix element value identifies the gray level at that point. The elements of such a digital array are called image elements, pixels, or picture elements.

DIP SEQUENCE:



- Object: area of interest.
- Imaging system:
  - Camera,
  - Scanner,
  - Satellites.
- Digitize
  - Sampling (digitization of coordinate values),
  - Quantisation (digitization of amplitude).
- Store: digital storage disk.
- Process: digital computer.
- Refresh/store: online buffer
- Display: monitor.

FUNDAMENTAL STEPS IN IMAGE PROCESSING:



PROBLEM DOMAIN: Problem domain may be pieces of mail, and the objective is to read the address on each piece. Thus the desired output in this case is a stream of alphanumeric characters.

IMAGE – ACQUISITION: The first step in the process is image acquisition that is to acquire digital image. To do so, requires an imaging sensor and the capability to digitize the signal produced by the sensor. The sensor could be monochrome or color TV camera that produces an entire image of a problem domain.

PREPROCESSING: The main objective of preprocessing is to improve the image in ways that increase the chance for success of the other process. Ex: Enhancing contrast, noise removal, and isolating regions.

SEGMENTATION: Segmentation is the process of partitioning an image into its constituent parts.

REPRESENTATION AND DESCRIPTION: Representation is the only part of solution for transforming raw data into a form suitable for subsequent computer processing. Here the method should also be specified describing data so that features of interests are highlighted.

Description is also called as feature selection which deals with extracting features result in some quantitative information of interest or features that are basic for differentiating one class of objects from another.

Recognition and interpretation: Recognition is a process that assigns the label to an object based on the information provided by the descriptors. Interpretation involves assigning meanings to an ensemble of recognised objects.

Knowledge base: Knowledge about the problem domain is coded into an image processing system in the form of knowledge database. The order to guide the operation of each processing module, the knowledge base also controls the interaction between modules.

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The possible forms of digital image manipulation:

1. Image restoration and rectification
2. Image enhancement
3. Image classification
4. Data merging & GIS integration
5. Biophysical modeling

Image rectification and restoration

These operations aim to correct distorted or degraded image data to create a more faithful representation of the original scene.

- Corrections for geometric distortions,
- Calibrate the data radio metrically
- To eliminate noise present in the data

Remotely sensed images of the environment are typically taken at a great distance from the earth's surface. As a result, there is a substantial atmospheric path that electromagnetic energy must pass through before it reaches the sensor. Depending upon the wavelengths involved and atmospheric conditions (such as particulate matter, moisture content and turbulence), the incoming energy may be substantially modified. The sensor itself may then modify the character of that data since it may combine a variety of mechanical, optical and electrical components that serve to modify or mask the measured radiant energy. In addition, during the time the image is being scanned, the satellite is following a path that is subject to minor variations at the same time that the earth is moving underneath. The geometry of the image is thus in constant flux. Finally, the signal needs to be tele-metered back to the earth, and subsequently received and processed to yield the final data we receive. Consequently, a variety of systematic and apparently random disturbances can combine to degrade the quality of the image we finally receive. Image restoration seeks to remove these degradation effects.

Broadly, the image restoration can be broken down into the two sub-areas of *radiometric restoration and geometric restoration*.

Geometric Restoration: For mapping purposes, it is essential that any form of remotely sensed imagery be accurately registered to the purposed map base. With satellite imagery, the very high altitude of the sensing platform results in minimal image displacements due to relief. As a result, registration can usually be achieved through the use of a systematic rubber sheet transformation process that gently warps an image (through the use of polynomial equations) based on the known positions of a set of widely dispersed control points.

With aerial photographs, however, the process is more complex. Not only are there systematic distortions related to tilt and varying altitude, but variable topographic relief leads to very irregular distortions (differential parallax) that cannot be removed through a rubber sheet transformation procedure. In these instances, it is necessary to use photogrammetric rectification to remove these distortions and provide accurate map measurements. Failing this, the central portions of high altitude photographs can be resampled with some success. Doing so also requires a thorough understanding of reference systems and their associated parameters such as datums and projections.

The sources of geometric distortions:
- Variations in the altitude,
- Velocity of the sensor platform
- Earth curvature
- Atmospheric refraction

It is implemented as a two-step procedure:

- Systematic or predictable distortions

- Random or unpredictable distortions

Systematic distortions are well understood and easily corrected by applying formulas derived by modeling the sources of distortions mathematically. Random distortions are residual unknown systematic distortions are corrected by analyzing well-distributed ground control points occurring in an image.

Radiometric Restoration: Radiometric restoration refers to the removal or diminishment of distortions in the degree of electromagnetic energy registered by each detector. A variety of agents can cause distortion in the values recorded for image cells. Some of the most common distortions for which correction procedures exist include:

- *Uniformly elevated values*, due to atmospheric haze, which preferentially scatters short wavelength bands (particularly the blue wavelength);
- *Striping*, due to detectors going out of calibration;
- *Random noise*, due to unpredictable and unsystematic performance of the sensor or transmission of the data; and
- *Scan line drop out*, due to signal loss from specific detectors.

It is also appropriate to include here procedures that are used to convert the raw, uniless relative reflectance values (known as digital numbers, or DN) of the original bands into true measures of reflective power (radiance).

Radiance measured by any given system over a given object is influenced by such factors as:

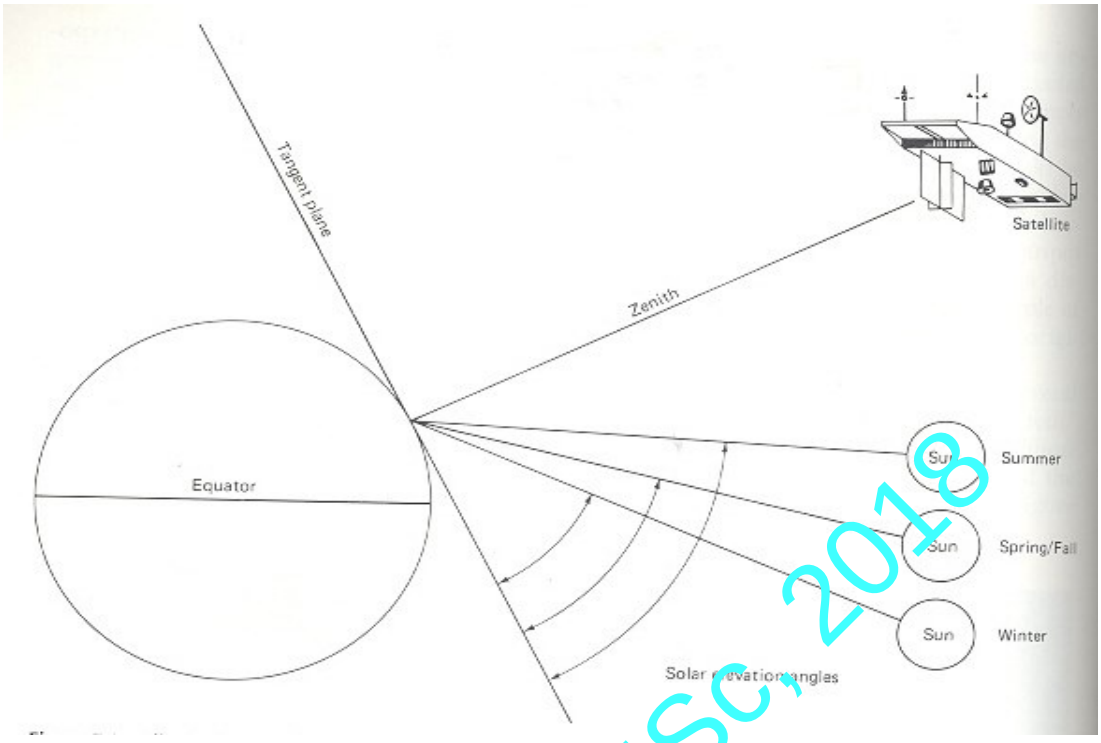
- Changes in scene illumination,
- Atmospheric conditions,
- Viewing geometry, and
- Instrument response characteristics

Sun – elevation correction and Earth-sun distance correction

The earth-sun distance correction is applied to normalize for the seasonal changes in the distance between the earth and the sun.
The combined effect of solar-zenith angle and earth-sun distance on the irradiance incident on the earth's surface can be expressed as,

$E = (E0 * \cos q0) / (d^2)$ where,

E = normalized solar irradiance
E0 = solar irradiance at mean earth-sun distance
q0 = sun's angle from the zenith
d=earth-sun distance in AU [ASTRONOMICAL UNITS]

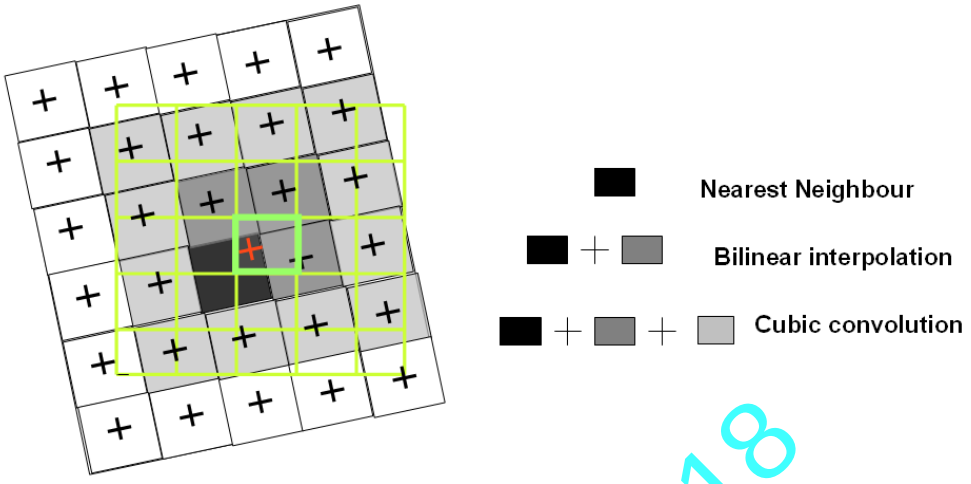


Noise removal:

- Image noise is an unwanted disturbance in image data that is due to limitations in the sensing, signal digitization, or data recording process
- If the difference between a given pixel value and its surrounding values exceeds an analyst-specified threshold, the pixel is assumed to contain noise.
- The noisy pixel value can then be replaced by the average of its neighboring values.

Geometric correction

Highly systematic source of distortion involved multispectral scanning from satellite altitude is eastward rotation of the earth beneath the satellite during imaging. This causes optical sweep of the scanner to the west of the previous sweep. This is known as skew distortion. Process of deskewing involves offsetting each successive line towards the west.



Principal of resampling using nearest neighbour, bilinear interpolation and cubic convolution.

Nearest Neighbour

- Consider the green grid to be the output image to be created.
- To determine the value of central pixel (bold), in the nearest neighbour the value of nearest original pixel is assigned, the value of black pixel in this example.
- Value of each output pixel is assigned simply on the basis of Digital Number closest to the pixel in the input matrix.
- Advantage of simplicity.
- Ability to preserve original values in unaltered scene.

Bilinear interpretation

- Calculates the value for each output pixel based on four nearest input pixels.
- Weighted mean is calculated for the four nearest pixels in the original image (dark gray and black pixels).

Cubic convolution

- Each estimated value in the output matrix is found assessing values within a neighbourhood of 16 surrounding pixels (the black and all gray pixel) in the input image.

Radiometric corrections-

Radiance measured by any given system over an object is influenced by-

- Scene illumination
- Atmospheric conditions
- Viewing geometry
- Instrument response
- Radiometric corrections can be divided into relatively simple cosmetic rectification, as well as atmospheric corrections.
- Atmospheric corrections constitute an important step on the preprocessing of remotely sensed data. Their effect is to rescale the atmospheric raw radiance data.
- Image data acquired under different solar illumination angles are normalized by calculating pixel brightness values assuming that sun was at zenith during each day of sensing.
- The correction is applied by dividing each pixel in a scene by sine of solar elevation angle for particular time and location of imaging.

Noise Removal

Random noise or spike noise

- Image noise is the unwanted disturbance in image data.
- Noise removal is done before any subsequent enhancement or classification of image data.
- The periodic line dropouts and striping are forms of random noise that may be recognized and restored by simple means. Random noise on the other hand requires a more sophisticated restoration process such as digital filtering.
- Random noise or temporary noise may be due to errors during transmission of data or temporary disturbance.

Individual pixels acquire DN – values that are much higher and lower than the surrounding pixels. In image they produce a bright and dark spot that interferes with the information extraction procedures.

- Spike noise can be detected by mutually comparing neighbouring pixel values. If neighbouring pixel values differ by more than threshold margin, it

is designated as spike noise and the DN is replaced by an interpolated DN value.

De-striping

- One method is to compile a set of histograms for the image –one for each detector involved in a given band.
- These histograms are then compared in terms of their mean and median values to identify problem detector.
- A grey scale adjustment factor is applied to adjust the histograms for problem lines and others are not altered.
- Line striping occurs due to non identical detectors response.
- Although the detectors for all satellite sensors are carefully calibrated and matched before launch of the satellite, with time response of some detectors may drift to higher or lower levels.
- Every scan lines are brighter or darker than the other lines. It is important to understand that valid datas are present in the defective lines, but that must be corrected to match the overall scene.

Periodic Line dropouts

- A number of adjacent pixels along a line or an entire line may contain defective Digital Number
- This problem is addressed by replacing defective Digital Number with the average of values for the pixels occurring in the line below and above.
- Digital Number from the preceding line can simply be inserted in the defective pixel.

Image enhancement: Image enhancement is concerned with the modification of images to make them more suited to the capabilities of human vision. Regardless of the extent of digital intervention, visual analysis invariably plays a very strong role in all aspects of remote sensing. While the range of image enhancement techniques is broad, the following fundamental issues form the backbone of this area These procedures applied to image data in order to more effectively display or record the data for subsequent visual interpretation.

- Contrast manipulation

- Spatial feature manipulation
- Multi-image manipulation

Contrast manipulation: Digital sensors have a wide range of output values to accommodate the strongly varying reflectance values that can be found in different environments. However, in any single environment, it is often the case that only a narrow range of values will occur over most areas. Grey level distributions thus tend to be very skewed. Contrast manipulation procedures are thus essential to most visual analyses.

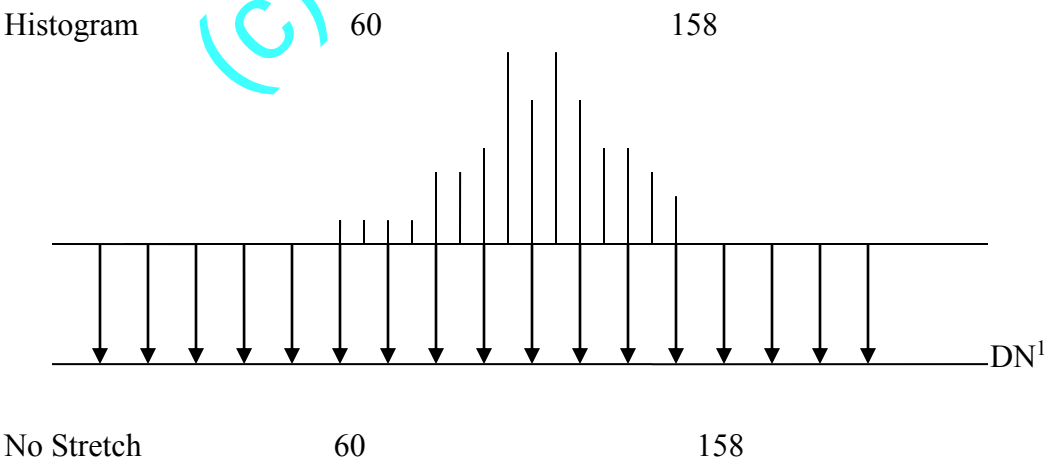
- Gray-level threshold is used to segment an input into two classes- one for those pixels having values below an analyst-defined gray level and one for those above this value.

• Level slicing is where all DN's falling within a given interval in the input image then displayed at a single DN in the output image

• Contrast stretching is to expand the narrow range of brightness values typically *p*resent in an input image
over a wider range of gray values.

Contrast Stretching

Hypothetical sensing system whose image output levels can vary from 0-255.

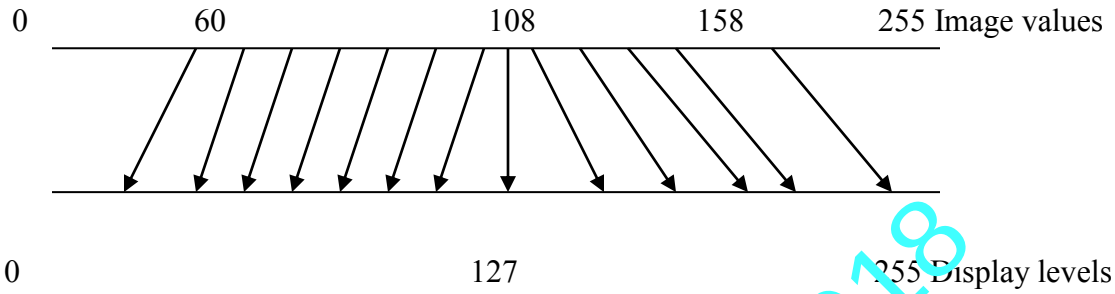


Illustrates a histogram of brightness levels recorded in one spectral band over a scene.

Histogram shows scene brightness values occurring in limited range of 60-158.

Linear stretch

A more expressive display would result if we expand the range of image levels present in scene (60-158) to fill the range of display values (0-255).



- Subtle variations in input image data values would now be displayed in the output tones that would be distinguished by the interpreter.
- Light tonal areas would appear lighter and dark areas would appear darker.
- Linear stretch would be applied to each pixel in an image using algorithm.

$$DN^1 = \frac{(DN - MIN)}{(MAX - MIN)} 255$$

DN^1 = DN assigned to pixel in output image

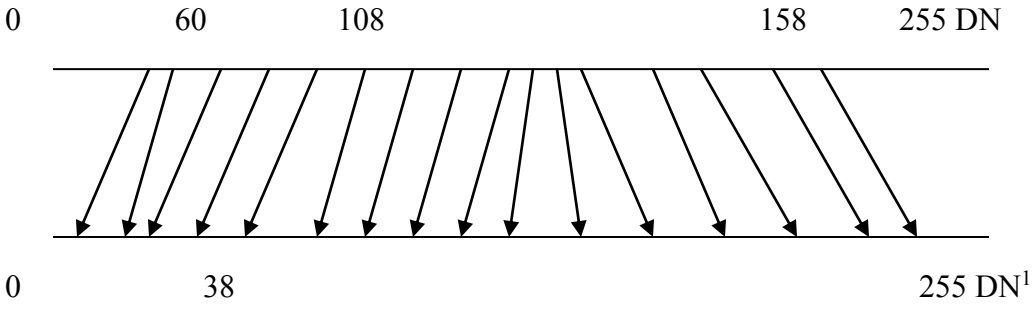
DN = original DN of pixel in input image

MIN=minimum value of input image to be assigned a value of 0 in the output image (60 in example)

MAX= maximum value of input image to be assigned a value of 255 in the output image (158 in example)

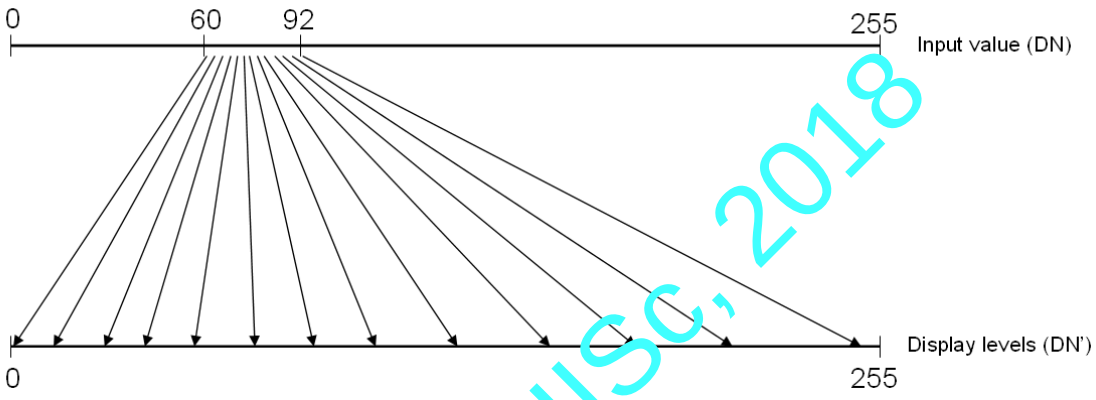
- Each pixel's DN is simply used to index a location in the table to find appropriate DN^1 to be displayed in the output image.

Histogram – equalized stretch



- Image values are assigned to display levels on the basis of their frequency of occurrence.
- Image value range of 109 to 158 is now stretched over a large portion of display levels (39-255).
- A smaller portion (0-38) is reserved for infrequently occurring image values (60-108).

Special Analysis



- Specific features may be analyzed in greater radiometric detail by assigning display range exclusively to a particular range of image value.
- If water features are represented by a narrow range of values in a scene, characteristics in water feature would be enhanced by stretching this range into small display range.
- Output range is devoted to a small range of input values between 60 and 92.
- On stretched display, minute tonal variations in the water range would be exaggerated.

Spatial Feature Manipulation

Spatial filtering

- A further step in producing optimal images for interpretation is the use of filter operations.
- Filter operations are local image transformations: a new image is calculated and the value of a pixel depends on the values of its formal neighbours.
- Filter operations are usually carried out in single band.
- Filters are used for spatial image enhancement, for example, to reduce noise or to sharpen blurred image.

Convolution

- A moving window is established that contains an array of coefficients or weighting factors.
- Such arrays are referred as operators or kernels and are normally an odd numbers of pixels in size.(example- 3X3, 5X5, 7X7)
- Kernel is moved throughout original image and DN at the center of the kernel in the second (convoluted) output image is obtained by multiplying the coefficient in kernel by corresponding DN in original image and adding all the resulting products. This operation is performed for each pixel in the original image.

Kernel

1/9	1/9	1/9
1/9	1/9	1/9
1/9	1/9	1/9

Original image DN

67	67	72
70	68	71
72	71	72

Convolution =
1/9(67)+1/9(67)+1/9(72)+1/9(70)+1/9(68)+1/9(71)+1/9(72)+1/9(71)+1/9(72) = 70

	70	

Edge Enhancement: Directional first differencing-

- Systematically compares each pixel in an image to one of its immediately adjacent neighbour and displays the difference in terms of gray level of output image.
- The distance used can be horizontal, vertical or diagonal.

A	H
V	D

Horizontal first difference= DN_A-DN_H
Vertical first difference=DN_A-DN_V
Diagonal first difference=DN_A-DN_D

- Horizontal first difference at Pixel A would result from subtracting DN in Pixel H from Pixel A.
- Vertical first difference would result from subtracting DN at Pixel V from that of Pixel A.
- Diagonal first difference would result from subtracting DN at Pixel D from that of Pixel A.
- The first differences can either be positive or negative, so a constant such as display value median (127 for 8-bit data) is added to the difference for display purpose.
- Pixel to Pixel differences are very small, the data in enhanced image has a very narrow range. Display value median and contrast stretch must be applied to output image.

Fourier analysis

- An image is separated into various spatial frequency components through application of mathematical operation known as Fourier transform.
- This operation amounts to fitting a continuous function through discrete DN values if they were along each row and column in an image.
- Peaks and valleys along any given row or column can be described mathematically by combination of sine and cosine waves with narrow amplitudes, frequencies and Phases.
- After an image is separated into its component spatial frequency it is possible to display these values in 2D scatter Plot known as Fourier spectrum.
- Fourier Spectrum of an image is known, it is possible to regenerate original image through application of inverse Fourier transform.This is mathematical reversal of Fourier transform.

SPATIAL FEATURE MANIPULATION

Spatial Filtering: Spatial filtering is a "local" operation in that pixel values in an original image are modified on the basis of the gray levels of neighboring pixels. A simple low pass filter may be implemented by passing a moving window throughout an original

image and creating a second image whose DN at each pixel corresponds to the local average within the moving window at each of its positions in the original image.

Composite Generation: For visual analysis, colour composites make fullest use of the capabilities of the human eye. Depending upon the graphics systems in use, composite generation ranges from simply selecting the bands to use, to more involved procedures of band combination and associated contrast stretch.

Multi-Image manipulation

Spectral Ratioing

Slope based: simple arithmetic combinations that focus on the contrast between the spectral response patterns of vegetation in the Red and NIR portion of the electromagnetic spectrum.

Simple Ratio	$\frac{NIR}{RED}$
NDVI (Normalised Difference Vegetation Index)	$\frac{(NIR-RED)}{(NIR+RED)}$
TVI (Transformed Vegetation Index)	$\sqrt{((NIR-RED)\div(NIR+RED)+0.5)}$
CTVI (Corrected Transformed Vegetation Index)	$\frac{NDVI+0.5}{ABS(NDVI+0.5)}\times\sqrt{ABS(NDVI+0.5)}$
TTVI (Thiam's Transformed Vegetation Index)	$\sqrt{ABS(NDVI)+0.5}$
RVI (Ratio Vegetation Index)	$\frac{RED}{NIR}$
NRVI (Normalised Ratio Vegetation Index)	$\frac{RVI-1}{RVI+1}$

Distance based: measures the degree of vegetation present by gauging the difference of any pixel's reflectance from the reflectance of bare soil.

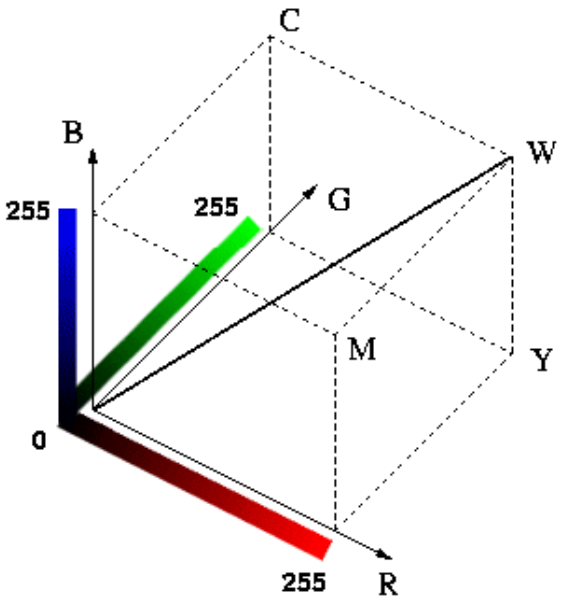
PVI (Perpendicular Vegetation Index)	$\{Sin(a)\times NIR\}-\{Cos(a)\times RED\}$
PVI1	$\frac{\{(b\times NIR)-RED+a\}}{\sqrt{(b\times b)+1}}$
PVI2	$\frac{(NIR-a\times RED+b)}{\sqrt{1+(a\times a)}}$
PVI3	$(a\times NIR)-(b\times RED)$
DVI (Difference Vegetation Index)	$(b\times NIR)-RED$
AVI (Ashburn Vegetation Index)	$NIR-RED$
SAVI_L1 (Soil Adjusted Vegetation Index) Where L = 1	$\frac{NIR-RED}{NIR+RED+L}\times(L+1)$

Ratio images are enhancement resulting from division of DN values in one spectral band by corresponding values in another band.

Land cover/ illumination	DN		
	Band A	Band B	Band C
Deciduous			
Sunlit	48	50	0.96
Shadow	18	19	0.95
Coniferous			
Sunlit	31	45	0.69
Shadow	11	16	0.69

- DNs observed for each cover type are lower in shadowed area than sunlit area.
- The ratio values for each cover type are nearly identical, irrespective of illumination condition.
- Ratioed image of scene effectively compensates for brightness variation and emphasizes colour content of the data.
- Ratioed image are useful for discriminating spectral variations in a scene that are masked by brightness variation in images.
- Near IR ratio for healthy vegetation is very high and for stressed vegetation it is low (as near IR reflectance decreases and red reflectance increases).

- Thus, near IR to red (or red to near IR) ratioed image might be very useful for differentiating between area of stressed and non stressed vegetation.
- The form and number of ratio combinations available to image analyst varies depending on the source of digital data.
- The number of possible ratios that can be developed from n bands of data is n(n-1). Thus, Landsat MSS data, 4(4-1), 12 different ratio combinations are possible (six original and six reciprocal).
- The ratio TM3/TM4 is depicted so that the features such as water and roads which reflects highly in the red band (TM3) and little in IR band (TM4) are shown in lighter tones.
- Features such as vegetation appears in darker tones because of its low reflectance in red band (TM3) and high reflectance in near IR (TM4).
- Ratio TM5/TM2, vegetation appears in light tones because of its high reflectance in mid IR band and low reflectance in green band (TM2).
- Ratio TM3/TM7, roads and other cultural features appear in lighter tones in this image due to high reflectance in red band (TM3) and low reflectance in mid-IR band (TM7).
- Differences in water turbidity are readily observable in ratio image.
- Ratio images can be used to generate false colour composites by combining three monochromatic ratio datasets.
- Such composites have two fold advantages of combining data from more than two bands and presenting it in colour which facilitates interpretation of subtle spectral reflectance differences.
- 20 colour combinations are possible when 6 original ratios of landsat MSS data are displayed 3 at a time.
- 15 original ratios of non thermal ratio of non thermal TM data result in 455 different possible combinations.
- Caution should be taken generating and interpreting ratio images.
- Such images are intensity blind.



R: red
G: green
B: blue
C: cyan
M: magenta
Y: yellow
W: white

Hybrid colour ratio composite.
(Reference:http://gimpsavvy.com/BOOK/index.html?node50.html)

- This product is prepared by displaying two ratio images in two of the primary colours but using third of primary.
- Noise removal is important since ratioing enhances noise pattern that are uncorrelated in component images.

Intensity-Hue-Saturation Colour Space Transformation

- Digital images are displayed as additive colour composites using three primary colours: red, green, blue (RGB)
- RGB colour cube is defined by brightness levels of each of the three Primary colours.
- For display 8 bit-per-pixel data encoding, range of possible DN for each colour component 0-255.
- 256^3 possible combinations of red, green and blue DNs can be displayed by such device.
- Every pixel is represented by 3-D coordinate Position somewhere within colour cube.
- Line from the origin of the cube to opposite corner is gray line since DN that lies on this line has equal components of red, green and blue.

- RGB are used in digital image processing to display normal colour, false colour IR, arbitrary colour composites.
- **Normal colour composite** may be displayed by assigning TM or ETM bands 1, 2 and 3 to blue, green, red components respectively.
- **False Colour IR composite** results when band 2, 3, 4 are assigned to these respective components.
- **Arbitrary colour composites** When other bands or colour assignments are used.
- Colour composite can be contrast stretched.

Intensity-hue-saturation (IHS system)

Intensity-total brightness of colour (whether it is light or dark).

Hue- dominant or average wavelength of light contributing to colour. It refers to the names we give to the colours: red, green, yellow, orange, purple, etc.

Saturation-describes a colour in terms of pale versus vivid. Purity of colour relative to gray.

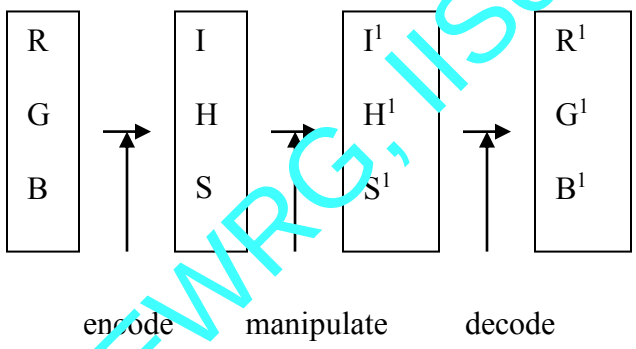


Figure 4: IHS/RGB encoding and decoding for interactive image manipulation.

In this figure original RGB components are transformed into corresponding IHS components.

- IHS components are then manipulated to enhance desired characteristics of the image.
- These modified IHS components are transformed back to RGB system for final display.

Decorrelation stretching

- Multiimage manipulation used when multispectral data are highly correlated.

- Traditional contrast stretching of highly correlated data as R, G, and B displays normally only expands the range of intensities.
- Decorrelation stretching involves exaggeration of least correlated information in an image primarily in terms of saturation with minimal change in image intensity and hue.
- IHS transformation, decorrelation stretching is applied in a transformed image space, the results are transformed back to RGB system for final display.

CLASSIFICATION

The term pattern refers to the set of radiance measurements obtained in the various wavelength bands for each pixel.

- **Spectral pattern recognition** refers to classification procedures that utilize this pixel-by-pixel spectral information as the basis for automated land cover classification.
- **Spatial Pattern recognition**-Categorization of image pixels on the basis of their spatial relationship with the pixel surrounding them. Spatial classifier considers aspect such as – Image texture, pixel proximity, feature size, shape directionality, repetition and context.
- **Temporal Pattern recognition**-uses time as an aid in feature identification. Distinct spectral and spatial changes during season can permit discrimination on multidate imagery that would be impossible given any single date.

Supervised Classification

Supervised classification - In this classification, the image analyst "supervises" the pixel categorization process by specifying, to the computer algorithm, numerical descriptors of the various land cover types present in a scene.

- One of the main steps in image classification is the partitioning of feature space.
- Supervised classification requires the operator to be familiar with the area of interest.
- The operator needs to know where to find the classes of interest in the area covered in the image.

Three basic steps are involved:

1. Training stage - the analyst identifies representative training areas and develops a numerical description of the spectral attributes of each land cover type of interest in the scene.

2. **Classification stage** - each pixel in the image data set is categorized into the land cover class it most closely resembles. The category label assigned to each pixel in this process is then recorded in the corresponding cell of an interpreted data set (an "output" image).

3. Output stage – After the entire data set has been categorized, the results are presented in the output stage. Three typical forms of output products are thematic maps, tables of full scene or sub scène area statistics for the various land cover classes, and digital data files amenable to inclusion in a GIS.

THE CLASSIFICATION STAGE

- Minimum-Distance-to-Means Classifier
- Parallelepiped Classifier
- Gaussian Maximum Likelihood Classifier

  - Each pixel in the image data set is categorized into class it closely resembles. If pixel is insufficiently similar to any training data set it is labeled as 'unknown'.
  - Category label assigned to each pixel in this process is recorded in corresponding cell of an interpreted data (output image).
  - After entire dataset has been categorized the results are presented in output stage.

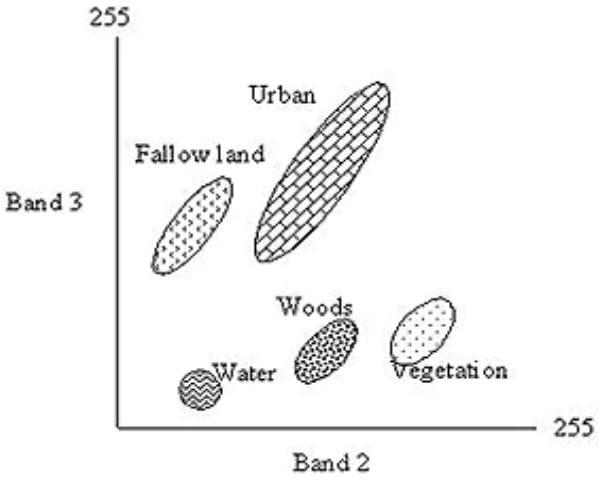


Figure 5: Spectral plot (scatter diagram) of various classes against band 2 and 3. (Reference: http://rst.gsfc.nasa.gov/Sect1/Sect1_19.html)

Minimum-Distance-to-Mean classifier.

- First, the mean, or average, spectral value in each band for each category is determined. These values comprise the mean vector for each category.
- For an unknown pixel value, the distance between this pixel value and each category mean value is computed, and then the unknown pixel is assigned to the "closest" class.

Advantage: It is mathematically simple and computationally efficient.

Disadvantage: It is insensitive to different degrees of variance in the spectral response data.

- We take a sample of pixel observations from two channel digital image data set.
- 2D digital values or measurement vectors attributed to each pixel can be expressed graphically by plotting them on scatter diagram.
- If band 2 DN for Pixel is 10 and band 3 DN for pixel is 68, the measurement vector for pixel is represented by a point (10, 68) in the measurement space.

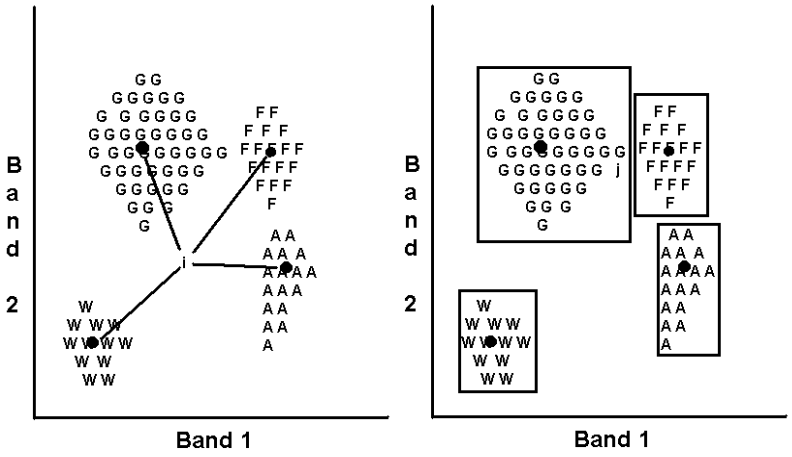


Figure 6: Minimum –Distance to means classifier (References: (http://www2.geog.ucl.ac.uk/~mdisney/lse/session3/mdmbox.gif)

Parallel piped classifier

- This range may be defined by the highest and lowest digital number values in each band and appears as a rectangular area in the two-channel scatter diagram.
- An unknown pixel is classified according to the category range, or decision region, in which it lies, or as "unknown" if it lies outside all regions.
- The multidimensional analogs of these rectangular areas are called parallelepipeds.
- It is fast and efficient computationally.

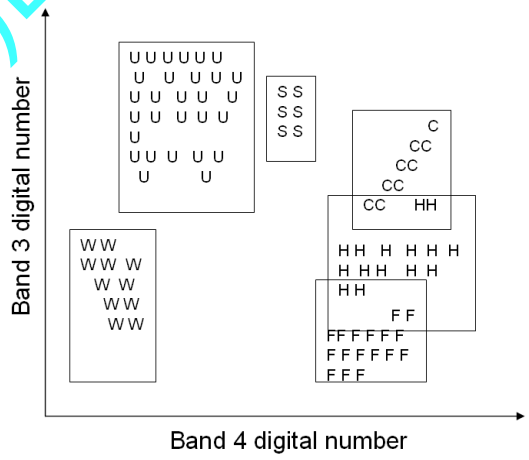
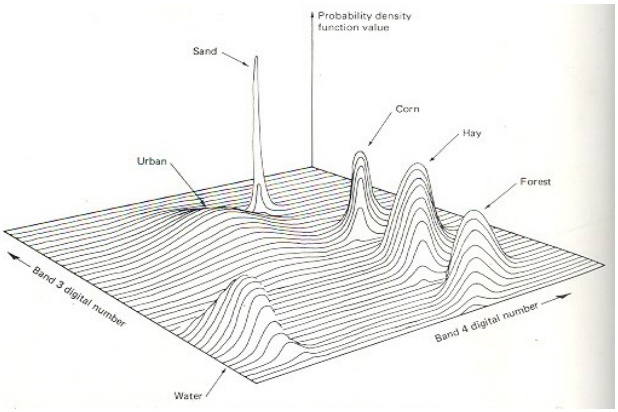


Figure 7: Parallelepiped Classifier.

- Difficulties are encountered when category range overlap. Unknown Pixel observations that occur in overlap areas will be classified as 'not sure'.
- Covariance is tendency of spectral values to vary similarly in two bands, resulting in elongated, slanted clouds of observation on scatter diagram.
- In this example 'corn' and 'hay' categories have Positive covariance(slant upward towards the right) meaning that high value in Band 3 are associated with high value in band 4, low value in Band 3 are associated with low value in band 4.
- Water category exhibits negative covariance (distribution slants down to the right) meaning that increased value of band 3 are associated with low value of band 4.
- 'Urban' class shows lack of covariance, resulting in circular distribution on scatter diagram.

Gaussian maximum likelihood classifier

- The distribution of a category response pattern can be completely described by the mean vector and covariance matrix.
- Given these parameters, we can compute the statistical probability of a given pixel value being a member of a particular land cover class.
- Probability density classifier is used to classify unidentified pixel by computing probability of pixel value belonging to each category.
- Computer would calculate probability of pixel value occurring in class 'corn' and likelihood of its occurring in class 'sand' and so on.
- After evaluating the probability in each category, the pixel would be assigned to the most likely class (highest probability value) or labeled 'unknown' if probability value are below threshold set by analyst.
- Maximum likelihood classifier delineates ellipsoidal 'equiprobablity contours' in scatter diagram.



Bayesian classifier

- Analyst determines 'a priori probability' or anticipated likelihood of occurrence for each class in a given scene.
- When classifying a pixel, probability of occurring 'sand' category might be weighted lightly and more likely 'urban' class weighted heavily.

Drawback

- Large number of computations required to classify each pixel.
- Slower computationally.

Graphical representation of Spectral response Patterns

Distribution of training area response patterns can be graphically displayed in many formats.

Histogram output is important when maximum likelihood classifier is used, it provides a visual check on normality of spectral response distributions.

Quantitative expressions of category separation

A measure of statistical separation between category response patterns can be computed for all pairs of classes and can be presented in form of matrix.

Self classification of training set data-

- Classifying training set pixels.
- Preliminary classification is only training set models (rather than full scene) is made to determine what percentage of training set pixels are actually classified as expected.
- These percentages are actually shown in the form of error matrix.
- Error matrix shows how well a classifier can classify training areas.
- Training areas are usually good, homogeneous example of each cover type can be expected to classify accurately than less pure that are found elsewhere in the scene.

Interactive Preliminary classification

- Training data are useful in classification of full scene.
- Preliminary classification with computationally efficient algorithm.

Representative subscene classification

- An image analyst will perform classification of representative subset of full scene to be classified.

Unsupervised Classification

- Classes that results are spectral classes
- Analyst must compare classified data with some form of reference data.
- Natural spectral groupings in the data can be visually identified by plotting scatter diagram.
- Classifier identifies distinct spectral classes present in image data.
- There are numerous clustering algorithms that can be used to determine natural spectral groupings present in the data set.
- Unsupervised classification is the use of algorithms that incorporate sensitivity to image 'texture' or 'roughness'.
- Texture defined by multidimensional variance observed in moving window passed through image. (3X3 window).
- Analyst set a variance threshold below which is considered smooth homogenous and above which is considered rough heterogeneous.

Hybrid classification

- Supervised training areas are located in regions of homogeneous cover type. Unsupervised training areas are chosen to contain numerous cover types at various locations throughout a scene.
- Particularly valuable in analyses where there is variability in the spectral response patterns for individual cover.

Classification of mixed Pixel

- Lower resolution sensor operating at higher altitude might focus on same field yet having its field of view occupied by mixture of soybean leaves, bare soil and grass.
- Presents a different problem for image classification since their spectral characteristics are not representative of single land cover type.

Spectral Mixture Analysis

- Range of techniques wherein mixed spectral signatures are compared to a set of pure reference spectra.
- Provides useful information at sub pixel level, since multiple land cover can be detected within single pixel.

Linear mixture

- Input to linear mixture model consists of single observed spectral signatures for each pixel in an image.
- Pure reference spectral signatures are referred as end members because they represent cases where hundred percent of sensor's field of view is occupied by single cover type.
- Sum of fractional proportions of end members included in a Pixel must be equal to 1.
- A given spectral band λ the observed DN λ for each pixel represents the sum of DNs that would be obtained from Pixel that is completely covered by a given end member weighted by fraction occupied by that member plus some unknown error.

Fuzzy classification

- Membership grade values are assigned that describe how close a pixel measurement is to means of all measurement.

Fuzzy Supervised classification

- Fuzzy mean vectors and covariance matrices are developed from statistically weighted training data.
- Instead of delineating training areas that are purely homogeneous, a combination of pure and mixed training site may be used.
- Known mixtures of various feature types define fuzzy training class weight.
- A classified pixel is weighted is assigned a membership grade with respect to its membership in each information class.
- Vegetation classification include pixel with grade 0.68 for class 'forest', 0.29 for 'street'.

THE OUTPUT STAGE

- Graphic Products
- Tabular Data
- Digital Information Files

Post classification smoothing

- Classified data manifest salt and pepper due to inherent spectral variability encountered by the classifier when applied on pixel by pixel basis.
- Application of majority filter

- A moving window is passed through the classified data set and majority of classes within the window is determined.
- If centre pixel in the window is not a majority class, its identity is changed to majority class.
- If there is no majority class in the window identity of center pixel is not changed.
- As window progresses through the data set, original class codes are continually used not the labels as modified from previous window positions.
- Major filters can incorporate some form of class / spatial weighting function.
- Certain algorithms can preserve the boundaries between land cover regions and involve user –specified minimum area of any given land cover that would be maintained in the smoothed output.

Classification Accuracy Assessment

Classification error matrix

- Compare on category by category basis, the relationship between known reference data (ground truth).
- Such matrices are square, with number of rows and columns equal to the number of categories where classified accuracy is being assessed.
- Several characteristics about classification performance are being expressed by error matrix.

Sample considerations

- Test areas are area of representative, uniform land cover that is different from and considerably more extensive than training areas.
- The accuracies obtained in these areas represent at least first approximation to classification performance through out the scene.
- Being homogeneous test areas might not provide valid indication of classification accuracy at individual pixel level of land cover variability.

Random sampling

- Collections of remote data for large sample of randomly distributed points are often difficult and costly.
- Validity of random sampling depends on ability to register reference data to image data.
- Simple random sampling tends to under sample small but important area.
- Stratified random sampling where each land cover category may be considered stratum is frequently used in each class.

Change detection process

Post classification comparison

- Two dates of imagery are independently classified and registered.
- An algorithm can be employed to determine those pixels with a change in classification between dates.
- Accuracy of such procedures depends upon accuracy of each of independent classifications used in the analysis.

Classification of multitemporal data sets

- Single classification is performed on a combined data set for two dates of interest.

Principal component analysis

- Used to analyze multi date image composites for change detection process.
- Two or more images are registered to from new multiband image containing all bands for each date.
- It s often difficult to interpret and identify specific nature of changes involved.

Temporal image ratioing

- Computing ratio of data from two dates of imaging.
- Ratio of areas of no change tends toward 1 and areas of change will have higher or lower ratio value.

Change vector analysis

- Change detection procedure that is conceptual extension of image differencing. Change verses no change binary mask to guide multidate classification
- Traditional classification of one image as reference (time 1).
- One of the spectral bands from this date (time 2).
- This two-band dataset is analyzed using one of the algebraic operations (example image differencing and ratioing).
- Threshold is set to separate areas that have changed between data's from those that have not.
- This mask is only applied to multiband image acquired at time 2 and only areas of change are classified for time 2.

Hyper spectral Image Analysis

- Provides vast information about physical and chemical composition of surface under observation as well as insight into characteristics of atmosphere sensor and the surface.

Disadvantage-

- Poor signal to noise concentration
- Increased susceptibility to effects of unwanted atmospheric interference.

Atmospheric correction of hyper spectral Images

- The magnitude of absorption will vary from place to place and from time to time depending on concentration and particle sizes of various atmospheric constituents.
- 'raw' radiance value observed by hyper spectral sensor cannot be directly compared to laboratory spectra or remotely sensed hyper spectral imagery acquired at other time or places.

Hyper image analysis techniques

- Once a hyper spectral image has been corrected for effects of atmospheric absorption and scattering reflectance "signatures" of each pixel can be compared to previously acquired spectra for known material types.
- Spectrum ratioing consists of dividing every reflectance value in the reference spectrum by corresponding value in image spectrum.
- If the average deviation from 1.0 across all wavelengths falls within some small levels of tolerance, image spectrum for that pixel is considered to match the reference spectrum.

Spectral angle mapping (SAM)

- Observed reflectance spectrum can be considered as vector in multi dimensional space, where the number of dimensions equals the number of spectral bands.
- If the overall illumination increases or decreases the length of the vector increases or decreases but angular orientation will remain constant.

DATA MERGING AND GIS INTEGRATION

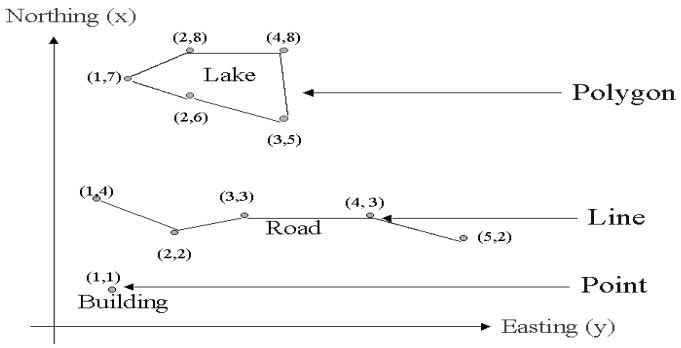
Many applications of digital image processing are enhanced through the merger of multiple data sets covering the same geographical area.

- Multitemporal Data Merging – combining images of the same area taken on more than one date to create a product useful for visual interpretation.
- Change Detection Procedures – involves the use of land cover change between dates of imaging.

Chapter 4: Basic Data Models

GIS depicts the real world through models involving geometry, attributes, relations, and data quality. In this chapter, the realization of models is described, with the emphasis on geometric spatial information, attributes, and relations. Spatial information is presented in two ways: as vector data in the form of points, lines, and areas (polygons); or as grid data in the form of uniform, systematically organized cells. Geometric presentations are commonly called *digital maps*. Strictly speaking, a digital map would be peculiar because it would comprise only numbers (digits). By their very nature, maps are analog, whether they are drawn by hand or machine, or whether they appear on paper or displayed on a screen. Technically speaking, GIS does not produce digital maps—it produces analog maps from digital map data. Nonetheless, the term *digital map* is now widely used that the distinction is well understood.

Vector Data Model: The basis of the vector model is the assumption that the real world can be divided into clearly defined elements where each element consists an identifiable object with its own geometry of points, lines, or areas (Figure 4.1). In principle, every point on a map and every point in the terrain it represents is uniquely located using two or three numbers in a coordinate system, such as in the northing, easting, and elevation Cartesian coordinate system. On maps, coordinate systems are commonly displayed in grids with location numbers along the map edges. On the ground, coordinate systems are imaginary, yet marked out by survey control stations. Data usually may be transformed from one coordinate system to another. With few exceptions, digital representations of spatial information in a vector model are based on individual points and their coordinates. The exceptions include cases where lines or parts of lines (e.g., those representing roads or property boundaries) may be described by mathematical functions, such as those for circles or parabolas. In these cases, GIS data include equation parameters: for example, the radii of the circles used to describe parts of lines. Together with the coordinate data, instructions are entered as to which points in a line are unconnected and which are connected. These instructions can subsequently be used to create lines and polygons and to trigger "pen up" and "pen down" functions in drawing.



Geometry	ID	Attributes		Coordinates
Point	1	A	B	1,1(single point)
Line	10	C	D	1,4 2,2 3,3 … 5,5 (string)
Area	100	C	E	1,7 2,6 3,5 … 4,8 (closed polygon)

Figure 4.1: In Vector data model data model each object is assigned an attribute and coordinates.

Coordinate systems are usually structured so that surveys along an axis register objects in a scale of 1:1; that is, 1 m along the axis corresponds to 1 m along the ground. In principle, the type of measuring method applied, while the required degree of precision will naturally influence the amount of work required to gather the data, decides the degree of accuracy of measurements along an axis. Mathematically, a vector is a straight line, having both magnitude and direction. Therefore, a straight line between two data coordinate points on a digital map is a vector—hence the concept of vector data used in GIS and the designation of vector-based systems. In a vector model, points, lines, and areas (polygons) are the homogeneous and discrete units that carry information. As discussed above, these three types of object may be represented graphically using coordinate data. However, as we shall see, the objects may also carry attributes that can be digitised, and all digital information can be stored.

Coding digital map for map production: Anyone familiar with maps knows that map data are traditionally coded. Roads, contour lines, property boundaries, and other data indicated by lines are usually shown in lines of various widths and colours. Symbols designate the locations of churches, airports, another buildings and facilities. In other

words, coordinates and coding information identify all objects shown on map. Not surprisingly, than, the digital data used to produce maps are also coded, usually by the assignment of numerical codes used throughout the production process—from the initial data to computer manipulation and on to the drawing of the final map. Each numerical code series contains specific codes assigned to objects in the group. For example, the codes for boundaries may be illustrated in table 4.1 and 4.2

Table 4.1 digital map data often use numerical coding, in the form of different numerical series, to identify object groups.

Numerical code series	object group
1000	Survey control point
2000	Terrain formation
3000	Hydrograph
4000	Boundaries
5000	Built-up areas
6000	Buildings and facilities
7000	Communication
8000	Technical facilities

Table 4.2 by using a numerical coding system, codes can be assigned to all levels of detailed information on the object.

Numerical code	Object type
4001	National border
4002	Country boundary
4003	Township boundary
4011	Property boundary
4022	National park border
	etc.

Digital data for map production comprise sequences of integers, such as
-5314401112345678912340678O-5314401112333678812330670O

Use of the format permits the numerical sequence to be divided into groups and read

-5/ 314/ 4011/ 12345/ 6789/ 12340/ 6780

-5/ 315/ 4011/ 12333/ 6788/ 12330/ 6700

The figures designations are as follows:

Figure	Designates
-5	Start of a continuous sequence of data (i.e., if there are several coordinates, they are to be connected in a line: *pen down*)
314	Serial number of data sequence (such as of a unique line)
4011	Property boundary (such as might produce a final line width of 0.3 mm)
12345	First easting coordinate
6789	First northing coordinate (pen moves to next coordinate set).
12340	Last easting coordinate
6780	Last northing coordinate
-5	End of data sequence, start of next sequence (pen up—moved and set down for a sequence of new coordinate, etc.)

In thematic coding, which may be compared to the overlay separation of conventional map production, data are divided into single-topic groups, such as all property boundaries. Information on symbol types, line widths, colours, and so on, may be appended to each thematic code, and various combinations of themes may be drawn. Data may be presented jointly in this way only if all objects are registered, using a common coordinate system.

Coding digital data for GIS

Point objects may easily be realized in a database because a given number of attributes and coordinates is associated with each point (Figure 4.1). Line and polygon objects are more difficult to realize in a database because of the variation in the number of points composing them. A line or a polygon may comprise two points or 2000 or more points, depending on the extent of the line and the complexity of the area, which is delineated by a boundary line that begins and ends at the same point. Object spatial information and object attributes are often stored in different databases to ease the manipulation of lines and areas, but in some systems they are stored together. As pivotal attributes are often available in existing computer memory files, dividing the databases conserves memory by precluding duplicate storage of the same data. The separate storage of attribute and spatial information data requires that all objects in the attribute tables be associated with the corresponding spatial information. This association is achieved by inserting spatially stable and relevant attribute data or codes from the attribute table into the special information, or vice-versa. In other words, identical objects have the same identities in both databases. The identity (ID) codes used to label and connect spatial information and attribute table data are most often numerical, but may be alphanumerical. Typical identity codes include building numbers, property numbers and addresses. If the data are ordered in a manuscript map, each object may be assigned a serial number used in both the spatial information and the attribute databases. Polygons for vegetation mapping can, for example, be numbered from 1 onward, while pipes, manholes, and so on, are usually numbered according to an administrative system. ID codes allow differentiation between objects, whereas theme codes allow differentiation between different groups of objects. In theory, identity codes and thematic codes are both attributive data. However, they are very closely tied to geometry and are therefore often treated as such, as described above.

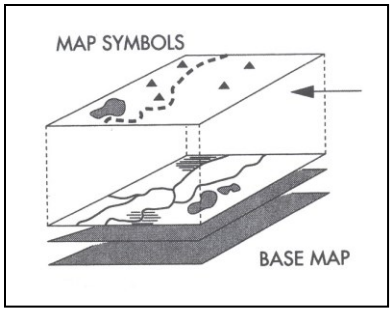
Table 4.3: typical section of digital map data with relevant code list

I.D.	Thematic code	X-coordinates (degree)	Y-coordinate (degree)
11	30	74.562323	14.035566
	30	74.253686	14.235891
34	40	74.567815	14.256874
	40	75.646433	14.872566
-	-	-	-
	-	-	-
122	20	75.894625	15.364615

Spatially defined objects without attributes need no identifiers, but they are required for all objects that are listed in attribute tables, and manipulated spatially. Identifiers are normally entered together with the relevant data, but they may also be entered later, using an interactive human—machine process such as keying in identifiers for objects pointed out on the screen.

Some systems tie a polygon's ID code to a characteristic point in the polygon, known as the *label point*. Label points may be computed or identified interactively on the screen, and codes may be entered manually for the relevant polygons. The attribute values of the polygon are then linked to this label point. Today, systems are available which treat polygons as independent objects. Typical digital geometric data for GIS are illustrated in table 4.3.

Plotting may be controlled by appending drawing instructions to the thematic code, to the individual identifiers, or to other object attributive values. In a finished map, tabular data appear on a foreground amp against the background of a base map derived from the remaining map data. Look-up tables are usually used to translate tabular data map symbols (Figure 4.2).



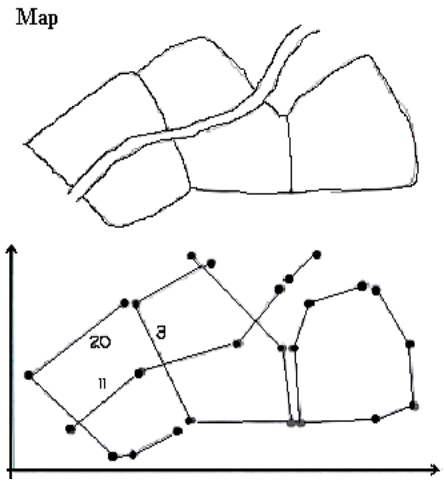
Thematic code	Map symbol
20	Triangle
30	Dotted line
40	Shaded area

ID	Thematic code	Coordinate
	20 30 40	

Figure 4.2: drawing instruction are designated in look-up tables. Thematic code values or attribute value are often input values in the tables, whereas output values can be symbol, type, colours, and so on

Spaghetti model

Digital map data comprise lines of contiguous numerals pertaining to spatially referenced points. *Spaghetti data* are a collection of points and line segments with no real connection (Figure 4.3). What appears as a long, continuous line on the map or in the terrain may consist of several line segments which are to be found in odd places in the data file. There are no specific points that designate where lines might cross, nor are there any details of logical relationships between objects. Polygons are represented by their circumscribing boundaries, as a string of coordinates so that common boundaries between adjacent polygons are registered twice (often with slightly differing coordinated). The lines of data are unlinked and together are a confusion of crossings.



Table

Line no	Coordinate
1	…
2	…
3	x, y, z
.	
.	…
.	
11	x, y, z
.	
.	
20	x, y, z

Figure 4.3: Spaghetti data is often used to describe digital map with crossing lines, loose ends, double digitalisation of common boundaries between adjacent polygons, and so on.

Unlinked (spaghetti) data usually include data derived either from the manual digitising of maps or from digital photogrammetric registration. Consequently, spaghetti data are often viewed as raw digital data. These data are amenable to graphic presentation— the delineation of borders, for example—even though they may not form completely closed polygons. Otherwise, their usefulness in GIS applications is severely limited.

One drawback is that both data storage and data searches are sequential. Hence search times are often unduly long for such routine operations as finding commonality between two polygons, determining line intersection points, or identifying points within a given geographical area. Other operations vital in GIS, such as overlaying and network analysis, are intractable. Furthermore, unlinked data require an inordinate amount of storage memory because all polygons are stored as independent coordinate sequences, which means that all lines common to two neighbouring polygons are stored twice. The typical memory required for unlinked data is illustrated in table 4.4

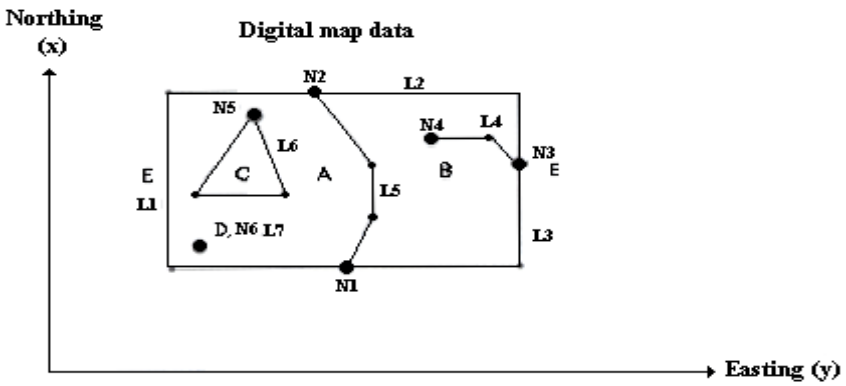
Map scales	Map sheet (cm)	M-byte
1:250000	50 x 60	25 – 50
1:50000	50 x 60	15 – 25
1:5000	48 x 64	2.5 – 10
1:1000	60 x 80	1 – 3

Table 4.4: A typical memory required for unlinked data

Topology model

Topology is the branch of mathematics that deals with geometric properties which remain invariable under certain transformations, such as stretching or bending. The *topology model* is one in which the connections and relationships between objects are described independent of their coordinates; their topology remains fixed as geometry is stretched and bent. Hence the topology model overcomes the major weakness of the spaghetti model, which lacks the relationships requisite to many GIS manipulations and presentations.

The topology model is based on mathematical graph theory and employs nodes and links. A *node* can be a point where two lines intersect, an endpoint on a line, or a given point on a line. For example, in road network the intersection of two roads, the end of a cul-de-sac, or a tunnel exit may generate a node. A *link* is a segment of a line between two nodes. Links connect to each other only at nodes. A closed polygon consisting of alternating nodes and links forms an area. Single points can be looked upon as a degenerate node and as a link with zero length (Laurini and Thompson 1992). Theme codes should be taken into consideration when creating nodes to ensure that they are created only between relevant themes (e.g., at the junction between a national highway and a county road, not between roads and property boundaries).



POLYGON TOPOLOGY

Polygon	Links
A	L1, L5
B	L2, L3, L5
C	L6
D	L7
E	L1, L2, L3

b)

NODE TOPOLOGY

Node	Links
N1	L1, L3, L5
N2	L1, L2, L5
N3	L2, L3, L4
N4	L4
N5	L6
N6	L7

c)

LINK TOPOLOGY

Links	Start Mode	End Mode	Left Polygon	Right Polygon
L1	N1	N2	E	A
L2	N2	N3	E	B
L3	N3	N1	E	B
L4	N3	N4	B	B
L5	N2	N1	B	A
L6	N5	N5	A	C
L7	N6	N6	A	A

d)

LINK COORDINATES

Link	Coordinates			
L1	4, 10	4,4	11, 4	11, 9
L2	11, 9	11, 16	8, 16	
L3	8, 16	4, 16	4, 10	
L4	11, 9	9, 15	9, 13	
L5	10, 7	8, 11	6, 11	4, 10
L6	10, 7	7, 8	7, 5	10, 7
L7	5, 5			

e)

Figure 4.4: Topology model: a)digital map data can be represented by nodes and links. b) a polygon table; c) a node topology table, and d) a link topology table. e) geographical coordinates

Unique identities are assigned to all links, nodes, and polygons, and attribute data describing connections are associated with all identities. Topology can therefore be described in three tables (figure 4.4):The polygon topology table lists the links comprising all polygons, each of which is identified by a number.

1. The node topology table lists the links that meet at each node.
2. the link topology table lists the nodes on which each link terminates and the polygons on the right and left of each link, with right and left defined in the direction from a designated start node to a finish code. The system creates these tables automatically.

A table with point coordinates to the links ties these features to the real world and permits computations of distances, areas, intersections, and other numerical parameters. The geometry of the objects is stored in its own subordinate table (see Figure 4.4). Numerous spatial analyses may then be performed, including:

- Overlaying
- Network analyses
- Contiguity analyses
- Connectivity analyses

Topological attribute data may be used directly in contiguity analyses and other manipulations with no intervening, time-consuming geometric operations.

Once the topology has been created, a map can be plotted with solid colours. This is not possible with spaghetti data. Thematic layers of topological data can also be used to steer the plotting sequence. The sequence influences what becomes visible on the map. For example, a green area superimposed on a white house will render the house invisible on the map (unless the house creates a window in the area).

Topology requires that all lines should be connected, all polygons closed, and all loose ends removed. Even gaps as small as 0.001 mm may be excessive, so errors should

be removed either prior to or during the compilation of topological tables.

A function known as *snap* can also be used in digitisation. Using the snap function with a defined tolerance of, say, 1 mm, a search can be carried out around the end of a line or around an existing point which is assumed to have the same coordinates as the last point registered. When this point is found, the two points will be snapped together to form a common node, thereby closing the polygon. The same procedure can be carried out automatically on existing data. A node can also be created in existing data by calculating the point of intersection between lines. Meaningless loose ends can be removed by testing with a given minimum length.

Topological information permits automatic verification of data consistency to detect such errors as the incomplete closing of polygons during the encoding process. The graph theory contains formulas for the calculation of such data errors. There has to be a fixed relationship between the number of nodes, lines, and polygons in one data set. A run-through of the data in positive and negative directions will produce the same result.

The topological model has a few drawbacks. The computational time required to identify all nodes may be relatively long. Uncertainties and errors may easily arise in connection with the closing of polygons and formation of nodes in complex networks (such as in road interchanges). Operators must solve such problems. When raw data are entered and existing data updated, new nodes must be computed and the topology tables brought up to date.

Topological data may require a longer plotting time than spaghetti data because of the separation of lines into nodes and links. However, the overall advantages of the topology model over the spaghetti model make it the prime choice in most GISs. Today, efficient software and faster computers enable topology to be established on-the-fly; thus the disadvantages of topological data as compared to spaghetti data have become less important.

Here it suffices to say that usually. Map data are not stored in a contiguous unit, but

rather, divided into lesser units that are stored according to a selected structure. This structure may be completely invisible to the user, but its effects, such as rapid screen presentation of a magnified portion of a map, are readily observable.

Data Compression

The amount of computer resources (memory and storage space) needed can be reduced by using data compression techniques. Most of these automatic techniques are based on removing points from continuous lines (contour lines, etc.). Good data compression techniques, therefore are those that preserve the highest possible degree of geometric accuracy. The most basic technique involves the elimination of repetitive characters: for example, the first character of all coordinates along a particular axis. The repetitive character needs to be entered only once; subsequently, it may be added to each set of coordinates. The particular technique has no effect on the geometry.

There are other automatic methods of removing points. One simple means is to keep only every nth point on the line. The lower the value of n, the greater the number of points that will be removed. This method does not take into account geometric accuracy; however, this can be compensated for by using the curvature of the line. One method is to draw a straight line between the first and last points on a curved stretch of line and to calculate the orthogonal distance from each point on the curve line below the straight one. Points that are closer than a given distance from the straight line will be removed. The endpoint of the straight line is then moved to the point with the greatest distance and the same procedure for removing points is repeated. This continues until all the relevant points are removed. This method is known as the *Douglas-Peucker algorithm.*

Points of little or no value in describing a line may be eliminated by moving a corridor step by step along a line and deleting points that are closer to the neighbouring point than a given value or where the vectors create an angle that is smaller than the given value. Contours and other lines can also be replaced with mathematical functions, such as straight lines, parabolas, and polynomials. A spline function comprises segments of polynomials joined smoothly at a finite number of points so as to approximate a line. A

spline function can involve several polynomials to build a complex shape. It has been reported that a spline function representing nautical chart data has reduced data volume by 95%.

The amount of memory required to store a given amount of data often depends on the format in which data are entered. Some formats contain more administrative routines than others, some have vacant space. Thus, the gross volumes stored are frequently related to format.

Storing vector data

The manner in which digital map data are stored in a record is determined by a format, a set of instructions specifying how data are arranged in fields. The latter are groups of characters or words, which, in turn, are treated as units of data. The format stipulates how the computer will read data into the fields: total number of fields specified, number of characters permissible in each field, number of spaces between fields, which fields are numeric and which are text, and so on.

He information content of the data is designated not in the format but ancillary to it, for example, in a heading. Typical specifications for information content might include field assignments, such as the point number in the first field, the thematic code in the second, easting in the third, northing in the fourth, and elevation in the fifth. The meanings of the numeric codes used must also be given. The spaghetti data are stored in simple file structure and in order in which the data have been registered.

Users of conventional maps know the frustrations of extracting information from maps produced by various agencies using differing map sheet series, varying scales and coordinate systems, and frequently, different symbols for the same themes. Moreover, the graphic version of Murphy's law dictates that the necessary information is all too often located in the corners where four adjoining map sheets meet.

Database storage of cartographic data can overcome these problems because it involves

standardization of data through common reference systems and uniform formats. Cartographic data from various sources can, with few limitations, be combined. The results are then independent of map sheet series and scales.

Standardized storage makes the presentation of data compiled from dissimilar sources much easier. For example, uniform storage formats permit the combination of telecommunications administration network data with property survey data, or of geological information from 1: 50,000 scale maps with vegetation data from 1: 20,000 scale maps.

Digital map data are stored in databases, the computerised equivalent of conventional file drawers and cabinets. Although data entries in a database can be updated far more rapidly than data printed on map sheets on file, the information is found more quickly from map sheets than by searching in a database. This is because a single map sheet contains an enormous amount of information, usually equivalent to 100,000 or more sets of coordinates. A sequential computer search of 100,000 items in a database is slow even for the most powerful computers in comparison with a quick visual scan of a map sheet. Therefore, "smart" programs known as database management systems (DBMSs) have been compiled to maintain, access, and manipulate databases. The various DBMSs differ primarily in the ways in which data are organized. Their selection and use are vital in GIS applications because they determine the speed and flexibility with which data may be accessed.

It is usual to split topological data into different thematic layers to simplify storage and to improve access to data. This division is done so that no overlap occurs between polygons within each thematic layer. For example, property boundaries are stored in one layer while other data overlapping the property, such as roads, buildings, and vegetation boundaries, are stored in another. The disadvantage of this system is that common lines between objects (e.g., roads and properties) that are stored in different layers have to be removed several times. This problem can be avoided by using object-based storage.

Comments on spaghetti and topology models

When digitising lines such as those on land-use maps, the borders of surfaces are digitised both as spaghetti data and as separate objects. When creating topology, this model is converted to a layer model. The discussion of spaghetti and topology is very much based on the assumption that a class of area entities is always a tiling of the plane in which every point lies in exactly one polygon. However, the problems related to spaghetti and topology have changed somewhat during recent years with the advent of new GIS software which treats polygons as independent objects that may overlap and need not fill the plane, and with systems permitting shapes. Many of the traditional arguments for area coverage/ layer model and use of topology are based on the assumption of needing to avoid computation. New and more powerful computers eliminate the need for reduction in calculation time. Today, topology can easily be built on-the-fly.

Raster data models

Raster data are applied in at least four ways:

1. Modelling describing the real world
2. Digital maps scans of existing maps
3. Compiling digital satellite and image data
4. Automatic drawing by raster output units

In the first example, raster data are associated with selected data models of real world: in the second and third, with compilation method, and in the fourth, with presentation methods. The respective computer manipulation may be entered in a raster model.

Raster models

Raster model represents reality through selected surface arranged in a regular pattern. Reality is thus generalised in terms of uniform, regular cells, which are usually rectangular or square but may be triangular or hexagonal. The raster model is in many ways a mathematical model, as represented by the regular cell pattern. Because square or rectangles are often used and a pictorial view of them resembles a classic grid of squares,

it is sometimes called the grid model. Geometric resolution of the model depends on the size of the cell. With in each cell the terrain is assumed to be flat.

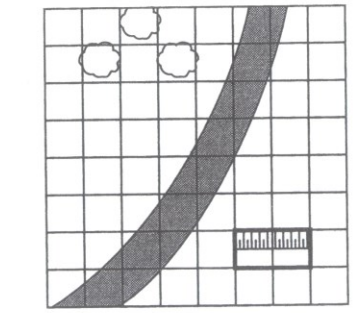
The rectangular raster cells, usually of uniform size throughout a model, affect the final drawing in two ways. First, lines that are continuous and smooth in a vector model will become jagged, with the jag size corresponding to the cell size. Second, resolution is constant: region with few variation are as detailed as those with major variations, and vice versa.

The cells of a model are given in a sequence determined by a hierarchy of rows and column in a matrix, with numbering usually starting from the upper left corner (figure 4.2). The geometric location of cell, and hence of the object it represents, is stated in terms of its directional and column number. This identification corresponds to the directional coordinates of the vector model. The cells are often called pixel. A pixel is the smallest element of an image that can be processed and displayed individually. The raster techniques used in GIS are sibling of the raster long used to facilitate the manipulation and display of the information and consequently are suited to computerised technique.

Realizing the raster model

Raster models are created by assigning real-world values to pixels (Figure 4.5). The assigned values comprise the attributes of the objects that the cells represent—and because the cells themselves are in a raster, only the assigned values are stored. Values, usually alphanumeric, should be assigned to all the pixels in a raster. Otherwise, there is little purpose in drawing empty rows and columns in a raster.

Consider a grid of cells superimposed on the ground or on a map. Assigning the values/ codes of the underlying objects/ features to the cells creates the model. The approach is comprehensive because everything covered by the raster is included in the model. *Draping* a ground surface in this way regards the ground or map as a plane surface.



	0	1	2	3	4	5	6	7
0	0	0	1	0	0	2	0	0
1	0	1	0	1	2	2	0	0
2	0	0	0	0	2	2	0	0
3	0	0	0	0	2	0	0	0
4	0	0	0	2	2	0	0	0
5	0	0	2	2	0	0	0	0
6	0	2	2	0	0	3	3	0
7	2	2	0	0	0	0	0	0

Cell table

Cell no.	Cell value
00	0
01	0
02	1
03	0
04	0
05	2
06	0
.	0
65	3
66	3
67	0
.	.
70	2
71	2
.	.
.	.

Code list	
0	unmapped
1	forest
2	road
3	house

Figure 4.5: a line and column number define the cell's position in the raster data. The data are then stored in a table giving the number and attribute value of each cell

Some GISs can manipulate both numerical values and text values (such as types of vegetation). Hence cell values may represent numerous phenomena, including:

- Physical variables, such as precipitation and topography, respectively, with amounts and elevations assigned to the cells
- Administrative regions, with codes for urban districts, statistical units, and so on
- Land use, with cell values from a classification system
- References to tables of information pertaining to the area(s) the cells cover, such as references to attribute tables
- Distances from a given object
- Emitted and/or reflected energy as a function of wavelength—satellite data

A single cell may be assigned only one value, so dissimilar objects and their values must be assigned to different raster layers, each of which deals with one thematic topic (figure 4.6). Hence in raster models as in vector models, there are thematic layers for topography, water supply systems, land use, and soil type. However, because of the differences in the way attribute information is manipulated, raster models usually have more layers than those in vector models. In a vector model, attributes are assigned directly to objects. For instance, pH value might be assigned directly to the object "lake". In a raster model, the equivalent assignment requires one thematic layer for the lake, in which cells are assigned to the lake in question, and a second thematic layer for the cells carrying the pH values. Raster databases may, therefore, contain hundreds of thematic layers.

In practice, a single cell may cover parts of two or more objects or values. Normally, the value assigned is that of the object taking up the greater part of the cell's area, or of the object at the middle of the cell, or that of an average computed for the whole of the cells. Cell locations, defined in terms of rows and columns, may be transformed to rectangular ground coordinates, for example, by assigning ground coordinates to the centre of the upper left cell of a raster (cell 0, 0). If the raster is to be oriented north-south, the columns are aligned along the northing axis and the rows along the existing axis. The coordinates of all cell corners and centres can then be computed using the known cell shapes and sizes.

Object relations, which in the vector model are described by topology, are only partly inherent in the raster structure. When the row and column numbers of a cell are known, the locations of neighbouring cells can easily be calculated. In the same way, cells contained ii a given polygon may be located simply searching with a stipulated value. It is much more difficult, however, to identify all the cells located on the border between two polygons. Polygon areas are determined merely by adding up constituent cells. Some operations, though, are more cumbersome. An example, of this is computation of a polygon's perimeter length, which requires a search for, and identification of, all the cells along the polygon's border.

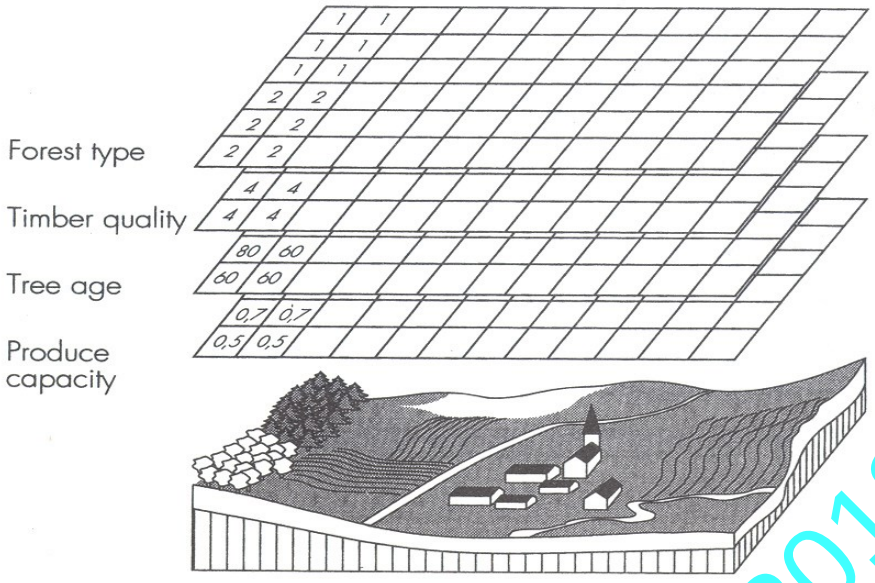


Figure 4.6: only one attribute value may be assigned to each cell. Objects that have several attributes are therefore represented with a number of raster layers, one for each attribute

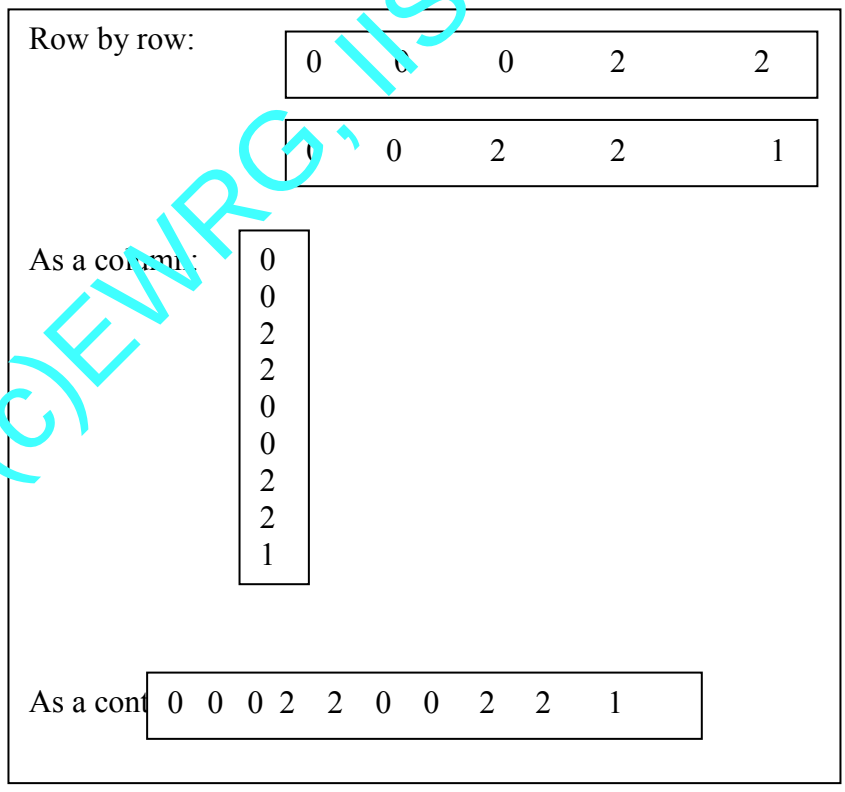


Figure 4.7: typical cell input. Raster data may be stored in the database as series of rows, a series of columns, or a continuous line.

Overviews of phenomena in a given area are obtained from a raster model quickly and easily b searching all the thematic layers for cells with the same row and column numbers. The relevant overlay analysis is described later. Raster data are normally stored as a matrix, as described above. However, they can also be stored in tabular form, where each individual cell in a raster forms a line in the table (see Figure 4.7)

Coding raster data

Numerical codes and, in some systems, text codes may be assigned to cells. Cell values are entered from word processing files, databases, or other sources in the same sequence as they are registered (Figure 4.7). The way in which the figures are read is dictated by format. For instance, it is essential to know the number of columns per row. Raster data may be available from a variety of dissimilar sources, ranging from satellite data and data entered manually to digital elevation data. Their collocation requires that cells from differing sources and thematic layers correspond with each other. In other words, cells having the same row and column numbers must refer to the same ground area. Various computations may be necessary to accommodate any differences in cell shape and size. Cells may contain values referenced to attribute tables. The cells of a thematic layer may be coded so that their values correspond to identities in a given attribute table. Attribute data or tabular data may be coded independently; irrespective of whether the geometry is represented using vector data or raster data.

Compression of raster data

It the cell values of a raster model are entered in fixed matrices with rows and columns identical to those of the registered data, only the cell values need to be stored; row and column numbers need not. Even when only the cell values are stored, the volumes of data can easily become unwieldy. Typical operations may involve 200 thematic layers, each containing 5000 cells. The total number of cell values stored is thus 200 x 5000 =1 million. A land sat satellite raster image contains about 7 million pixels, a Landsat TM image about 35 million pixels.

Various devices may be employed to reduce data volume and, consequently, storage memory requirements. Cells of the same value are often neighbours because they pertain to the same soil type, the same population density of an area, or other similar parameters. Thus cells of the same value in a row may be compacted by stating the value and their total. This type of compacting, called *run-length encoding*. Further compacting may be achieved by applying the same process recursively to subsequent lines.

Housekeeping tools

From the users viewpoint the ideal GIS should include enough functions perform all conceivable manipulations data. In practice, user needs comprise various tasks.

i). Database management system (DBMS)
ii). Query language (QL)
iii). User interface
iv). Application function and programs

Database management system

Data is the name given to the basic facts and entities such as names and numbers. Data consists of a series of facts or statements that may have been collected, stored, processed and / or manipulated but not have been organised or placed into context. When data is organised, it becomes **information**. Information can be processed and used to draw generalised conclusions or knowledge.

Database can be defined as 'A collection of structured data'. The structure of the data is independent of any particular application. A **Database** is a file of data structured in such a way that it may serve a number of applications without its structure being dictated by any one of those applications. A **Database Management System** is a computerised record-keeping system that stores, maintains and provides access to information. A Database system involves four major components Data, Hardware, Software and the Users.

The **Database Models** that are been used to organise and represent the data are

1. Hierarchical Database Model,
2. Network Database Model and
3. Relational Database Model.

The *Hierarchical Database Model* uses one to many relationships. The parent-child relations are employed here. This model is easy to understand and easy to update and expand. The disadvantage of this model is that large memory is required and at times

certain attribute values should be repeated, which results in redundancy, storage and access costs. This software uses this database model only.

The *Network Database Model* uses many to many relationships. The attributes are linked from one place to another. These are interlinked within each other. The attributes can be retrieved from another place also. The entity can have more than one parent. One member can belong to more than one relationship. The Hierarchical and Network models are conceptually simple but while implementing they appear to be complicated in giving the interrelationships.

The *Relational Database Model* uses relations to store the data. A relational database is a collection of tabular relations, each having a set of attributes. The data in a relation are structured as a set of rows and is called as 'tuples' consisting of a list of values, one for each attribute. An attribute has a domain, associated with it, from which its values are drawn.

A Database Management System (DBMS) is a program that allows users to define, manipulate and process the data in a database, in order to produce meaningful information. DBMS is a collection of programs that enables one to store, modify and extract information from a database. There are many types of DBMSs, ranging from small systems that run on personal computers to huge systems that run on mainframes.

Functions of a DBMS:

- To store data
- To organise data
- To control access to data
- To protect data

Advantages of DBMS:

- DBMS is not only effective for generating and maintaining a wide variety of routine management and operating reports, but also adaptable to meeting the new and emerging requirements of management to answer a myriad of "What if?" questions.
- Data elements can be structured in a manner more suitable to their application, allowing their retrieval with a minimum effort.
- DBMS keeps redundancy of data elements to a minimum.
- Application programs are independent of the changes in the database, so that their maintenance is kept to a bare minimum.
- It gives a clear picture of logical organisation of data set.
- It provides data protection not only for accessing one database record at a time, but also for preventing database access by unauthorised personnel.
- It provides centralisation for multi-users.
- It provides data independence.
- It monitors database performance.
- Centralised data reduces management problems.
- Data redundancy and consistency are controllable.
- Program-data interdependency is diminished.
- Flexibility of data is increased.
- Reduction in data redundancy.
- Maintenance of data integrity and quality.
- Data are self-documented or self-descriptive.
- Avoidance of inconsistency.
- Reduced cost of software development.
- Security restrictions.
- Application programs are independent of structure of DB.
- Application programs share the same data.
- New programs are easier and cost less to implement.

Normalization: *Normalization* is a process that involves eliminating problems by decomposing the relation into two or more relations without loss of information. It is the

procedure by which a relation in one normal form can be replaced by a set of relations in some more desirable form. It is the process of successive reduction of a given collection of relations to some more desirable form. This process is reversible and information preserving. The *Normal Forms* are the set of rules that are to be followed in decomposing of relations.

1NF*:* A relation is said to be in 1NF if and only if all underlying domains contain atomic values only. Generally every relation is in 1NF.

Every relation is said to be in 1NF.

For example, consider the following relation in which the supplier number (s#), status, city, part number (p#) and quantity of parts supplied is given.

S#	status	city	P#	qty
S1	20	London	P1	300
S1	20	London	P2	200
S1	20	London	P3	400
S1	20	London	P4	200
S1	20	London	P5	100
S1	20	London	P6	100
S2	10	Paris	P1	300
S2	10	Paris	P2	400
S3	10	Paris	P2	200
S4	20	London	P2	300
S4	20	London	P4	300
S4	20	London	P5	400

Though the above relation in 1NF, we have certain problems called as ANOMALIES in handling the relation. To overcome the problems we decompose the relation into two relations without loss of information.

2NF: A relation is said to be in 2NF if and only if it is in 1NF and every non-key attribute is fully dependent on the primary key.

For example, consider the following relations, which are obtained after decomposing the first relation. These are in 2NF.

S#	status	city
S1	20	London
S2	10	Paris
S3	10	Paris
S4	20	London

S#	P#	qty
S1	P1	300
S1	P2	200
S1	P3	400
S1	P4	200
S1	P5	100
S1	P6	100
S2	P1	300
S2	P2	400
S3	P2	200
S4	P2	300
S4	P4	300
S4	P5	400

Though some of the anomalies are rectified in this decomposition, some more anomalies are still present. To resolve those anomalies, we decompose the second relation further.

3NF: A relation is said to be in 3NF if and only if it is in 2NF and every non-key attribute is non-transitively dependent on the primary key.

For example, consider the following relation, which is in 3NF and is obtained by decomposing the second relation.

S#	city
S1	London
S2	Paris
S3	Paris
S4	London
S5	Athens

city	Status
Athens	30
London	20
Paris	10

These relations are obtained by decomposing the second relation. These relations are in 1NF, 2NF and 3NF and free of all anomalies.

Consider the following relation, which is in 3NF.

S#	major	fname
100	Maths	Cauchy
150	Psychology	Jung
200	Maths	Rieman
250	Maths	Cauchy
300	Psychology	Pearls

BCNF: A relation is said to be in BCNF if and only if it is in 3NF and every determinant is a candidate key. The relations designed in this software are normalized to this level.

Though the above relation is in 3NF, it has some anomalies still. One faculty member can teach only one major and at the same time, one student studies one major only. If we delete the student information, the faculty member's information is also deleted.

To resolve the anomalies, we decompose the relation into two relations. For example, consider the following relations.

S#	Adviser
100	Cauchy
150	Jung
200	Rieman
250	Cauchy
300	Pearls

Fname	Major
Cauchy	Maths
Jung	Psychology
Rieman	Maths
Cauchy	Maths
Pearls	Psychology

These two relations are in 3NF but not in BCNF. One student may have more than one major. The following relation is both in 3NF and in BCNF.

Sid	major	activity
100	Music	Swimming
100	Accounting	Swimming
100	Music	Tennis
100	Accounting	Tennis
100	Maths	Jogging

It is in BCNF as it is an all-key relation.

4NF: A relation is said to be in 4NF if and only if it is in BCNF and if all the multivalued dependencies are the functional dependencies.

For example, consider the above relation. It is in BCNF but not in 4NF. We decompose the above relation to reduce the anomalies and to bring it to 4NF.

Sid	Major
100	Music
100	Accounting
100	Maths

Sid	Activity
100	Swimming
100	Tennis
100	Jogging

These relations are in 4NF and BCNF.

5NF: A relation is said to be in 5NF if and only if it is in 4NF and every join dependency is satisfied.

For example, consider the following relation. It is in 4NF but not in 5NF due to join dependency.

Emp number	Item number	Customer number
17	4014	1002
17	4019	1003
19	4014	1003
19	4014	1003

This relation has the employ number, who sold the item with that particular item number to a customer with a particular customer number.

This relation is decomposed into three independent relations to bring the relations into 5NF. The relations are as follows.

EmpNo	ItemNo
17	4014
17	4019
19	4014

ItemNo	CustNo
4014	1002
4019	1003
4014	1003

EmpNo	CustNo
17	1002
17	1003
19	1002

These relations are in 5NF.

Database management systems specialise in the storage and management of all types of data including geographic data as dealt in the introduction. DBMSs are optimised to store and retrieve data and many GIS rely on them for this purpose. By using simple storage structures in standard DBMS, the basic data model and applications become less dependent on each other.

Distributed database: Distributed database are specialised decentralized solution. A system with a distributed database comprises several database on different computers closely integrated with the assistance of a network and treated as one unit. The users experience this as if they are working against one database.

Database for map data: Database for digital map data should be able to manipulate records of varying length efficiently. For example the length may vary considerably, resulting in a corresponding variation in the number of coordinates entered. A database

system should reflect geographic reality by such means as requiring that data on object of the same type, such as the lines forming a property boundary, be stored in the close proximity in the database, to speed up the response.

Partitioning and Indexing: We have ascertained that spaghetti data require a long search time since the data are stored in a relatively casual and unconnected sequence in this file. The time used to search for and retrieve topological data is also governed by the way in which the data are structured for storage. A rational data structure will reduce the storage volume. Special techniques have therefore been developed for dividing and structuring data.

Generally, map data are stored in map sheets or other geographical units, but storing map sheet data in single sequential files lengthens the response time. This has resulted in some GISs employing indexing to speed up the searching process, and enabling current map sheets to appear on screen almost immediately. Indexing specifies locations, so map sheets are divided into sections which are distributed in such a manner as to accelerate the search. For example, *zooming* focuses on data in those sections relevant to a selected area and ignores the remainder of the map sheet.

The use of traditional hashing techniques and trees makes it very difficult to handle divided areas that overlap. However, routines have been developed that can handle overlapping data relatively efficiently. These have also been implemented for object-oriented solutions. In recent years, more powerful and rapid hardware has made it easier to use simple data structures for storage, but many GISs still use different "smart" solutions to obtain rapid access to data stored on the disk.

No current database system or structure completely fulfils the needs of database applications. There are grounds for suspecting that the excessively complex and voluminous data collections of many GISs may be ascribed to the databases employed. It goes without saying, then, that further database development is in order. One goal might be to develop better object-oriented database systems.

Structured Query Language: The simple structures of relational database systems have permitted the development of standard query languages, one of which is Structured Query Language (SQL). SQL gives users access to data in relational DBMSs by describing the data they may wish to see. SQL also allows users to define data in a database and to manipulate those data. Additional functions that SQL supplies to relational databases are very useful for many GIS applications.

Relational algebra may be performed using two classes of storage and retrieval operations. The set operations include union, intersection, difference, and product. The relational operations include selection (accessing rows), projection (accessing columns), joining, and dividing. Relational joining links tables and creates a new table from data retrieved from various tables. The new table need not be stored physically in the database.

There are six logical operations in SQL:

1. = Equal
2. <> Not Equal
3. < Less than
4. > Greater than
5. ≤ Less than or equal
6. ≥ Greater than or equal

There are five aggregate functions:

1. The total of all rows, satisfying any conditions, of the given column, where the given column is numerical
2. The average of the given column
3. The largest figure in the given column
4. The smallest figure in the given column
5. The number of rows satisfying the conditions

Most GIS users have developed application programs with various human—machine interfaces. SQL is used most frequently in searching, although other query procedures are also used. Complex GIS functions such as data search within specified rectangles or circles, creation of buffer zones, and overlay require operations that are not implemented in standard SQL. However, several suppliers of GIS software have developed special SQL dialects. This applies in particular to systems that use relational databases for storage of both geometry and attributes.

Organization of Data Storage Operations

Software systems often organize data to ensure effective use. Such organization may involve various logical paradigms concerning the grouping of object types and the divisions of geographical areas. The physical limitations of system file capacities may also be a practical reason for thematic and geographic divisions. A list of all maps in a system, organized by location and theme, forms a map library, from which the user can select the map he or she needs and store it in the workspace of the computer.

Thematic layers: Data in most GIS are organized in layers (levels), much like the overlays of conventional mapmaking. Similarly, individual data layers are stored in individual data files. These layers may contain object types intended to be processed together, such as points in one layer, lines in another, and polygons in a third. Alternatively, the individual data layers may be organized by theme, perhaps one layer for topography, another for property boundaries, others for roads or types of land use, and so on. Furthermore, each layer may contain subsidiary layers in a hierarchy. Thus a layer for roads might encompass subsidiary layers for national, county, urban, and private roads.

Collecting logically similar objects can reduce the amount of data required to describe an individual object. Objects that represent several themes, such as lines that are simultaneously roads and property or land-use area boundaries, may be collected in one layer. The line geometry of that layer may be transferred to other layers as needed.

Objects that are updated frequently or from the same source of information may also be collected in a single layer to facilitate updating work. The cartographic effects of plotting are frequently dependent on the sequential plotting of layers containing like objects.

The separation of data into layers may seem analogous to the traditional separation of map information into overlays, and therefore not always a realistic data model of reality. One of the reasons for this layered storage is that many earlier systems have not been able to store overlapping polygons in the same layer. Today, however, there are systems that can handle this problem. These GISs circumvent "map overlay thinking" by being more object oriented; that is, each object is manipulated as an independent entity with regard to both its geometry and its attributes.

Partitioning the area: Many GISs have facilities that will divide surfaces to promote efficient storage, use, and updating of data. Individual surface segments are then stored in individual files, division by map sheets being the most common. Some GISs support divisions of data structures into projects, each of which may then be further divided into subprojects.

The manipulation of data for a larger area often involves combining data for their constituent segments. This is done either manually by the user or automatically by the system. As many GISs are seamless (i.e., data need not be regarded as belonging to fixed map sheets), though stored data may be divided into map sheets, which in turn may be divided into cells in grids .

Users must select the most suitable elements for storing data, such as the map sheet sizes and area divisions. Choice is vital for two reasons. First, the organization of data storage elements can have a considerable influence on the efficiency with which data are been used. Second, once the storage elements are chosen and data have been stored, restructuring to other storage elements is extremely complicated.

Editing Attribute Data: Like digital map data, attribute data must be edited and corrected. These operations include error correction, updating, and amending. The editing tasks may be carried out by using standard editing tools, such as those available in word processing, or specific GIS commands. Some GISs use SQL (Structured Query Language) to manipulate attribute data in relational databases. Specific GIS commands include commands for changing object thematic codes and switching codes between objects, as well as for editing thematic codes containing texts.

The guidelines for entering data may change with time, mandating changes in the codes of older data. Usually, common mathematical signs as +. -, * and / are used for this purpose. The currencies in which prices in attributes are expressed may be changed [e.g., from U.S. dollars ($) to Indian rupees (Rs.)] by entering an exchange rate. Relational and other databases used to store attribute data usually incorporate effective editing tools. These permit a variety of operations, including searching for members of a prescribed class and then editing one by one, or assigning new values to an entire class using a single command.

Chapter 5: Basic Spatial Analysis

Analysis of Spatial Information

Even though most of the real world can be observed with the naked eye, it is often difficult to interpret and systematize what is observed. It becomes even more difficult when the image of that reality is stored in digital form as map data and attribute tables. To bring out the patterns, connections, and possibly, the causes of variations in the data, various computer-based techniques are applied to analyse the data. Spatial analysis techniques are an attempt to imitate what concerns the human brain (i.e., to create an understandable image of reality). These are the techniques discussed in this and the following chapter.

Technology can still only help to a limited extent, however. Stating problems and delineating the approaches to solutions together comprise one of the most difficult steps in GIS analysing. This has to be solved by the individual user or operator before the technology can be put into use, based on his or her professional knowledge in the fields of agriculture, environmental protection, planning, and so on, supplemented with knowledge of GIS. Analysing data normally comprises two principal phases:

1. Choice of data
2. Analyses of the data chosen

All GISs provide functions for analyses of data chosen and for storing the results of such analyses. Data may be selected according to

- Geographical location
- Thematic content

Most GISs permit defining the criteria for selection. These are often based in SQL or are in menus with provisions for generating SQL queries. Some GISs provide predefined selection criteria; other systems use a macro language to set up the selection criteria.

Specific systems have predefined menus dedicated to the relevant applications. In most systems, selection criteria may be stored for subsequent use.

Data may be analysed at various levels:

1. Data in attribute tables are sorted for presentation in reports or for use in other computer systems.
2. Operations are performed on geometric data, either in search mode or for computational purposes.
3. Arithmetic, Boolean, and statistical operations are performed in attribute tables.
4. Geometry and attribute tables are used jointly to:
    a. Compile new sets of data, based on original and derived attributes
    b. Compile new sets of data based on geographical relationships.

Within each of these levels, the operations used may be logical, arithmetic, geometric, statistical, or a combination of two or more of these four types. Operations may be performed on individual points or on areas, and may involve considerations of proximity or of changes over time. Numerous operations may be performed on line networks. The more important commands are discussed below. The functions implemented vary from one GIS to another, and some GISs contain functions not discussed here.

Logic Operations: Logical searches in databases normally employ set algebra or Boolean algebra. Set algebra uses the three operators equal to, greater than, and less than, and combinations thereof:

$$=, >, <, \geq, \leq, <>$$

These operators are included under SQL.

Practical applications include:

- Identifying extrema, such as finding attribute minima or maxima within various polygons and, as a result, delineating a new thematic layer (new row in the attribute table)
- Selection or isolation, where particular values are selected for subsequent ranking in a new thematic layer

Boolean algebra uses the AND, OR, NOR, and NOT operators to test whether a statement is true or false. AND, OR, and NOT are used in SQL. For two items, A and B, we might have any of the following statements:

A AND B, A OR B, A NOR B, A NOT B

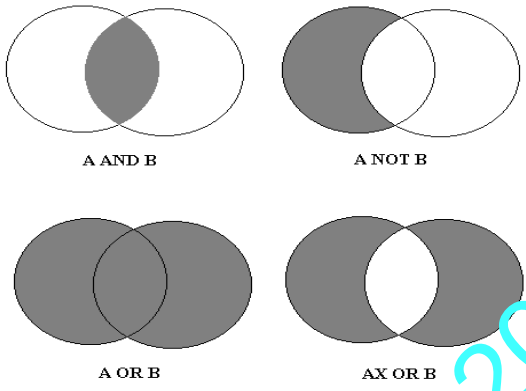


Figure 5.1: Logical operations showing in a Venn diagram

Such statements may be illustrated in a Venn diagram, which is a schematic representation of a set in which magnitudes illustrated by surfaces are superimposed, as shown in Figure 5.1. The shaded areas represent true statements. This technique is well suited to analysing geographical data. For example, assigning A to potentially productive forest tracts and B to known grazing areas can illuminate potential conflicts between forestry and cattle farming. The tests A AND B on the two operands will identify conflict areas that can be assigned special symbols and drawn on maps. Logic operations are particularly powerful when the relationships are complex. In GIS, logic operations may be performed simultaneously on more than two themes and involve several operators.

General Arithmetic Operations

Arithmetic operations are performed on both attribute and geometric data. All GISs support the customary arithmetic operations of addition, substraction, multiplication, division, exponential, square root, and the trigonometric functions:

$+, -, \times, /, ^{n}, \sqrt{}$, sin, cos, tan

these operators may be used for many purposes, including assigning new thematic codes. Typical examples include:

- Reclassification of soil types, in which areas are to be converted from square kilometers to hectares by dividing all area figures by 10.
- Conversion of distances along roads to driving times, by dividing all distances by a specified average vehicle speed. The result is a new set of attributes that are useful in transportation planning.

Arithmetic functions are used in all geometric computations involving coordinates, as in calculating distances, areas, volumes, and directions.

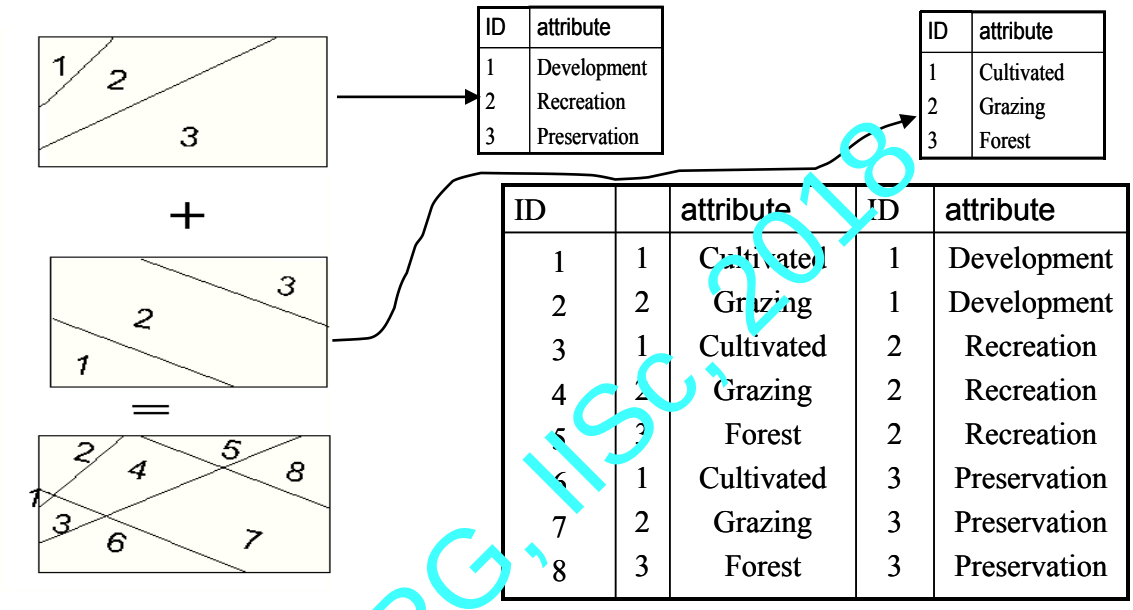
General Statistical Operations

Statistical operations are performed primarily on attribute data, but may also be effected on some types of geometric data. Most GISs support a range of statistical operations, including sum, maxima, minima, average, weighted average, frequency distribution, bi-directional comparison, standard deviation, multivariate, and others. The computation of averages requires averaging two or more attribute values and stating the result as a new attribute. Frequency distributions are used to compile *histograms*, charts comprising rectangles whose areas are proportional to relative frequencies and whose widths are proportional to class intervals. The data used to draw a histogram may also be employed to plot a curve. Other statistical operations in common use include least-squares computations of transformation parameters from regression models, with the standard deviation as an expression of accuracy. Bidirectional comparison involves point-by-point correlation of two themes to produce a new statistical thematic layer and hence a new attribute.

Satellite data are usually analysed statistically in dedicated image processing systems, which are often connected to GIS facilities. Some vector GISs support image processing. Multivariate operations, such as cluster analyses, are vital in image analyses. These operations assign new classes to entities on the basis of statistical selection criteria. Pattern recognition based on statistical models is incorporated in some GISs.

Integrated Processing of Geometry and Attributes

One of the simpler forms of integrated processing of geometry and attributes is to point to the location of a building displayed on screen and request retrieval of all information stored on the building. On receiving the query, the GIS searches the map database to find the building corresponding to the coordinates that have been pinpointed. Using the



ID	attribute
1	Development
2	Recreation
3	Preservation

ID	attribute
1	Cultivated
2	Grazing
3	Forest

ID		attribute	ID	attribute
1	1	Cultivated	1	Development
2	2	Grazing	1	Development
3	1	Cultivated	2	Recreation
4	2	Grazing	2	Recreation
5	3	Forest	2	Recreation
6	1	Cultivated	3	Preservation
7	2	Grazing	3	Preservation
8	3	Forest	3	Preservation

Figure 5.2: Integration of geometric and attribute data. This leads to expansion of the attribute table, in addition to the geometric changes.

building ID number stored with the coordinates, the system then searches the attribute database for all available information, which can then be displayed or printed out. More advanced integrated processing is also based on the condition that each object type (cultivated land, deciduous forest, protected area, etc.) is represented both in geometry and in an attribute table. The geometry concerned may be likened to a single thematic map. Single maps may then be superimposed to integrate with each other and thus produce a multithematic map containing information from each of the initial thematic maps. The integrated map comprises comparable units [integrated terrain units (ITUs)] and a new attribute table is compiled, as illustrated in Figure 5.2. Arithmetic, logical, and statistical operations may be performed in the new attribute table. The geometry and the attributes may then be used to compile a new thematic map.

Overlay: Overlay is used in data integration and is a technical process, the results of which can be used in realistic forms of spatial analysis.

Polygon overlay

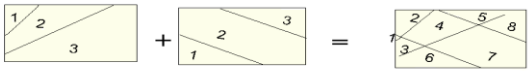
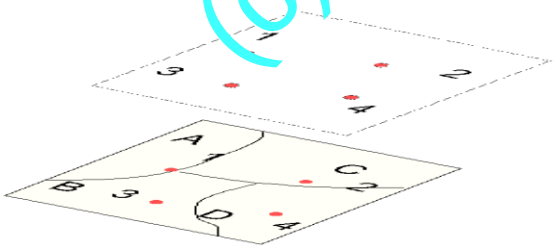


Figure 5.3

Polygon overlay is a spatial operation in which a first thematic layer containing polygons is superimposed onto another to form a new thematic layer with new polygons. This technique maybe likened to placing map overlays on top of each other on a light table (Figure 5.3). The corners of each new polygon are at the intersections of the borders of the original polygons; hence computing the coordinates of border intersections is a vital function in polygon overlay.

Points on polygons:

Just as polygons maybe superimposed on other polygons, so may points be superimposed on polygons (Figure 5.4). The points are then assigned the attributes of the polygons upon



ID	building no.	Polygon	property
1	660	A	44/110
2	659	C	44/95
3	610	D	44/121
4	665	B	44/81

Figure 5.4: Superimposing points on polygon.

which they are superimposed. The relevant geometric operation means that points must be associated within polygons. One approach requires computing the intersection of a

polygon border with parallel lines through points. Attribute tables are updated after all points are associated with polygons.

Lines on polygons: Lines may also be superimposed on polygons (Figure 5.5), with the result that a new set of lines contains attributes of both the original lines and the polygons. These particular computations are similar to those used in polygon overlay: intersections are computed, nodes and links are formed, topology is established, and attribute tables are updated.

ID	Line	Road no	Polygon	country
1	1	Rv. 410	B	Akershus
2	1	Rv. 410	C	Oslo
3	2	Rv. 9	C	Oslo
4	3	E 18	C	Oslo

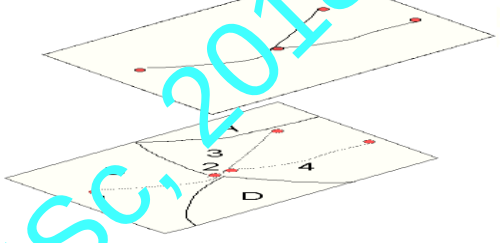


Figure 5.5: Superimposing lines on polygon.

Buffer Zones

Buffer zones are used to define spatial proximity (Figure 5.6). These comprise one or more polygons of a prescribed extent around points, lines, or areas. The new polygons have the attributes of the original objects. Many GISs support the automatic compilation of buffer zones. Here, the operator interaction usually consists of keying in a specific zone parameters, such as stipulating a 50-m zone width or either side of a road. The creation of a buffer zone is not in itself an analysis, but the new polygons that are created can be used in analysis. Buffer zone polygons maybe processed in the same way as polygons generated during operations such as overlay, arithmetic, logical, and statistical computations in which attribute values come within the respective zones.

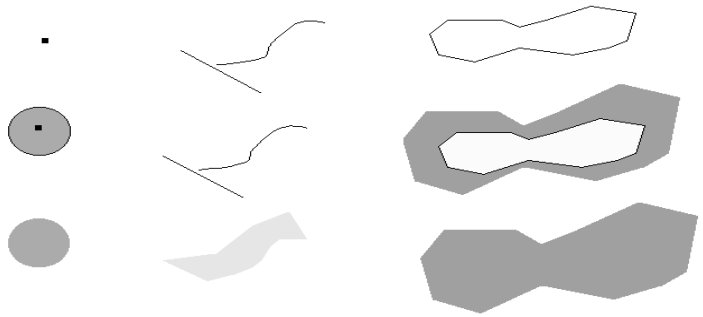


Figure 5.6: Buffer zones can be established around a points, line and polygon.

Raster Data Overlay

Raster data may also be overlaid. Indeed, raster overlay is often more efficient than vector overlay (Figure 5.7). The positions of the overlaid thematic layers need be tested only to see whether or not they contain cell values. The resultant cell-to-cell comparison presupposes that all cells in each thematic layer are queried, regardless of their values. The total number of cells therefore has an effect on processing time. The new composite cells are assigned attributes composed of those from the original cells. These new cells are registered as a new thematic layer.

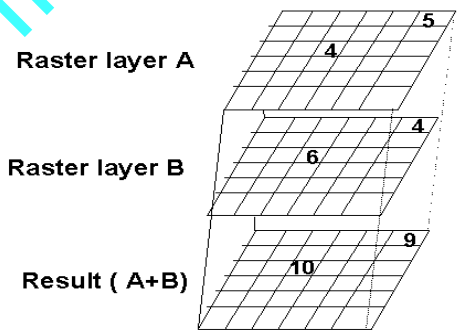


Figure 5.7: Raster data overlay is the simpler than vector overlay and can be carried out directly on the attribute the cell value.

Raster data consist of equally spaced cells of equal size (assuming that the various thematic layers cover the same area or have been modified to do so). Consequently, there is no formation of smaller erroneous polygons as with vector data overlays, and there is no need to distinguish between polygons, lines, and points, because all raster data

comprise cells. In raster data, attributes are not usually listed in tables as in vector data, but are represented by thematic layers. Therefore, arithmetic operations and some logical and statistical operations may be performed directly during the overlay process; two thematic layers may be combined, subtracted, multiplied, and so on. If for example, an attribute of volume in liters is to be modified to decilitres, the thematic layer of volumes merely needs to be multiplied by 10 in each cell of an ancillary thematic layer.

The arithmetic operations on two thematic layers, A and B, produce a new thematic layer, C, through the operations

$$C=A + B,\ C=A - B,\ C=A/B,\ C=A \times B$$

Typical logical operations might be

If A> 100, C =10; otherwise C= 0

Or

C= max. (or min.) of A nad B

Some GISs support logical operations in the resultant Clayer but not directly in the original A and B layers.

As raster overlay is far more efficient than vector overlay, many GISs support functions for manipulating both raster and vector data. Vector data may be converted to raster data in order that overlaying can be performed, and results can then be converted back to vector form.

Procedures in integrated Data analysis:

Integrated data analysis follows fixed procedures:

1.Starting the problem.

2.Adapt the data for geometric operation.

3.Perform the geometric operation.

4.Adapt attributes for the analysis.

5.Perform the analysis.

6.Evaluate the results.

7.Redefine and instigate new analysis if needed.

Stating the problem: It involves defining the problem, and the criteria to be used in the analysis.

Adapting the data for geometric operations: Data available from a database must be modified before they can be used for geometric operations.

Performing the geometric operations: Geometric operations, employed to sort out the objects to be analysed include specification of the buffer zones, overlaying, search and retrieval, joining polygons, and other operations.

For each task the geometric operations must be defined on the basis of the analytic criteria involved.

Adapting attributes for analysis: Attribute data must also be processed before analysis.

Attribute table must contain an adequate number of empty rows and columns for new entries.

Performing attributes analysis: Arithmetic, logical and statistical operations are performed on attribute data associated with the object chosen in geometric phase.

Evaluating the results: The results must be evaluated for their trustworthiness

Redefinitions and instigating new analysis: Unacceptable results must be modified or the analysis that produced them improved and performed again.

Presenting the final results: Analytical results are best presented in easily read maps and written reports.

• Selection of a recreational area that can provide a wilderness experience:

Step 1:

a) Remoteness, at a specified distance from the manufactured facilities

b) Reasonable accessibility

c) lakes and streams

d) varied topography

e) A variety of vegetation

Step 2: Map data or attribute data or both be modified by clipping a selected area out of a map database, modifying the area from hectares to kilometers, etc.

Step3: a) In the location of the recreational area broad buffer zones may be set up around the roads and other manufacturing facilities.

b) The untouched zones can areas outside these zones may then be overlaid with vegetation, hydrology and other relevant data.

Step 4: A new attribute labeled "suitable characteristic " may be complied to hold codes that indicate the degree of suitability of various combinations of thematic layers.

Step 5: Analysis may be performed to identify an areas outside the buffer zone around manufactured facilities. another analysis might aim to select areas classified as moderately hilly, etc.

Step 6: Evaluation is done and if require modifications are made at suitable stage

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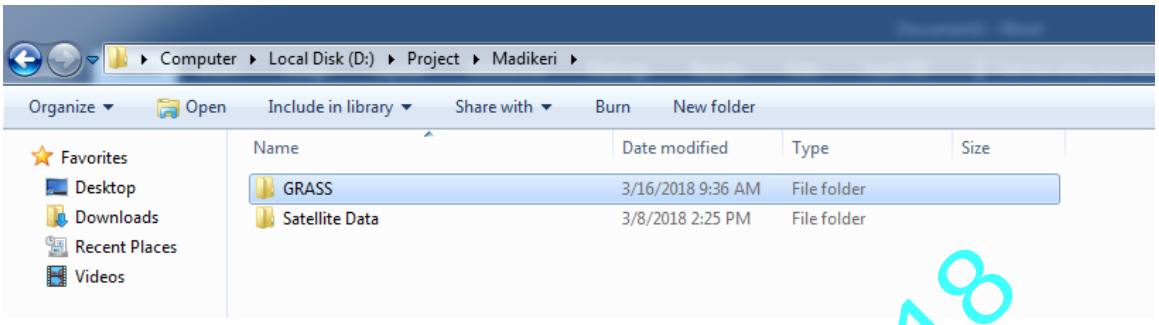
34. http://wgbis.ces.iisc.ernet.in/biodiversity

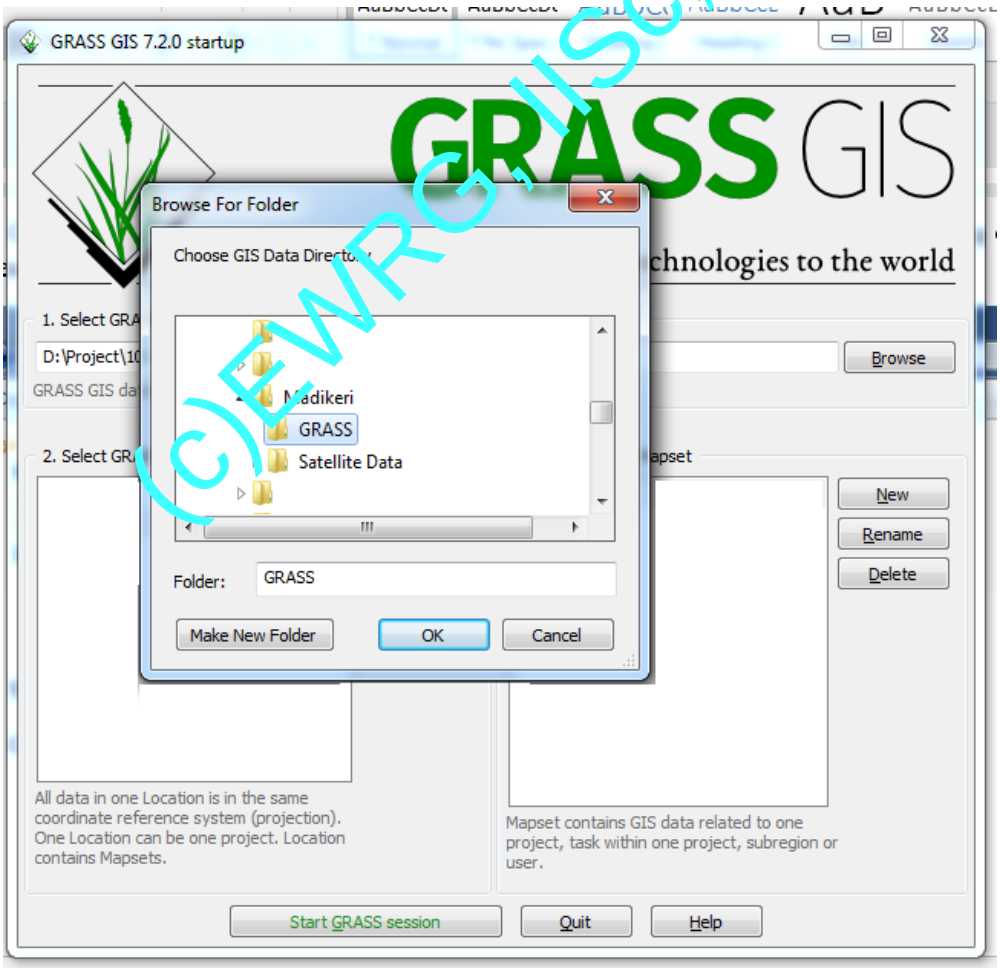
WORKING WITH GRASS

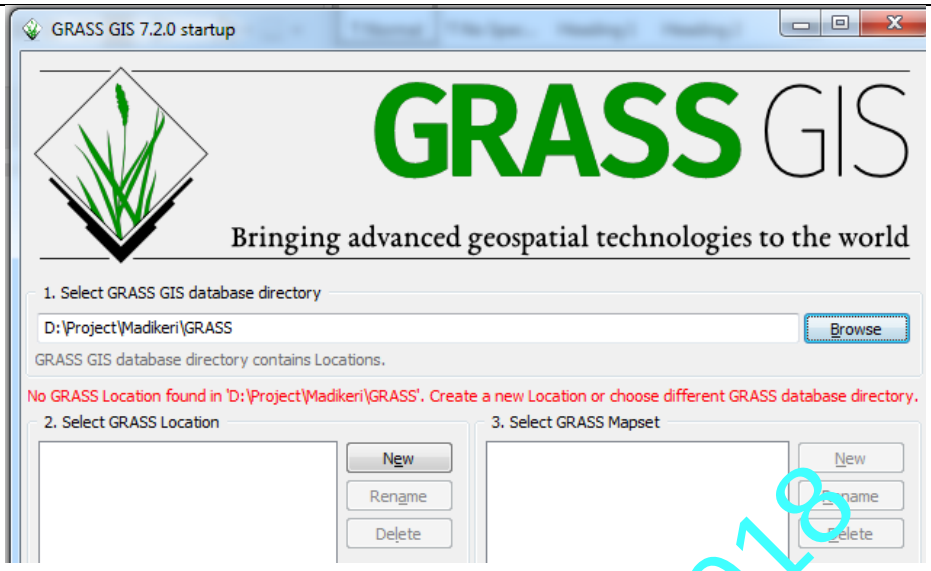
STEP 1) Creation of Folder: Create a working folder for Grass, Example: If you are working on a study area, Create a new folder named GRASS.



STEP 2) Start Grass: Use Grass version 7.0 and above.

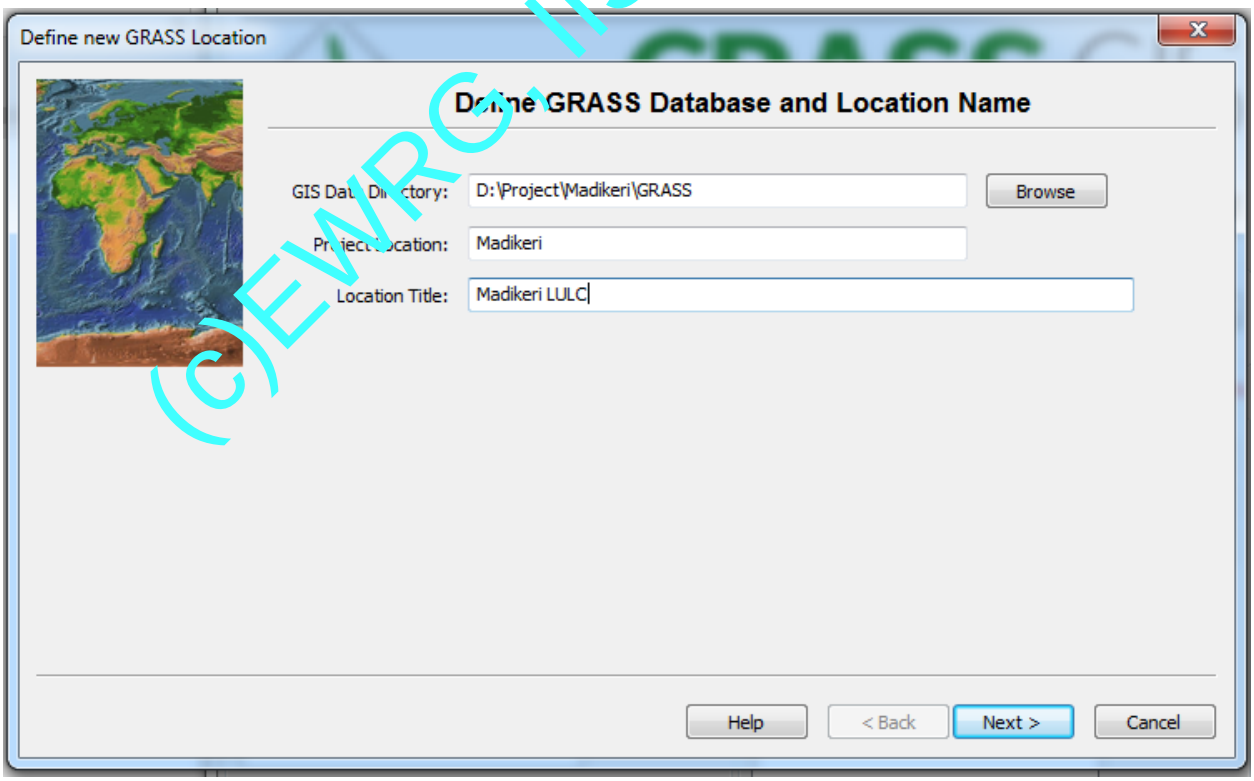
STEP 3) Go to Select Directory, and select the folder you have created and Click on OK





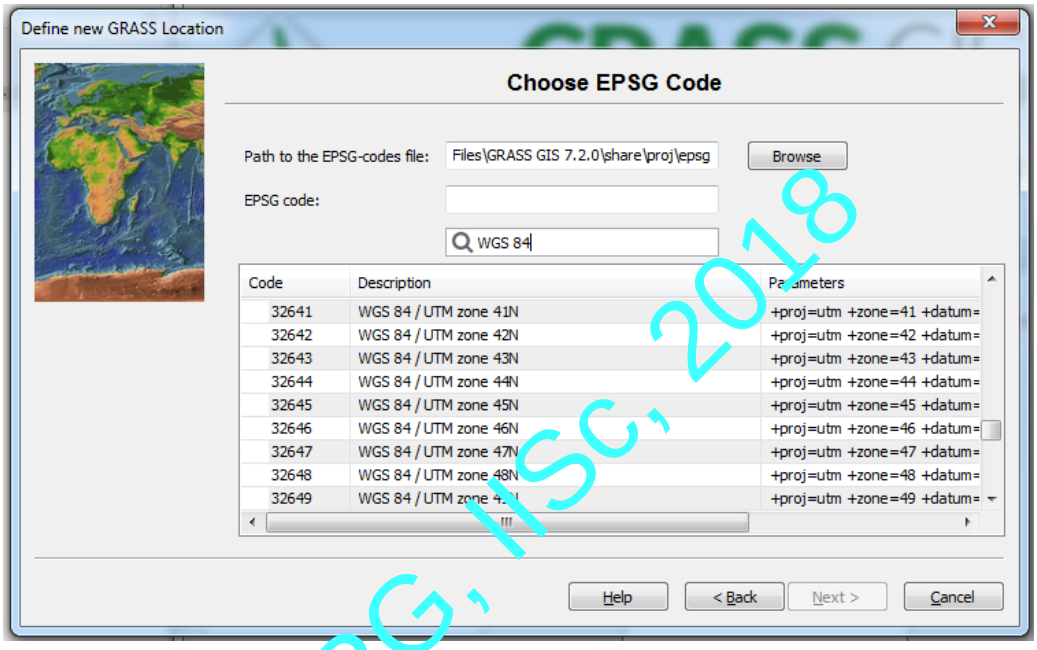
STEP 4) Creating New Location:

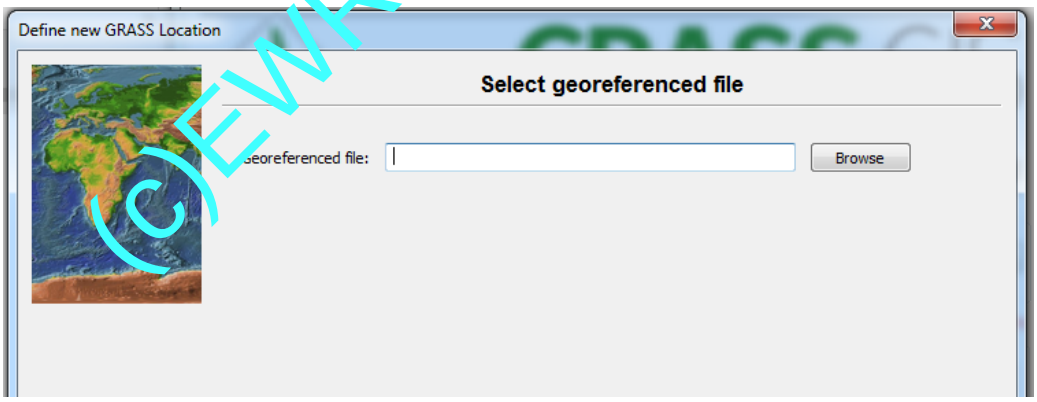
Step i) Click on New under the Grass location tab, Enter Project location and Location title, Click on next

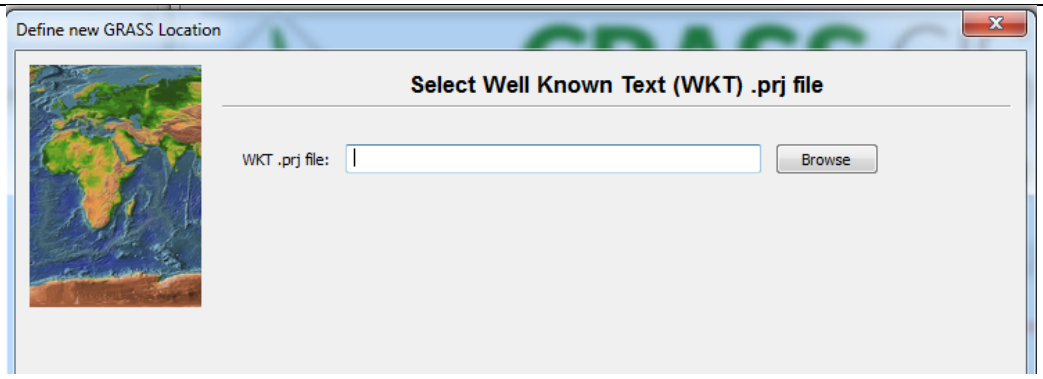


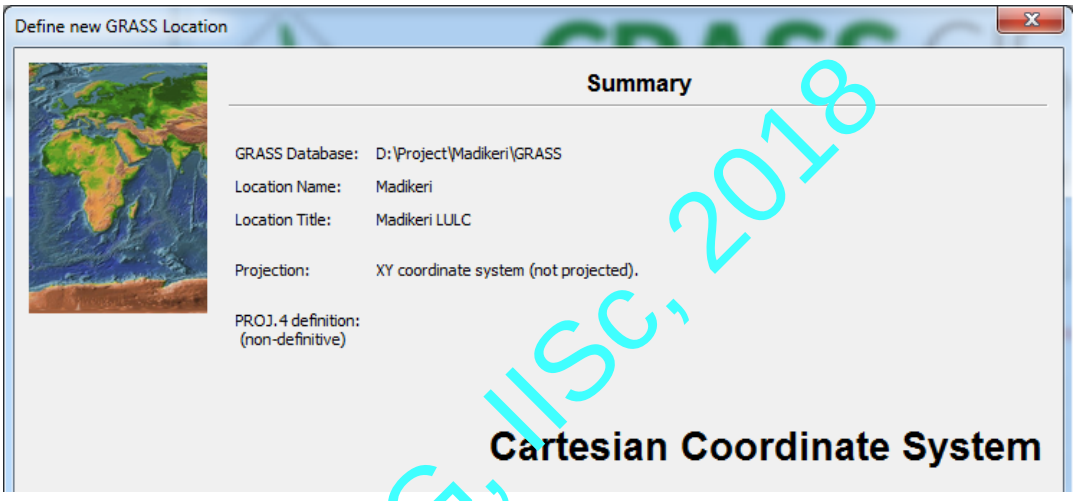
Step ii) Choose method of creating new location. This can be done using ***a)*** EPSG codes of spatial reference (one can search by datum's or based on EPSG codes), ***b)*** Georeferenced

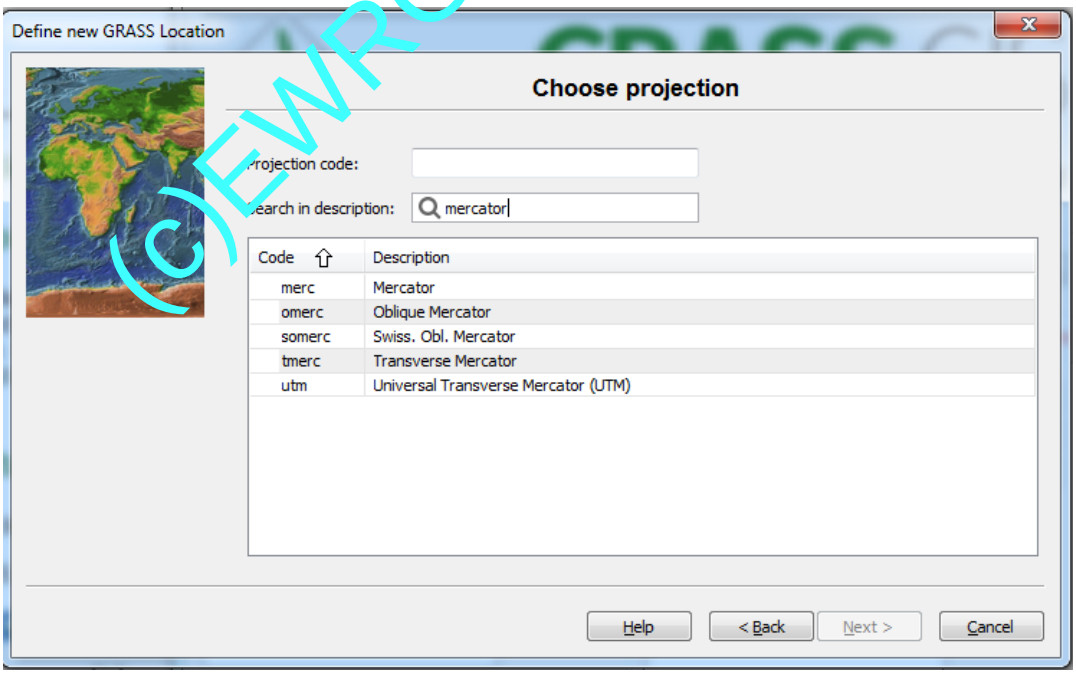
files (Raster or Vector), ***c)*** Using Well Known Text file – (***.prj*** files), ***d)*** Cartesian Co-ordinate system (use this if no information available *or* if the study area falls in 2 UTM zones, later while importing files, projections and datum's can be over written using single or multiple files), ***e)*** Selection Projection and Coordinate system from the available list, ***f)*** Specifying Projection and Datum using Custom parameters.

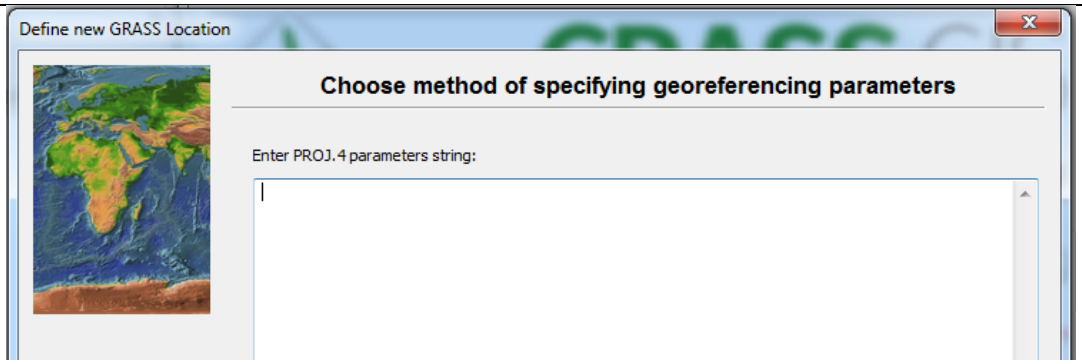








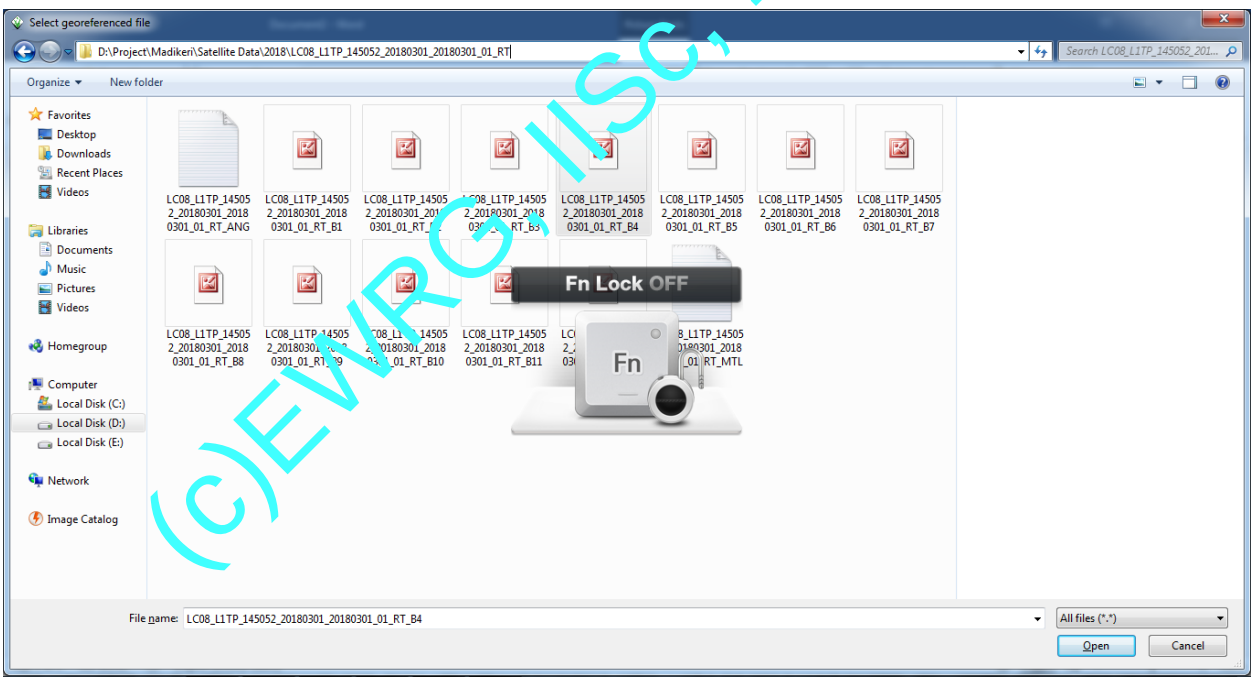




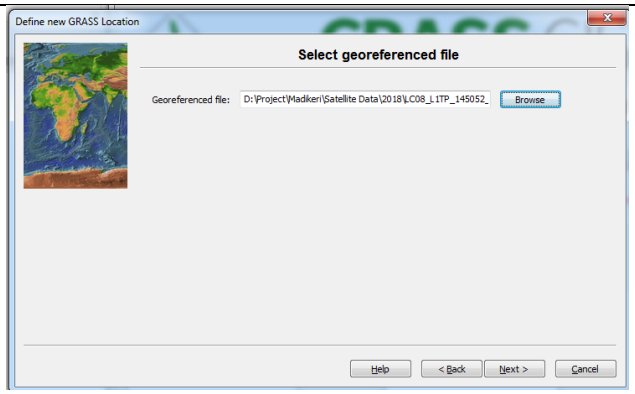
Note: One can Always Help to open GRASS GIS Quickstart Guide

step iii) Lets continue by selecting "read projection and datum from a georeferenced file"

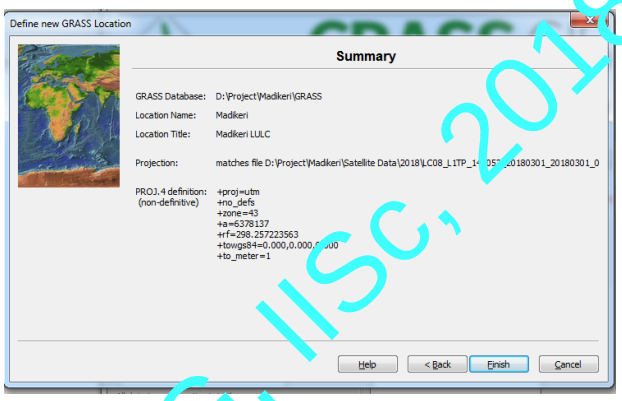
step iv) Browse and Select a file (Raster) to append the reference information from file to Location and click on open



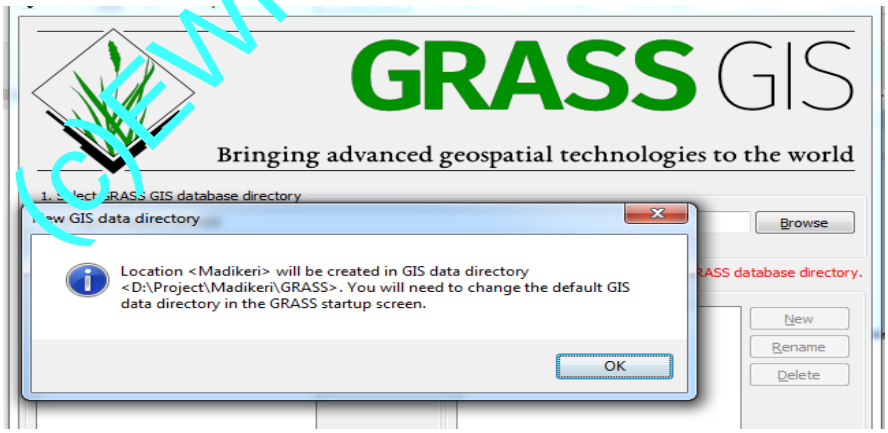
Selected file (either raster or vector would be taken as reference), Click on next



step v) Projection and datum are defined for Location, Click on Finish

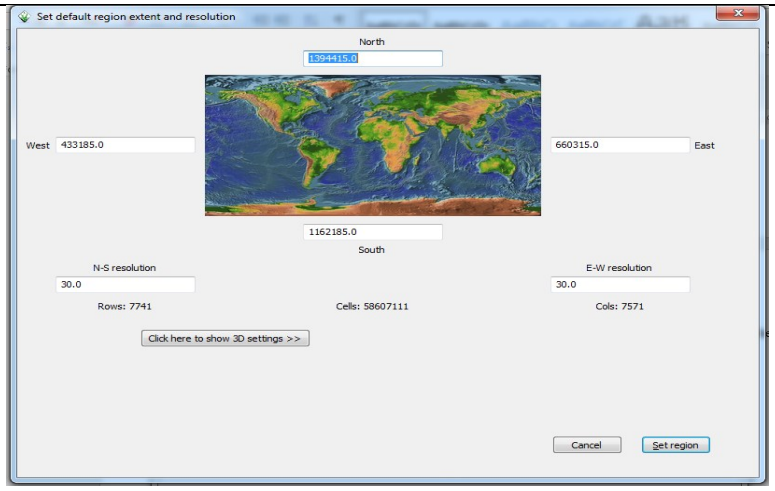


Step vi) New Location (New GIS data directory) is created, click on OK



step vii) Location and Permanent Mapset are created, Option is provided to import the reference data, Click on Yes or No accordingly.

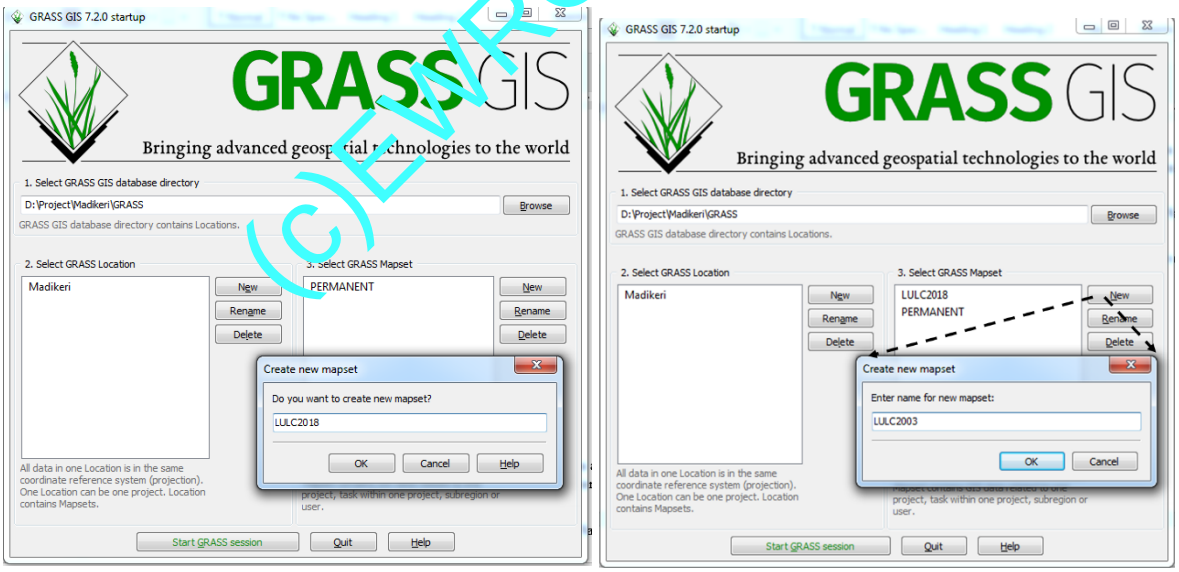
Step vii) Regions settings are displayed, click set region. If the area of interest is smaller than the selected map, in region settings, values can be changed accordingly



Step 5) Creation of New Mapset: Since Permanent mapset contains all datum, projection and other information, it is recommended not to alter the Permanent mapset. Any manual alteration in permanent mapset may lead to data corruption of entire location.

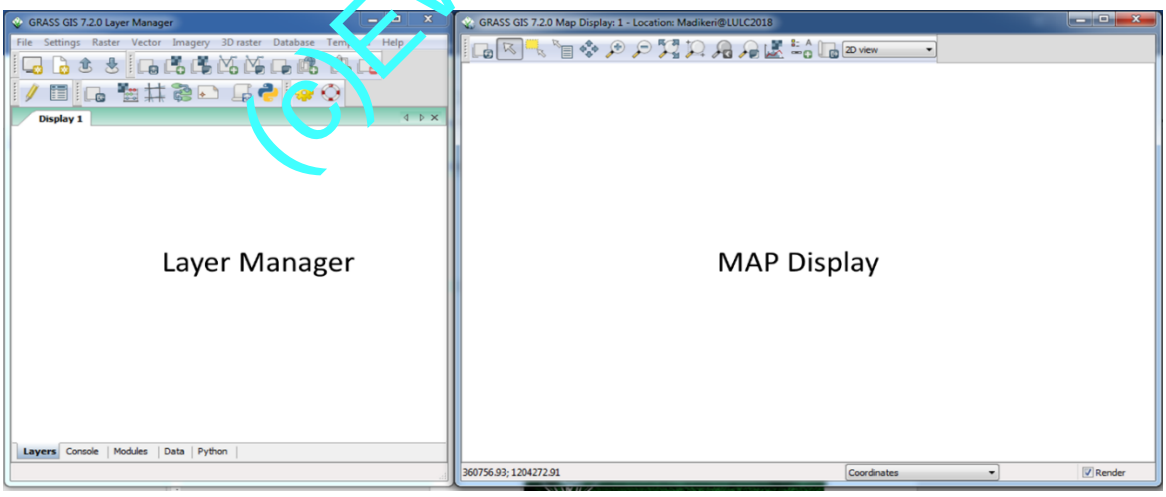
For the first time when a new location is created, Option is provided to create a new mapset. Name the mapset and click on ok

For Subsequent creation of mapsets, click on New in "Select GRASS Mapset" tab, and create new mapsets accordingly

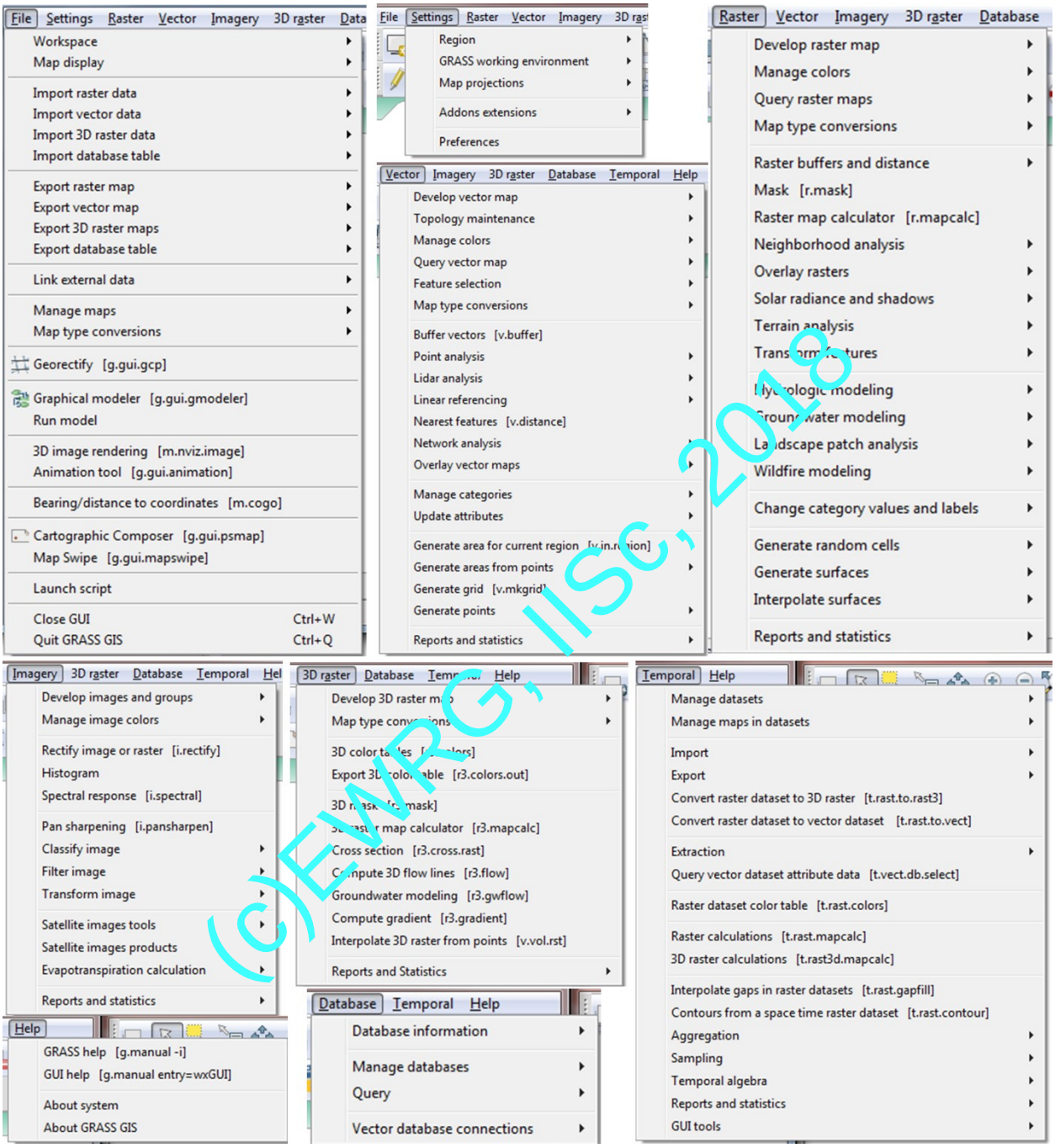


You can use New, Rename, Delete in Location and Mapset tabs for managing grass location and mapsets.

Step 6) Starting Grass Session: Select the Mapset you want to work with, and click on Start Grass Session which will open Layer Manager and Map display windows

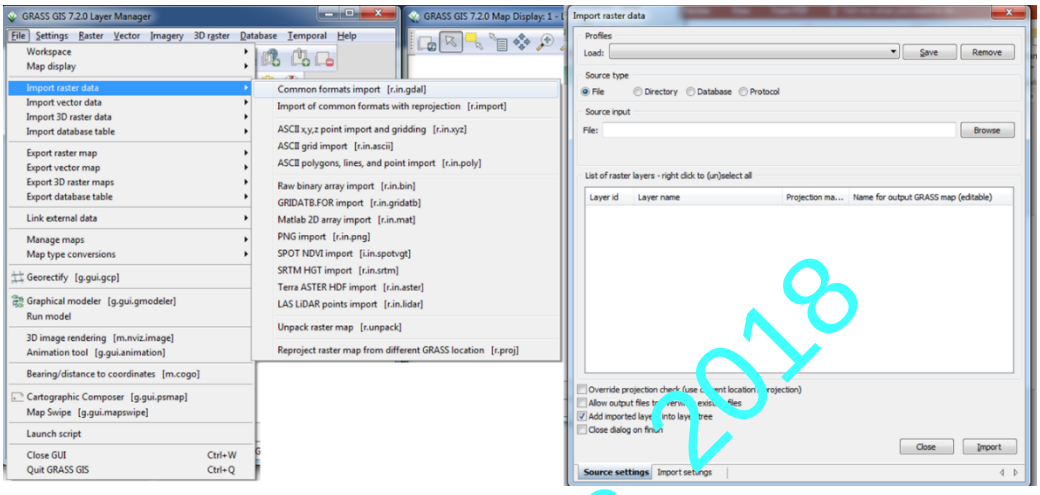


Step 7: Various Tools

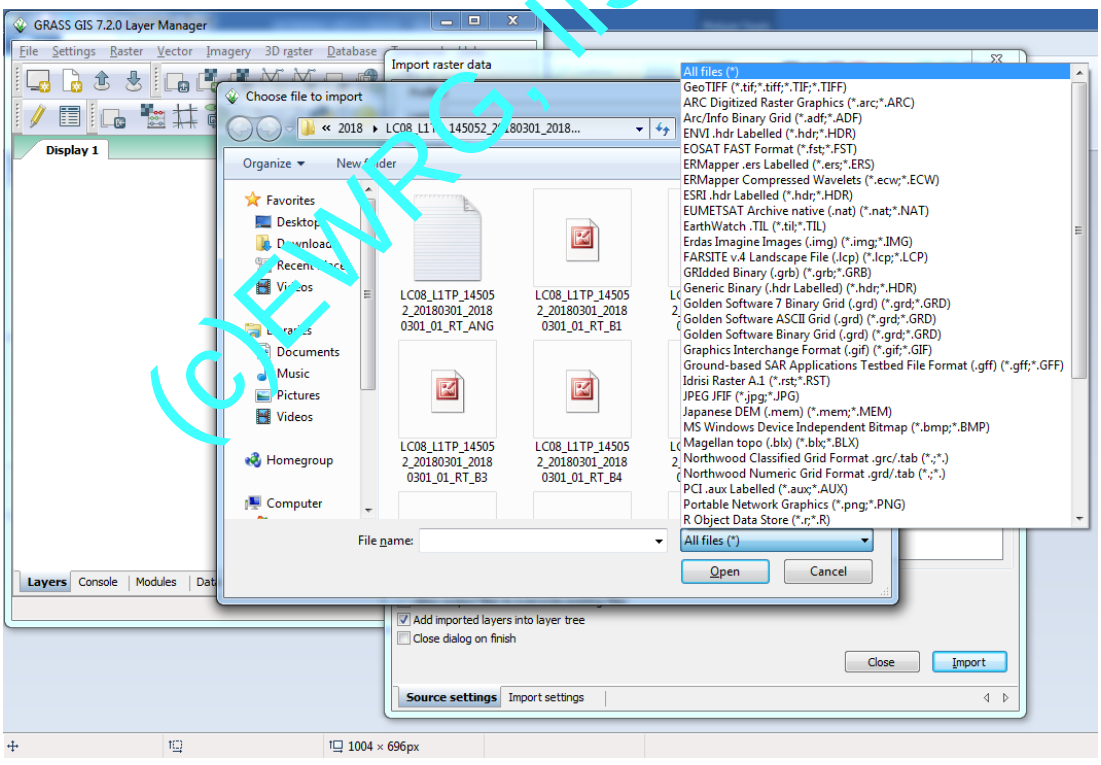


Step 8) Importing Data

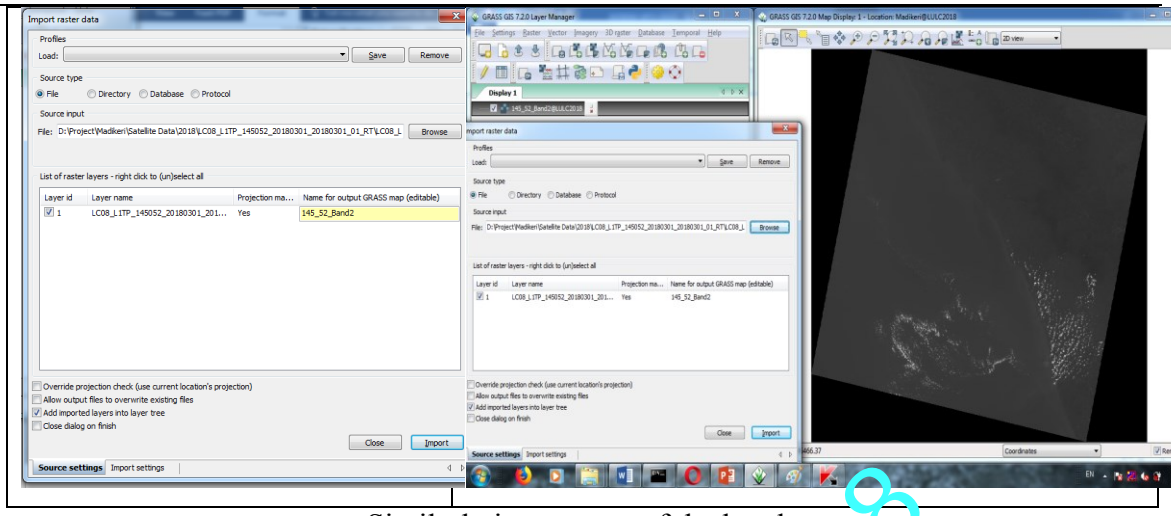
Step i) Go to File, Import Raster, Common Format import. Input Raster Tab will be opened. You can use Source type as i) File for individual files, ii) Directory to import multiple files.



step ii) Select **File,** click on browse and select file format to be imported, Click on Open



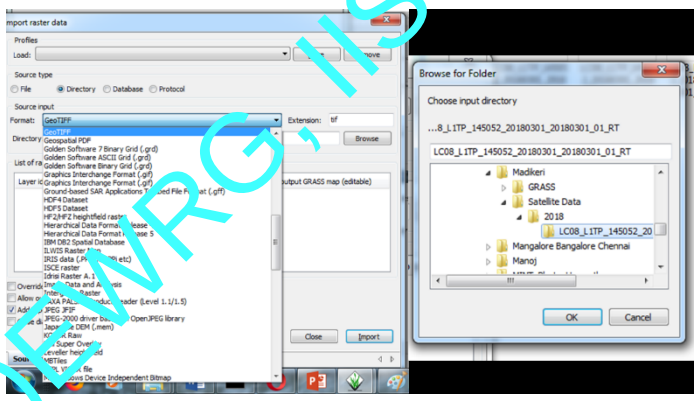
Step iii) Rename the file as Path_Row_Band number **Example 145_52_Band2** Click on Import. File is imported with new name, and displayed in Map display and layer manager



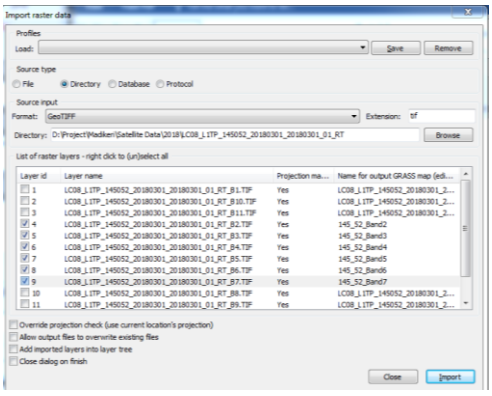
Similarly import rest of the bands

(preferably all of same resolution, Blue, Green, IR, NIR, SWIR bands)

Importing Raster as Directory: Go to File, Import Raster, Comman Raster formats. Click on Directory, Select Source type and Browse the Directory where the data is stored.

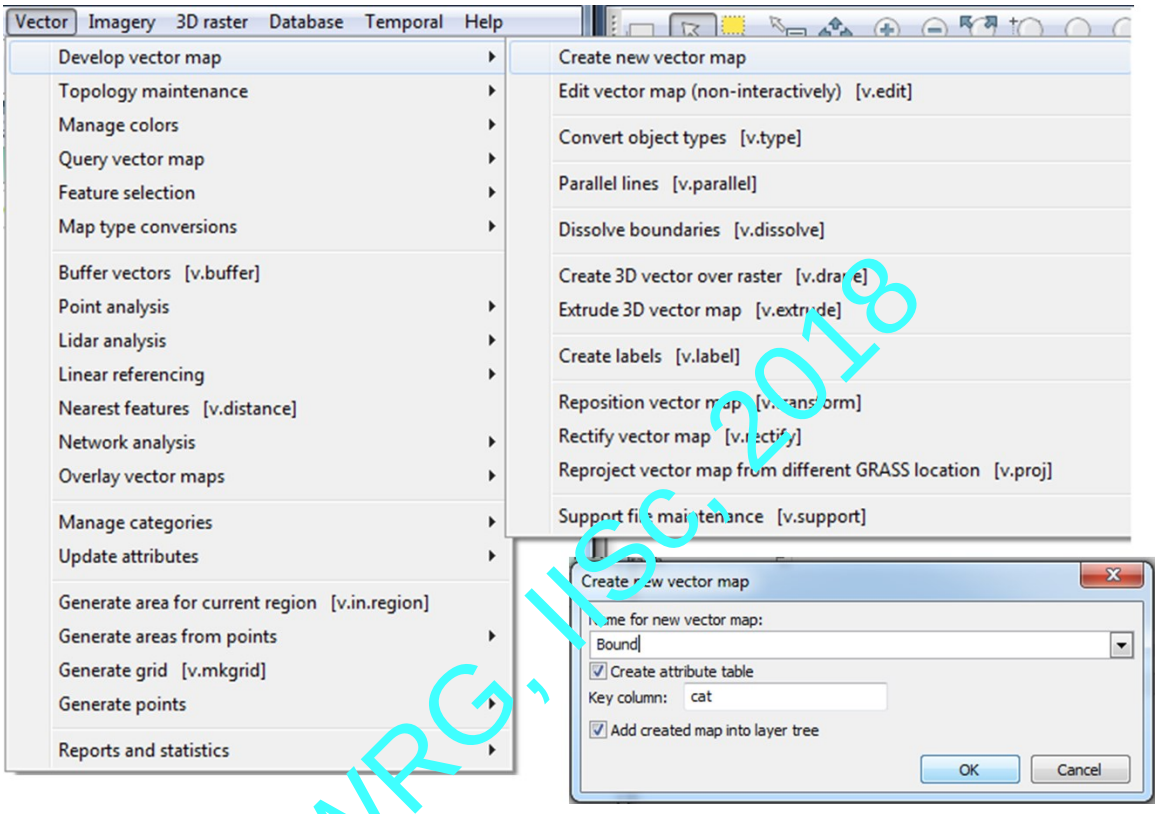


This will open all the raster files in the directory, select files to be imported and rename them

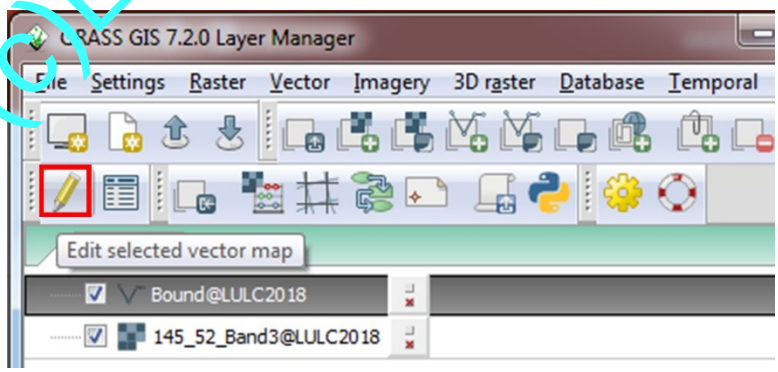


Step 9) Crop the image to eliminated background data

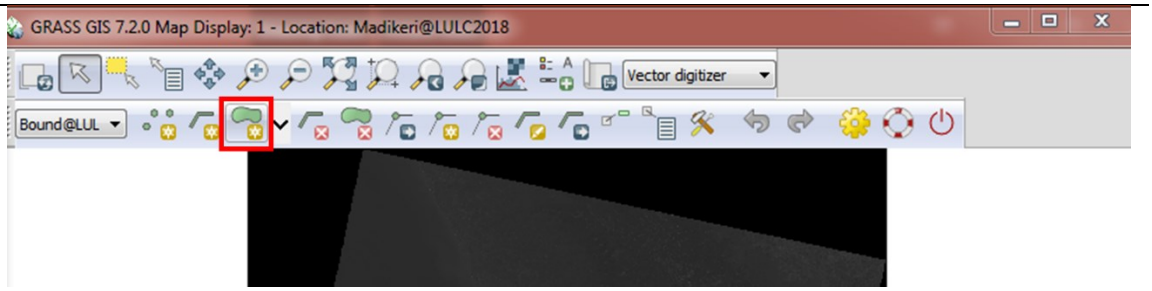
step i) Create a new Vector Map. Go to Vector, Create new Vector map, Enter name of Vector file click on ok



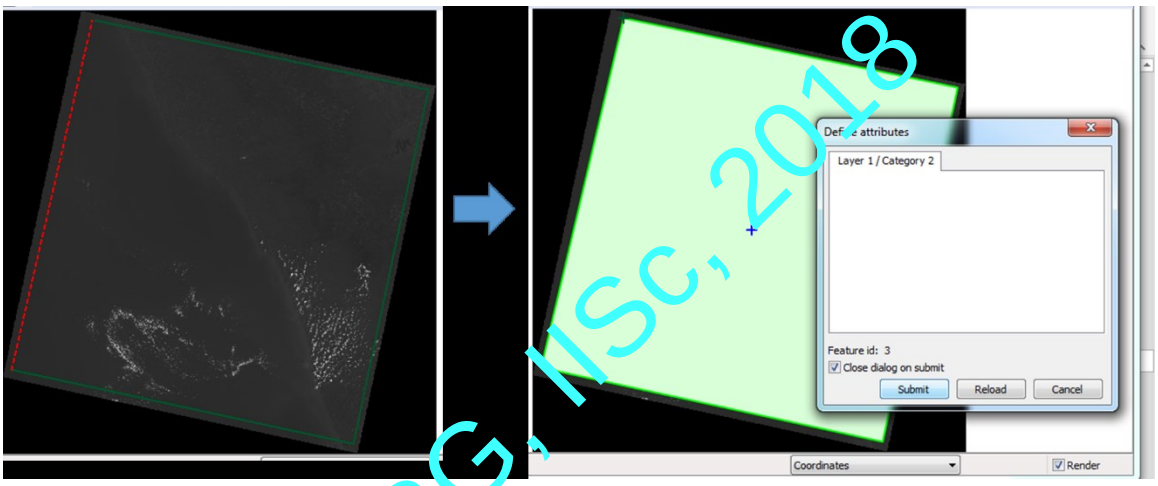
step ii) Select Vector layer, click on ***Vector editor***



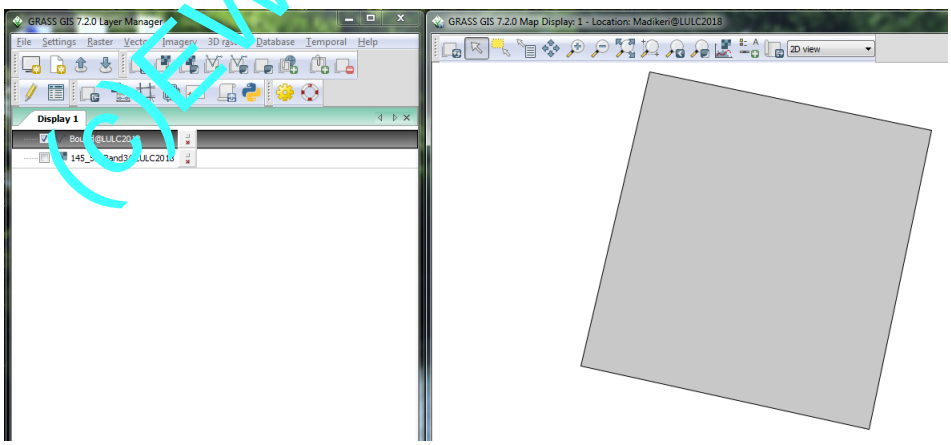
step iii) Select digitize new area,



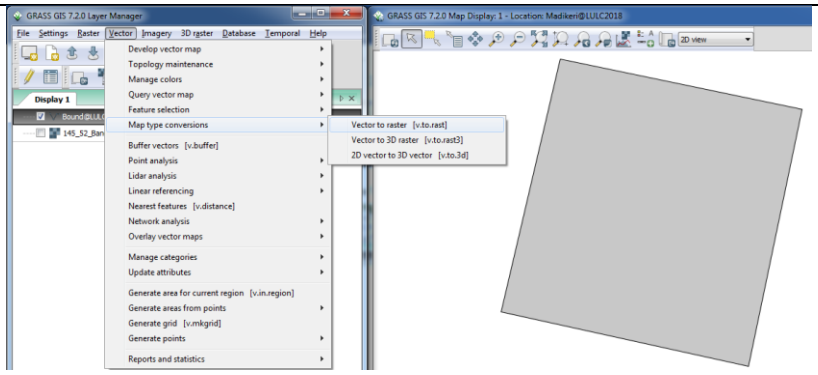
Click on the image at corners leaving the edges/null data. To completer the polygon, right click, click on submit.



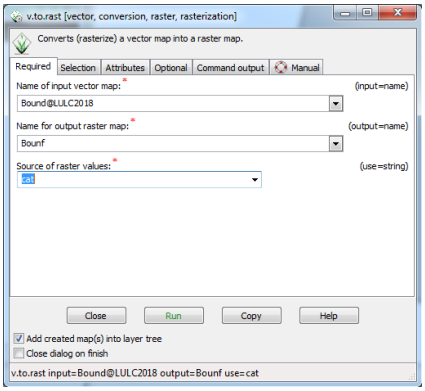
Click on Vector editor to save and stop editing, Output is as shown below

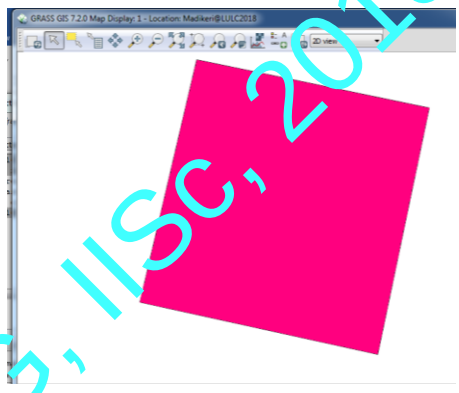


step iv) Convert Vector to Raster. Go to Vector, Map type conversions, Vector to Raster



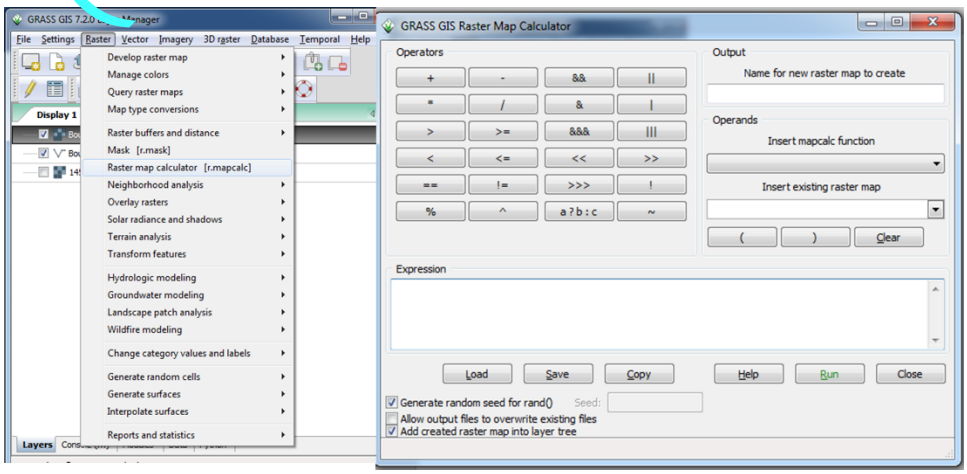
Select input vector layer, define output name, source of raster values (category 'cat'), then click on run to obtain the boundary raster





step v) cropping satellite data: to eliminate null values, Satellite data is extracted within the boundary of study using raster map calculator.

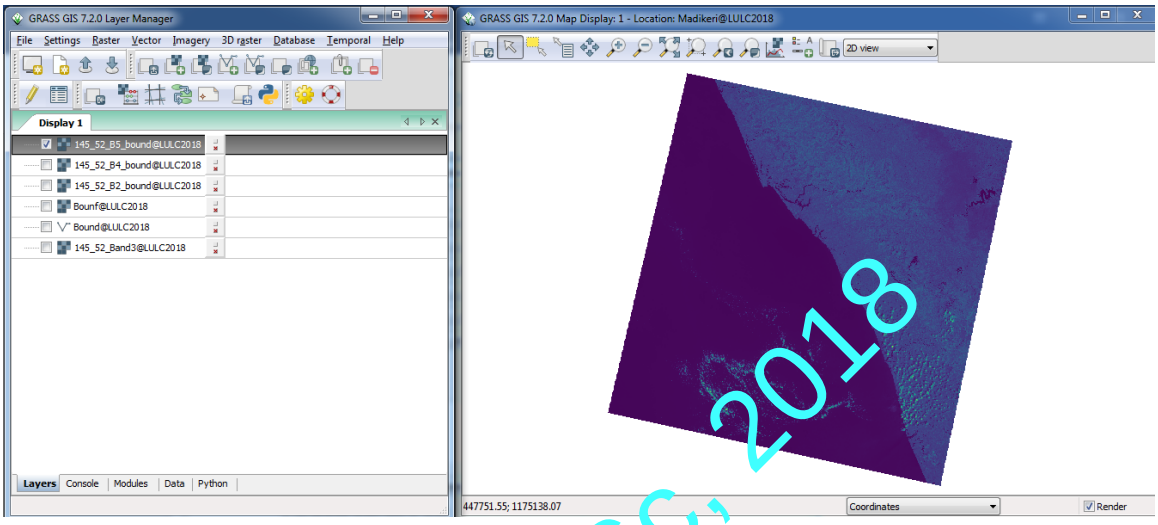
Go to Raster, **raster map calculator** to do numerical data operations. Use Boundary/mask layer and Raw satellite image by multiplication derive cropped maps



In the expression window, use existing raster maps, raster operators to derive output maps.

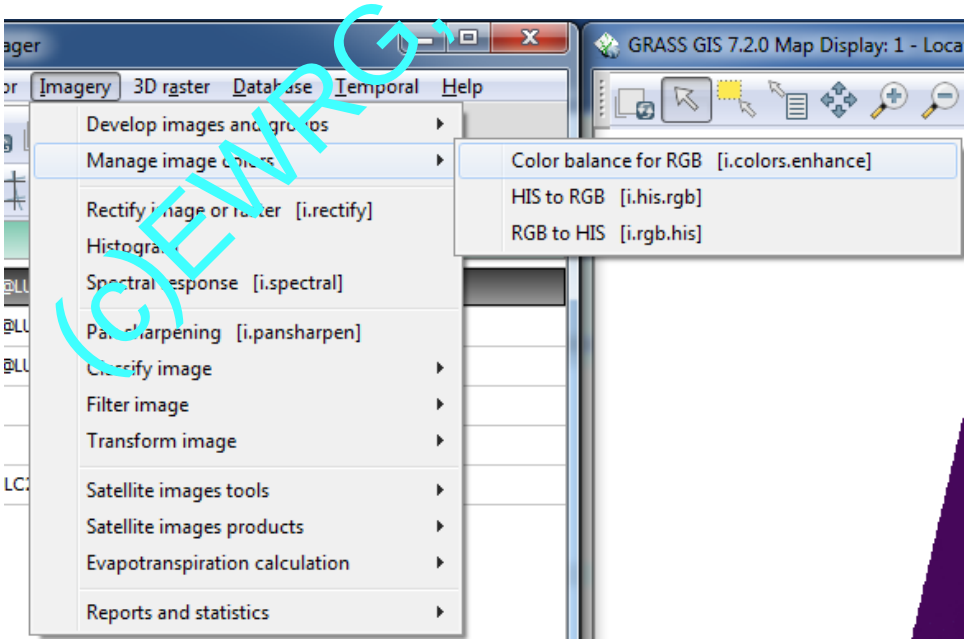
Provide output map name

Example: 145_52_Band2 * Bound = 145_52_B2_bound

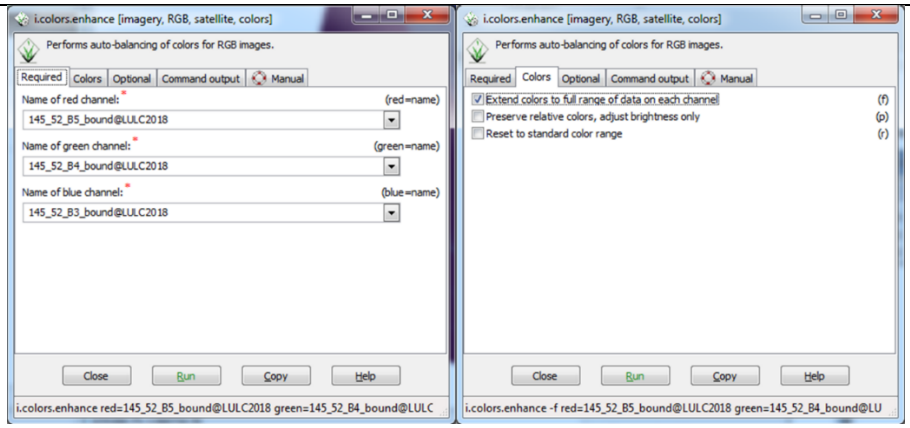


Step 11) Preparation of FCC

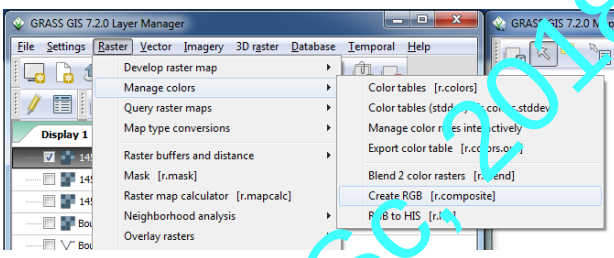
Step i) Auto balancing of colors: Go to Imagery, Manage image colors, Color balance



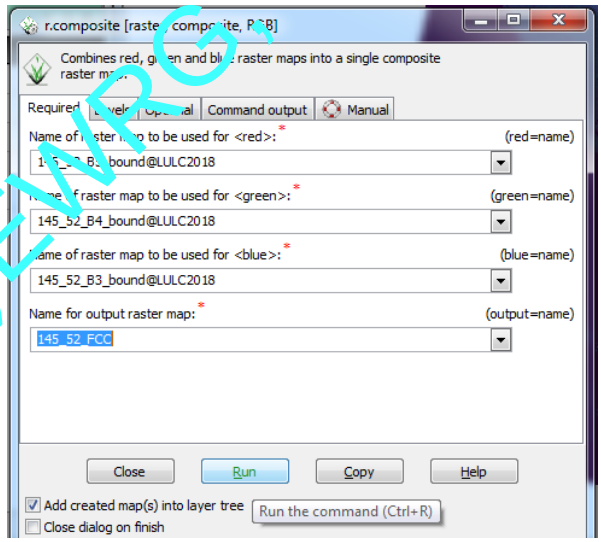
Step ii) Assign false colors i.e., Green to Blue, Red to Green and NIR to Red bands, select colors tab, click on extend colors to full range, then click on run

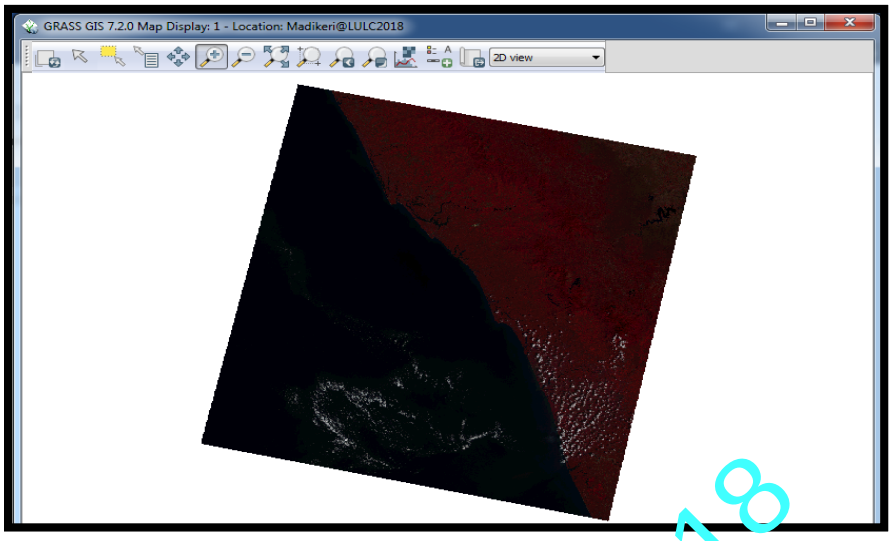


step iii) to prepare an FCC, go to Raster, Manage colors, Create RGB,



step iv) Assign Colors such Green to Blue, Red to Green and NIR to Red bands, provide output file name, example "145_52_FCC", click on run



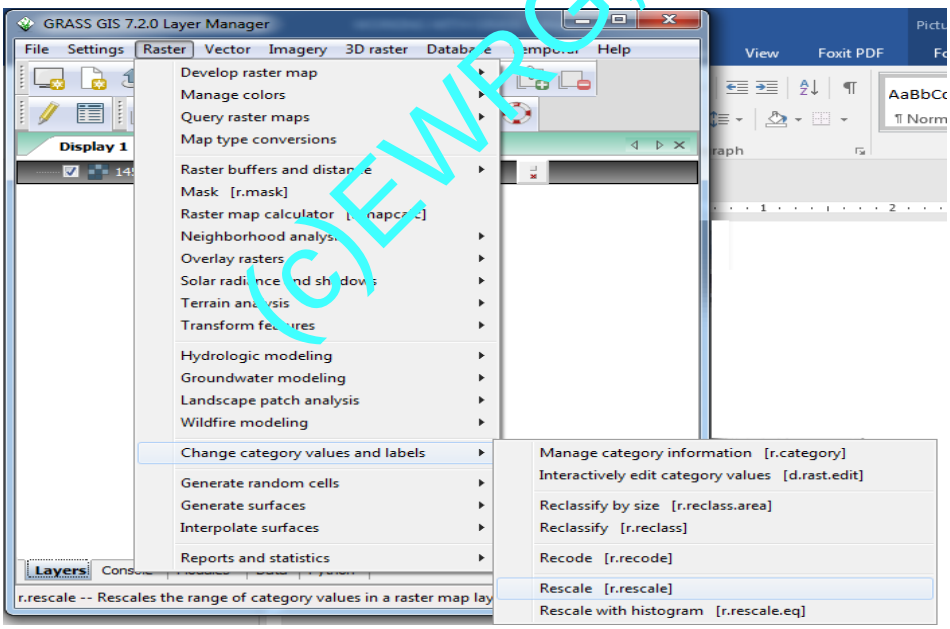


Step 12) Radiometric Correction

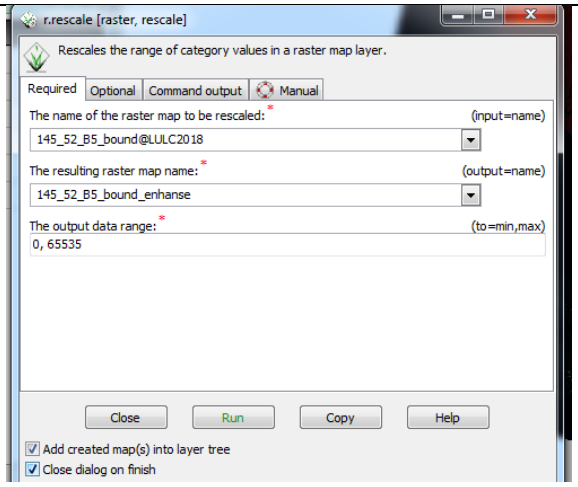
Since the FCC is not clear and if it shows high or low contrast, Check the histogram of individual satellite image, if the range is not to full scale, use raster rescale

Check Histogram: Open the image, go to

Rescale: Go to Raster, Change Category values and Labels, Rescale.



Select input image, define name for output image, Set color range (example landsat 8 is 16 bit data, color range is between 0 to 65535, similarly for other satellite images) Repeat same for all bands.



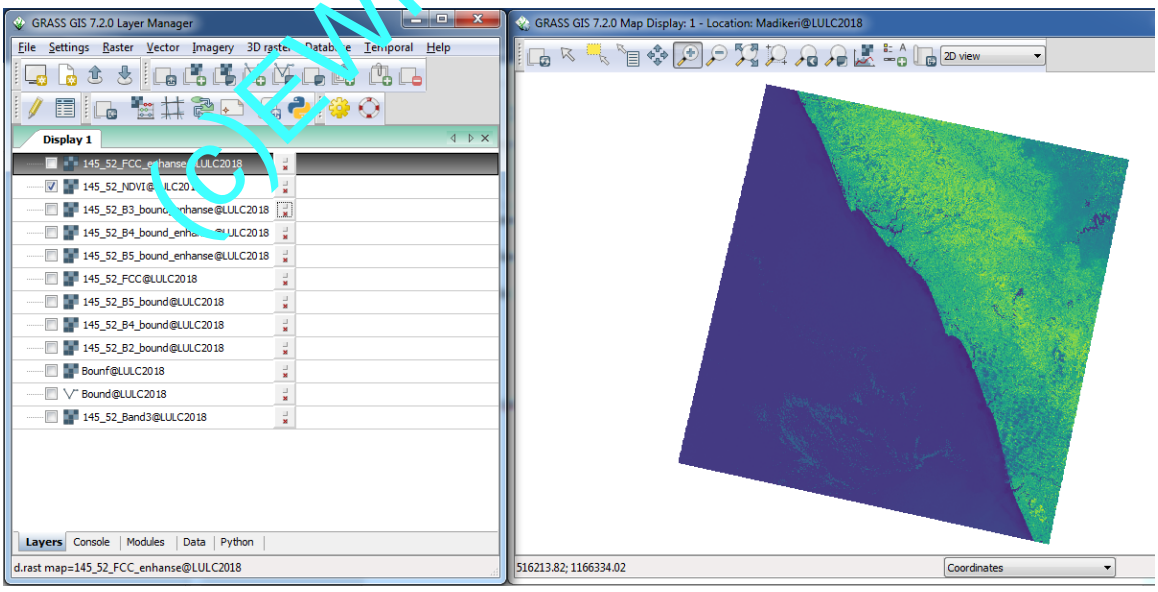
Once enhancement is complete, Follow **Step 11 – Preparation of FCC**

Step 13) Vegetation Indices (LAND COVER ANALYSIS)

Step i) Creation of Vegetation map: Vegetation indices (or any map operations are done using Map Calculator). Go to Raster Map Calculator

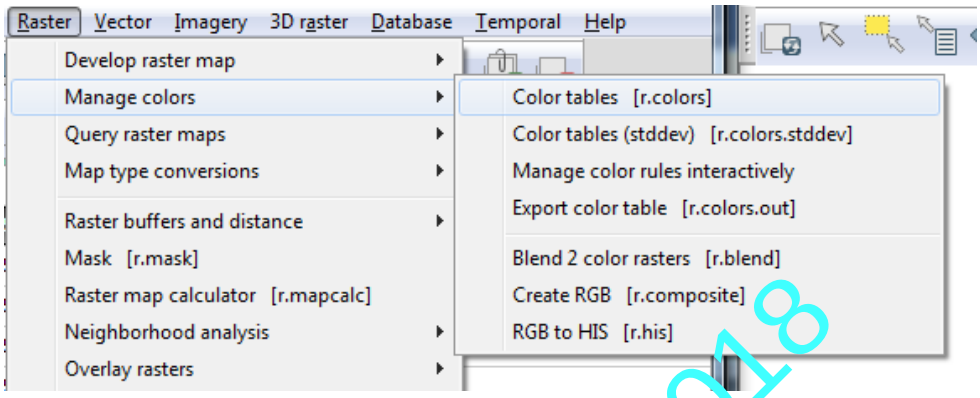
Note: Since Vegetation indices are signed decimal numbers, we need to use "float" for calculation

Example: NDVI = float(float(NIR-R)/float(NIR + R))

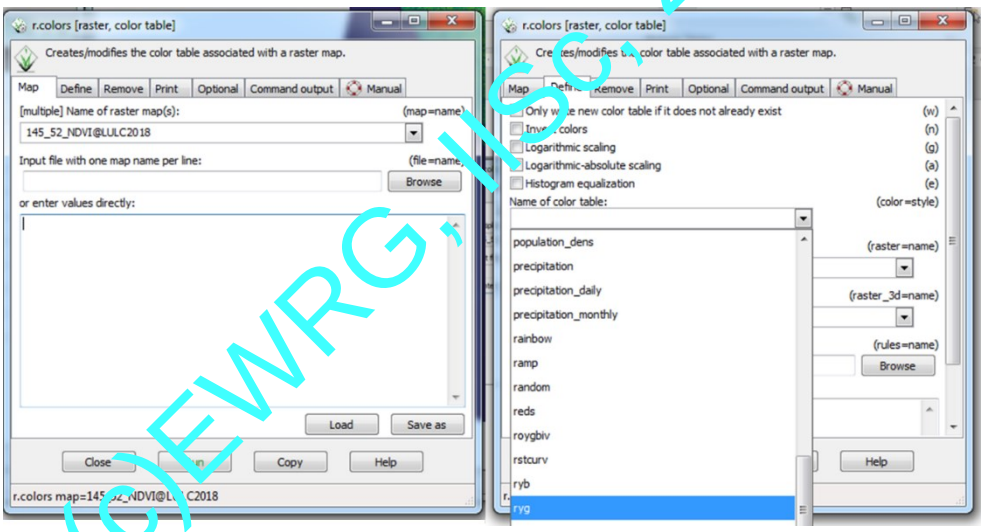


Assign color i.e., represent vegetation in shades of Green, Non Vegetation in shades of Yellow to Red i.e., use ***ryg*** color range for representing the data.

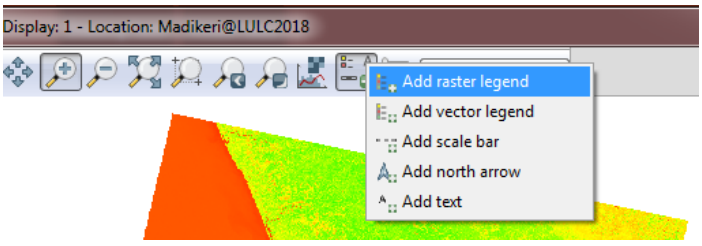
Go to Raster, Manage Colors, Color tables

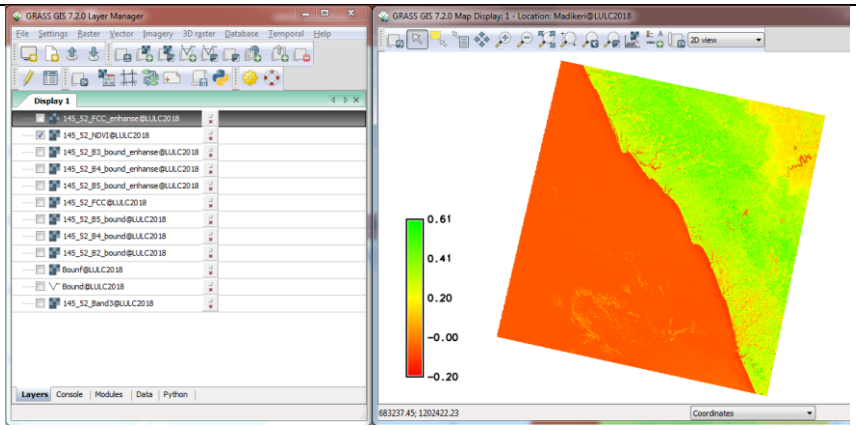


Provide NDVI map as input map, Select Define Color, Choose color from color table "***ryg***"

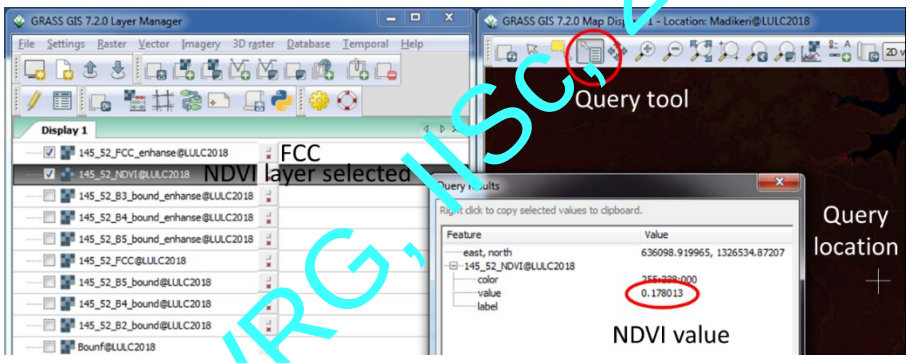


Click on Add Raster elements and add raster legend for NDVI

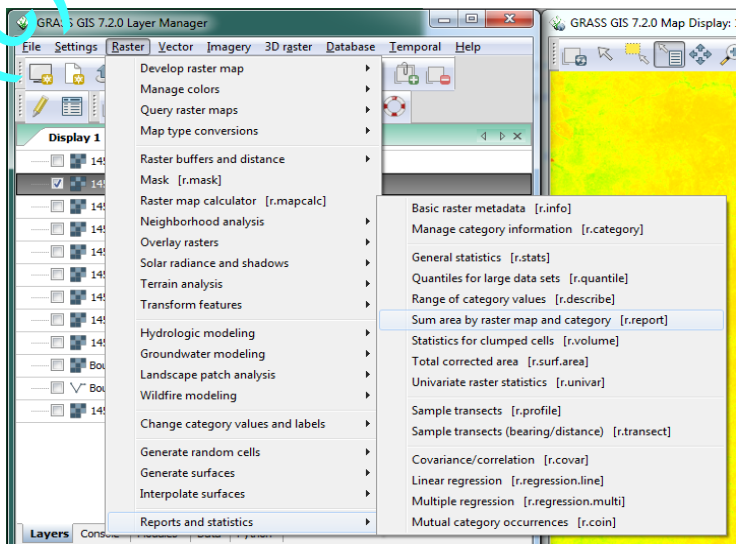




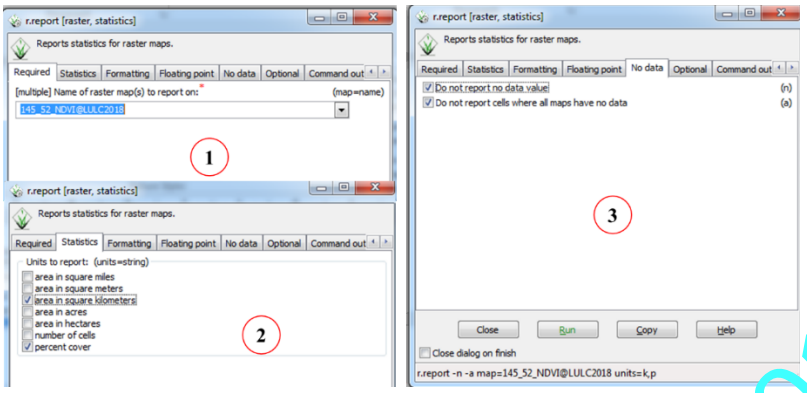
Step ii) Extraction of Statistical information: Overlay FCC, on NDVI. Select NDVI, zoom to sparse vegetation, use Query tool and click on pixels, select the lowest value as minimum for vegetation



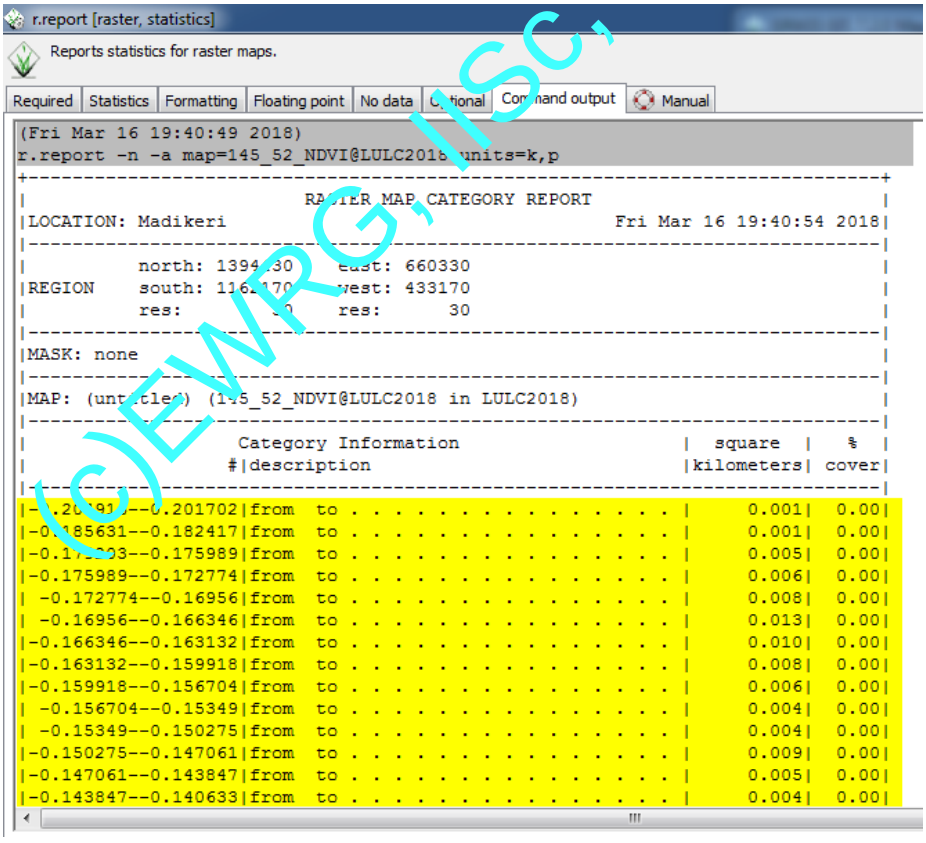
To obtain statistical information, go to Raster, Reports and Statistics, Sum area by raster map and category

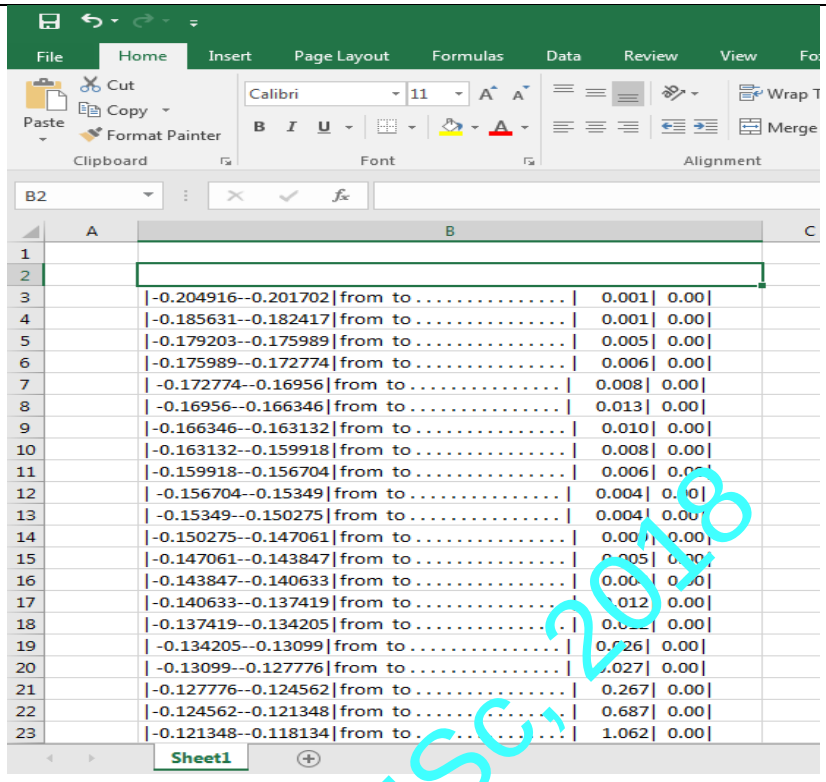


Select input NDVI map, select statistics and choose percent area and area in square kilometer or other units as necessary, then select No data, click on "do not report no data value and cells tabs"



NDVI output statistics are generated as text, copy the contents and paste in excel



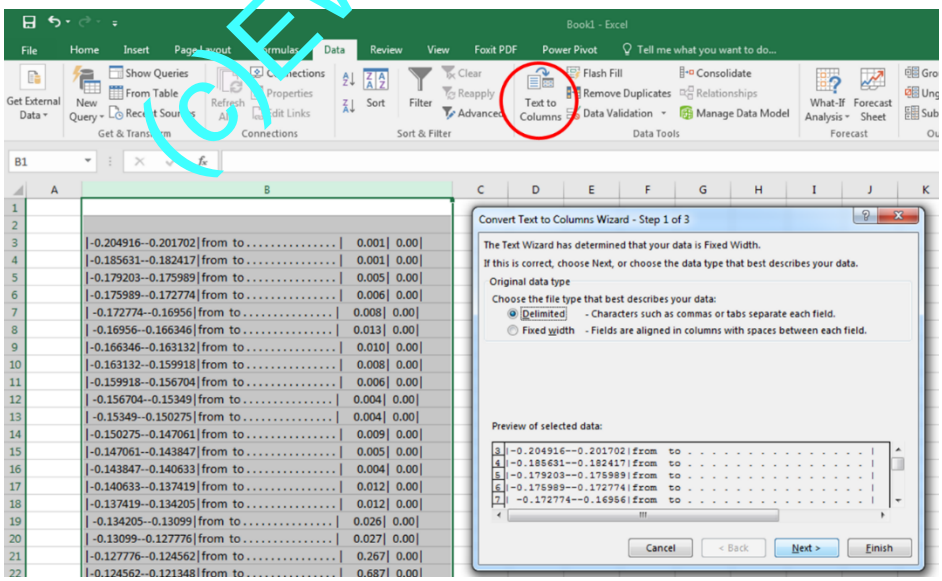


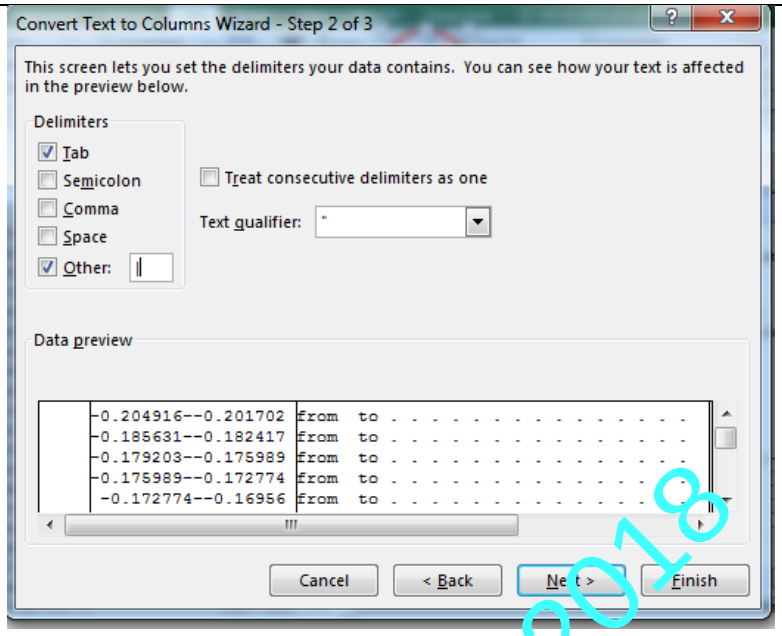
	A	B	C
1			
2			
3		|-0.204916--0.201702|from to . . . . . | 0.001| 0.00|	
4		|-0.185631--0.182417|from to . . . . . | 0.001| 0.00|	
5		|-0.179203--0.175989|from to . . . . . | 0.005| 0.00|	
6		|-0.175989--0.172774|from to . . . . . | 0.006| 0.00|	
7		| -0.172774--0.16956|from to . . . . . | 0.008| 0.00|	
8		| -0.16956--0.166346|from to . . . . . | 0.013| 0.00|	
9		|-0.166346--0.163132|from to . . . . . | 0.010| 0.00|	
10		|-0.163132--0.159918|from to . . . . . | 0.008| 0.00|	
11		|-0.159918--0.156704|from to . . . . . | 0.006| 0.00|	
12		| -0.156704--0.15349|from to . . . . . | 0.004| 0.00|	
13		| -0.15349--0.150275|from to . . . . . | 0.004| 0.00|	
14		|-0.150275--0.147061|from to . . . . . | 0.00| 0.00|	
15		|-0.147061--0.143847|from to . . . . . | 0.005| 0.00|	
16		|-0.143847--0.140633|from to . . . . . | 0.00| 0.00|	
17		|-0.140633--0.137419|from to . . . . . | 0.012| 0.00|	
18		|-0.137419--0.134205|from to . . . . . | 0.0| 0.00|	
19		| -0.134205--0.13099|from to . . . . . | 0.026| 0.00|	
20		| -0.13099--0.127776|from to . . . . . | 0.027| 0.00|	
21		|-0.127776--0.124562|from to . . . . . | 0.267| 0.00|	
22		|-0.124562--0.121348|from to . . . . . | 0.687| 0.00|	
23		|-0.121348--0.118134|from to . . . . . | 1.062| 0.00|	

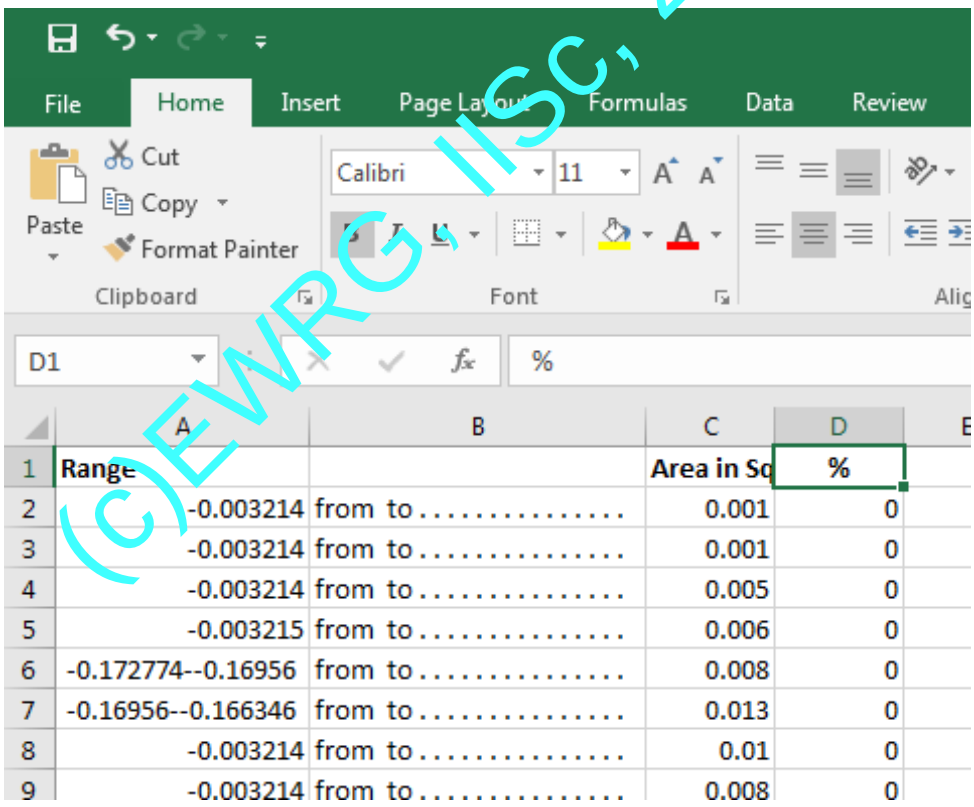
Sheet1

Since the data is not organized, we need to split the data accordingly.

Select the column, go to Data tab and select text to column. This will open a convert text to column wizard. In the wizard, select delimited. In the Delimited, Select Others and use "|" (Shift+ backslash), click on finish.







	A	B	C	D
1	Range		Area in Sq	%
2	-0.003214	from to	0.001	0
3	-0.003214	from to	0.001	0
4	-0.003214	from to	0.005	0
5	-0.003215	from to	0.006	0
6	-0.172774--0.16956	from to	0.008	0
7	-0.16956--0.166346	from to	0.013	0
8	-0.003214	from to	0.01	0
9	-0.003214	from to	0.008	0

In the first row, type "Range, Area in sq.km (used units), %. Scroll down for the observed minimum value of NDVI for vegetation (example 0.139 – this value is close to 0.138998). all values below specified values fall under Non Vegetative category, others in Vegetation category

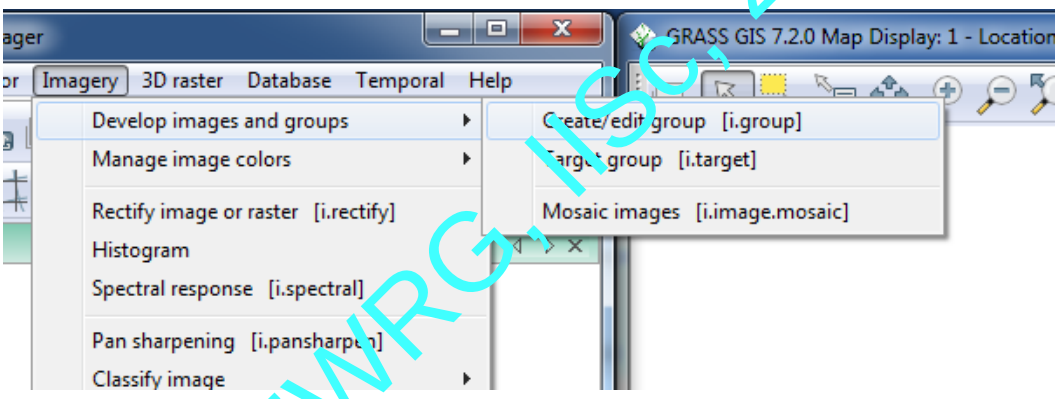
101	0.13257-0.135784	from to	46.012	0.13
102	0.135784-0.13899	from to	48.585	0.14
103	0.138998-0.142212	from to	51.719	0.15
104	0.142212-0.14542	from to	55.914	0.16

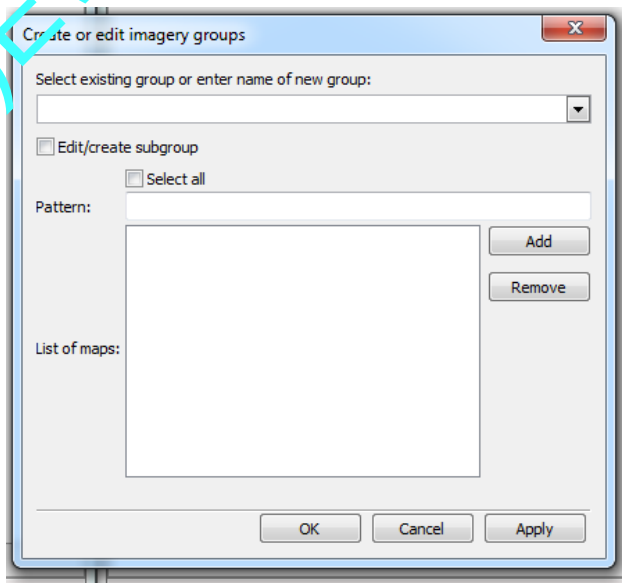
Results of NDVI: Non Vegetation (NDVI < 0.139) = 58.74%, 20044 sq.km, Vegetation (NDVI >0.139) = 41.19%, 14069 sq.km

Step 14) LAND USE ANALYSIS

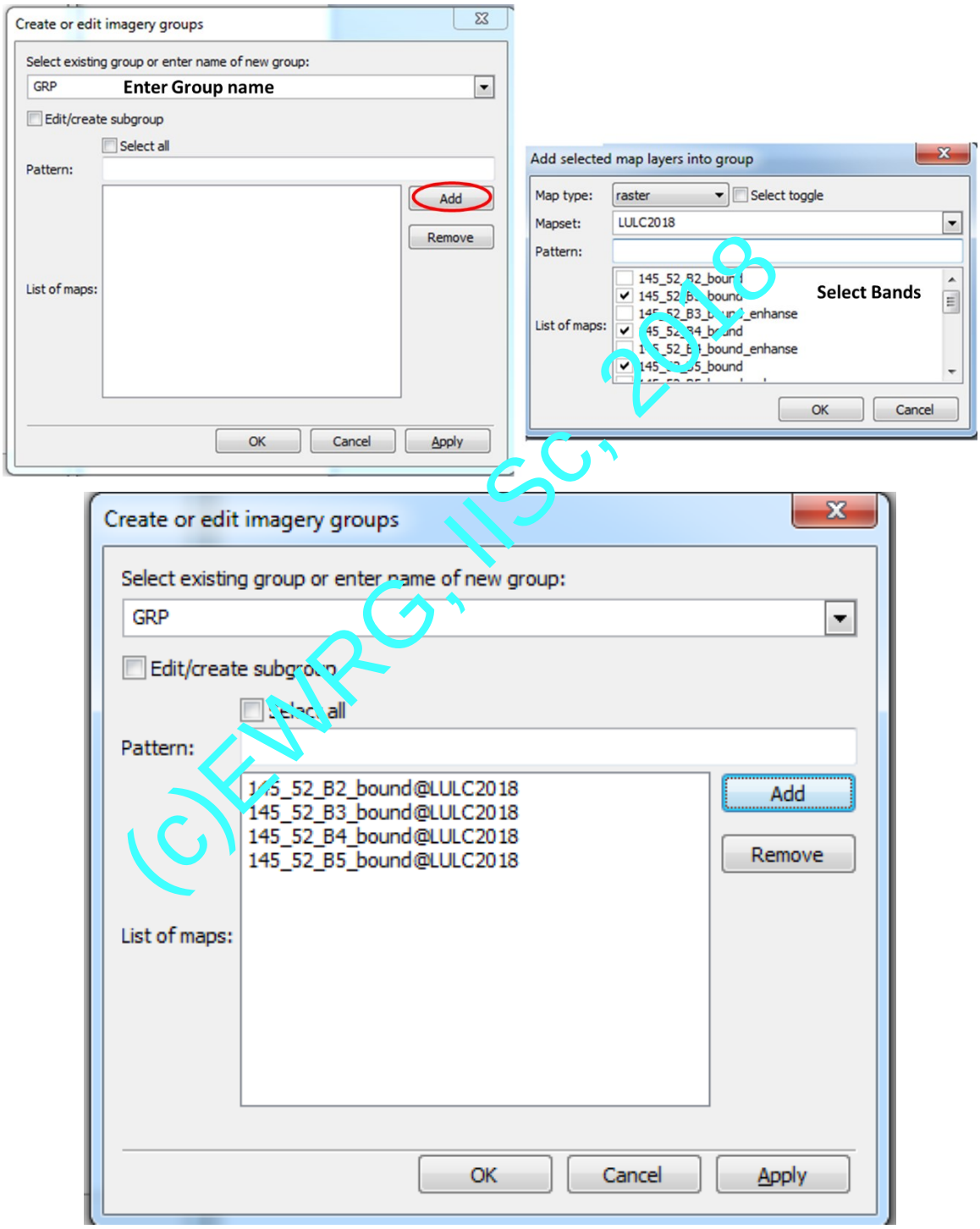
Step i) Create of FCC

Step ii) Creation of image group and sub group: Go to imagery > Develop images and groups, Create/edit group

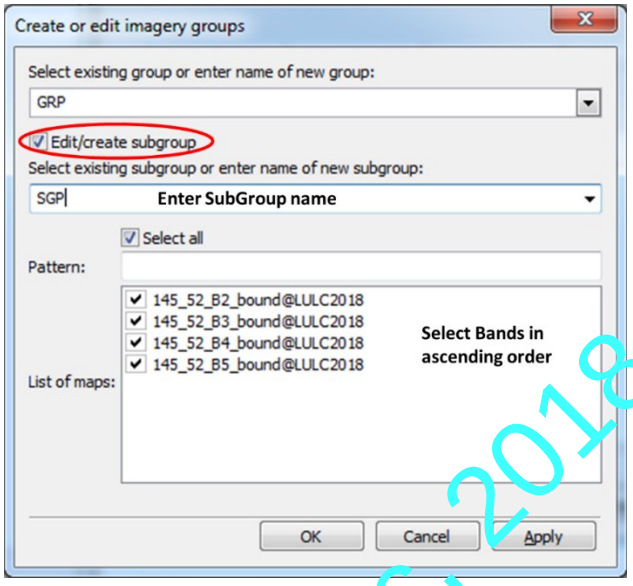




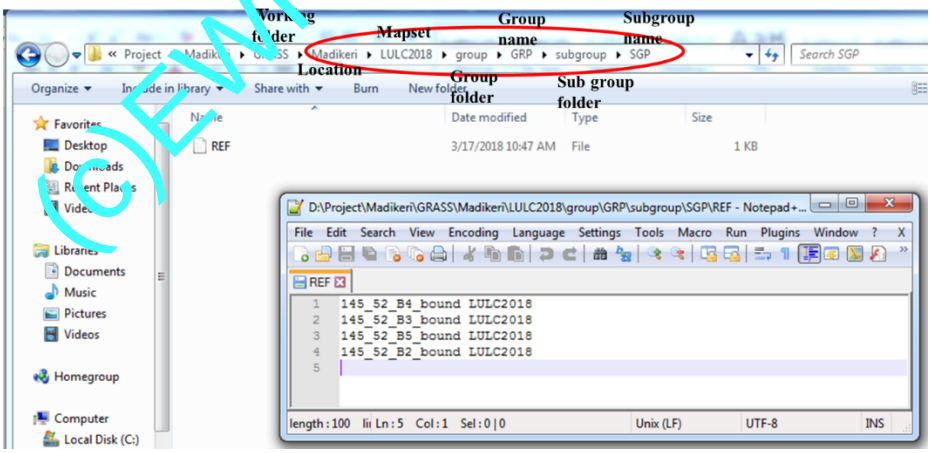
Enter name of Group (Example:GRP), Click on Add, Select Bands to be added (Green, Red, NIR – better results with better number of spectral information) click on ok. This will load images that needs to be grouped in the data.



Select Edit/create subgroup, provide subgroup name, select bands in the order of Green to NIR. Click on Ok. Now Group and Subgroups are created.

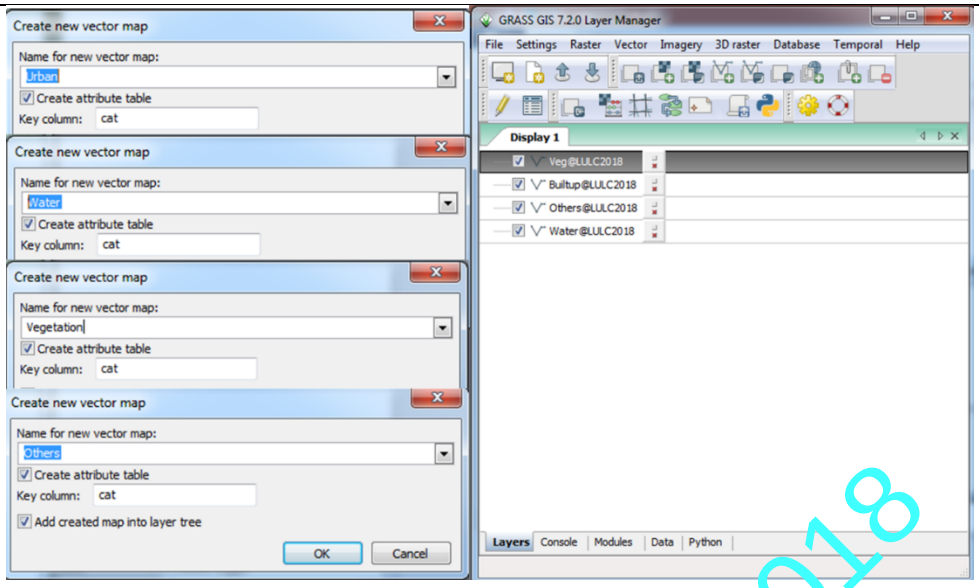


One can check the Mapset folder, for the group and sub group folders after creation. Right Click on REF and open with Notepad ++ or word pad. This would show the list of bands selected to form a sub group. A Mapset can have any number of groups, and a group can have any number of subgroups.



Step iii) Training Sites Creation: Create Vector files titled class names (Example: Water, Forest, Agriculture, Horticulture, Built up, Open area, Others, *etc*...)

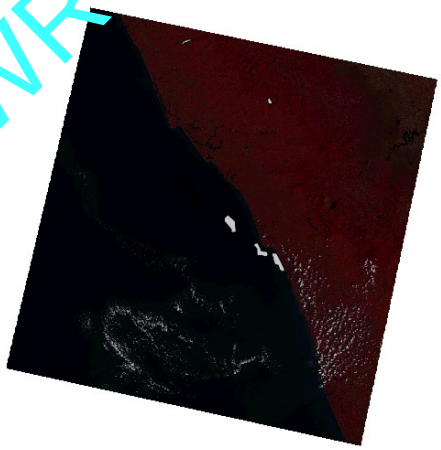
Go to Vector, Develop Vector Map, Create New Vector map



Overly FCC, Start editing individual vector file

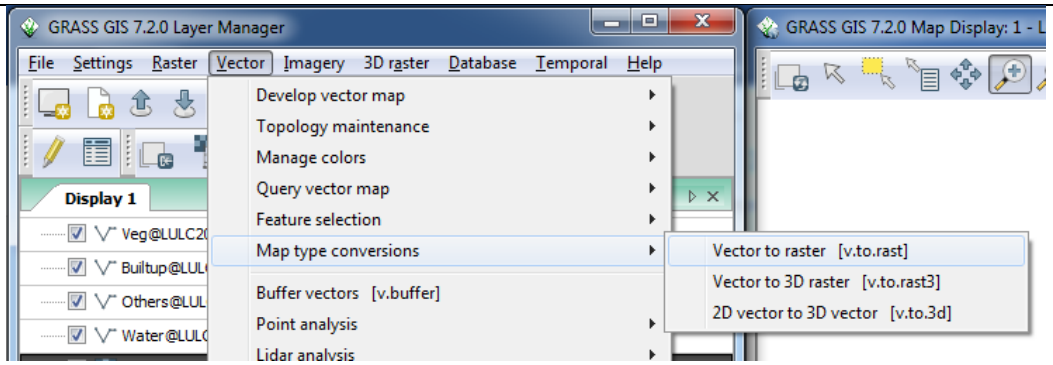
Example: Start editing water, start adding add polygon/lines on the water bodies, about 10 for the first try, similarly all other classes until classification is visually precise.

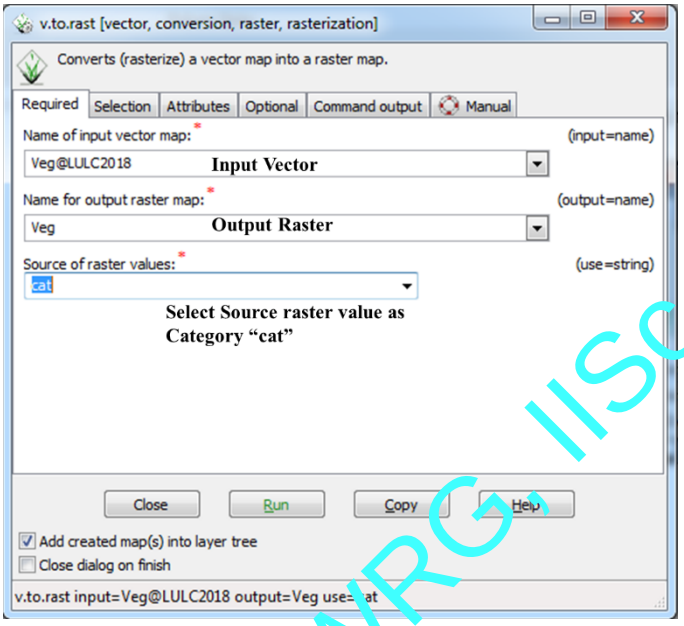
Once training sites are digitised, click on editor, save edits and stop editing. Make sure you take atleast 10 pixels per signature (generally N +1 where N is number of Bands)

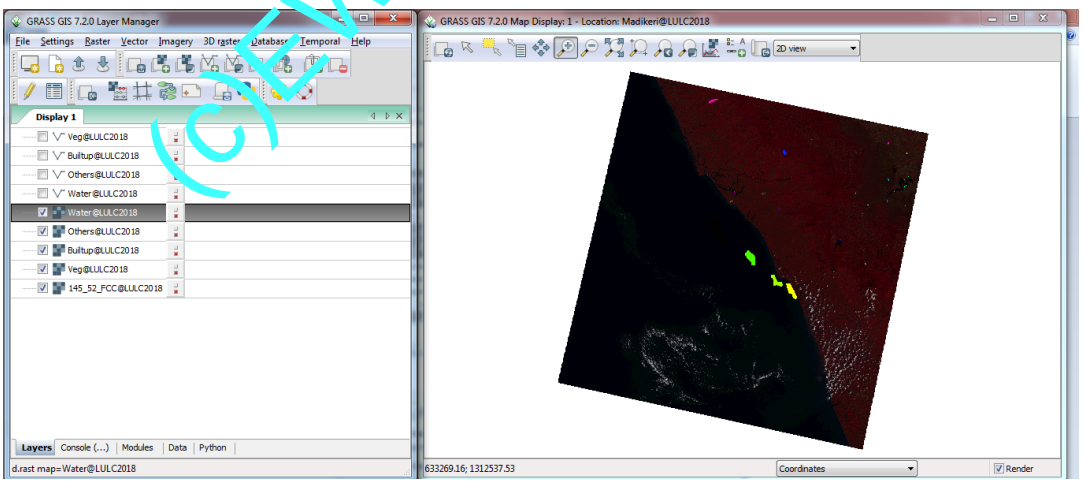


Once all initial training datasites are completed, convert each training vectors to raster.

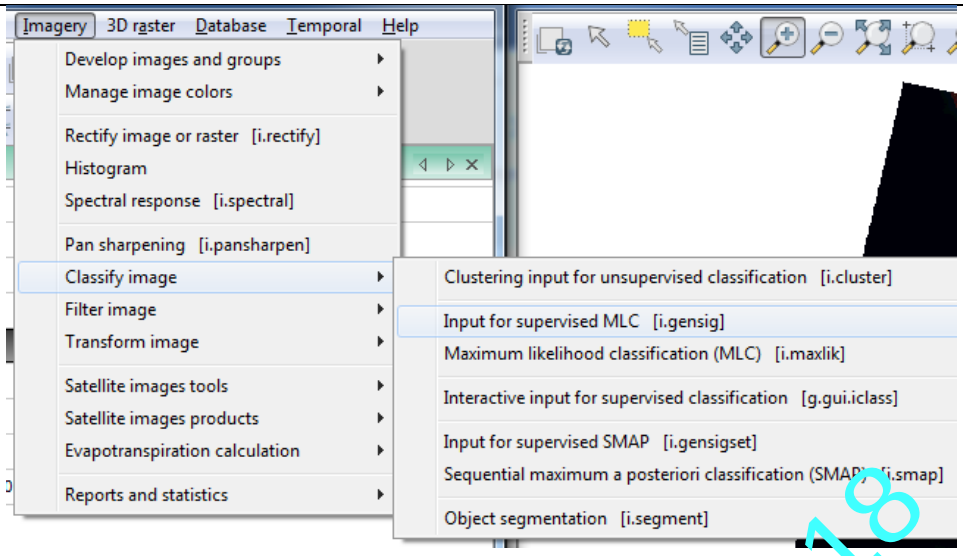
Provide input Vector (Example Vegetation) provide output raster name (Veg), Select Source of raster value as category.



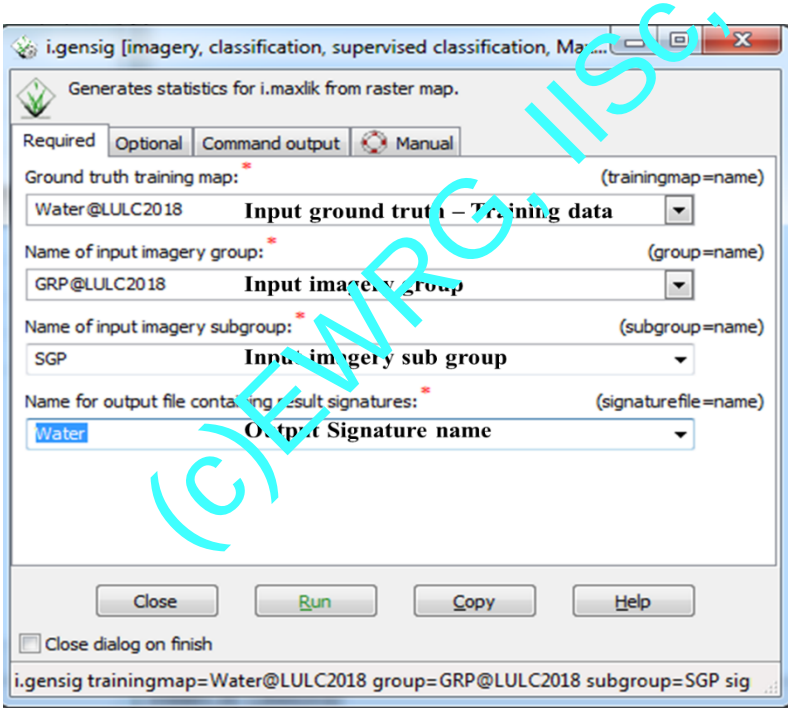




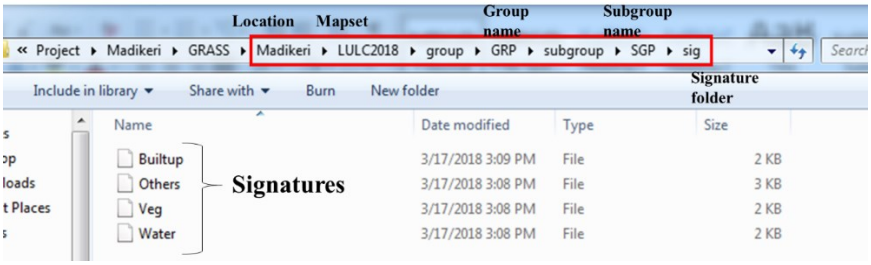
step iv) Generation of Signatures: After the training sites are rasterised, Signatures are developed for classifying an image. To Generate Signatures, go to Imagery, select Classify image, then select Input for supervised MLC



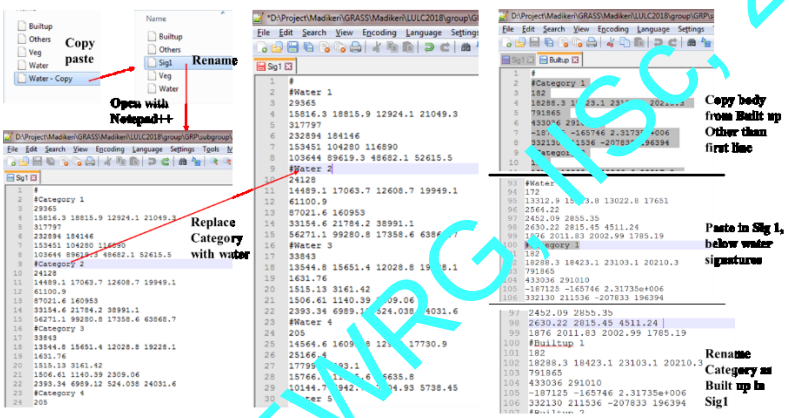
Provide information such as input training file (raster), Group and Subgroup, Output signature name. Signatures are generated for each land use category separately.



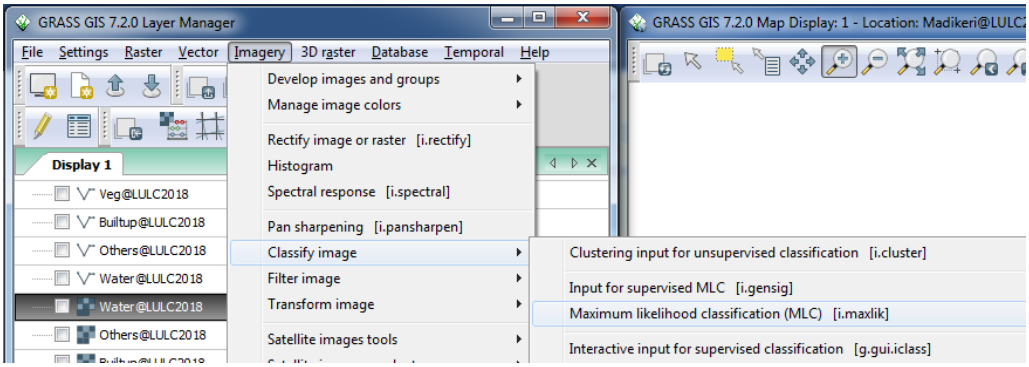
After creating all signatures, go to the signature folder inside the subgroup folder created in the earlier steps.



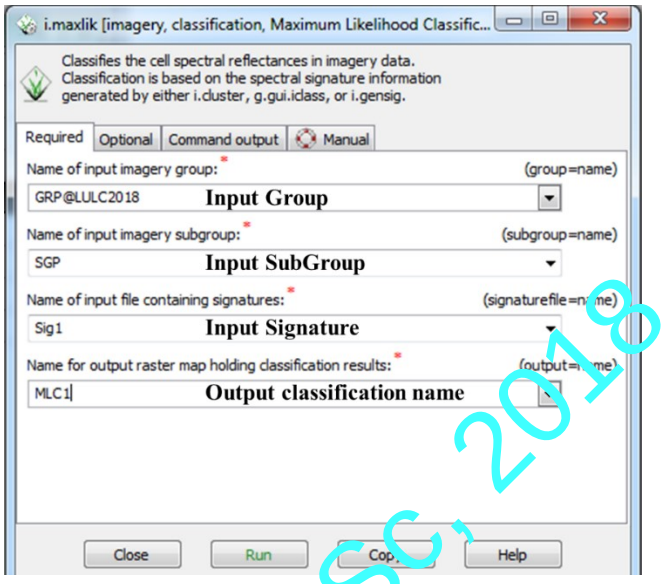
Copy paste one of the Signature file, rename as "sig1", Replace "# Category number" with "#landuse_number# for individual signatures. Copy paste and rename each signature of different classes respectively. Make sure the editing's are done using Notepad ++ or Wordpad. While adding second land use signature, copy entire body other than line one, and paste below the first set of land use signature in the "sig1" file. Follow the process for all land use signatures save the "sig1" signature file.

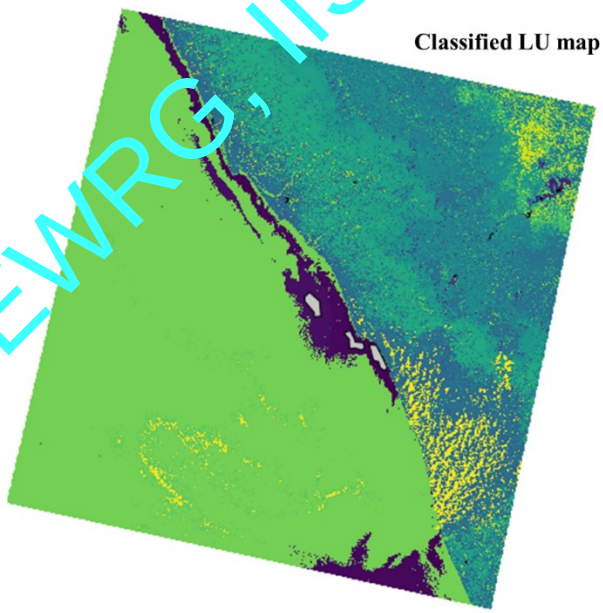


step v) Classification: Classification can be carried out in various ways, for the current analysis we would be using Maximum likelihood classifier algorithm. GO to imagery, Classify image, Maximum likelihood classification.

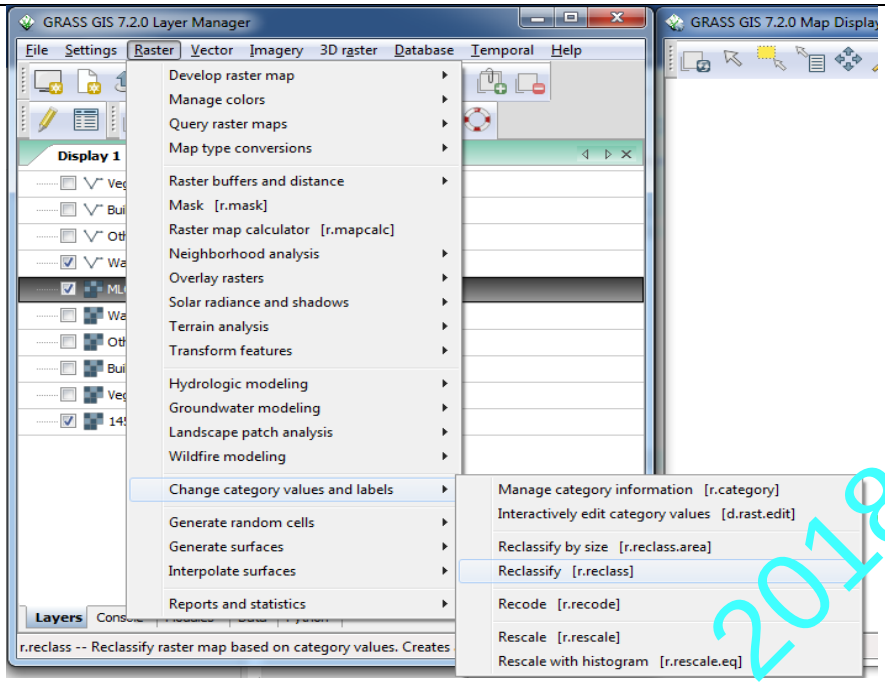


Provide input data such as Group name, Sub group, signature with respect to which classification would be done, provide output Classification file name (example: MLC1), click on run.

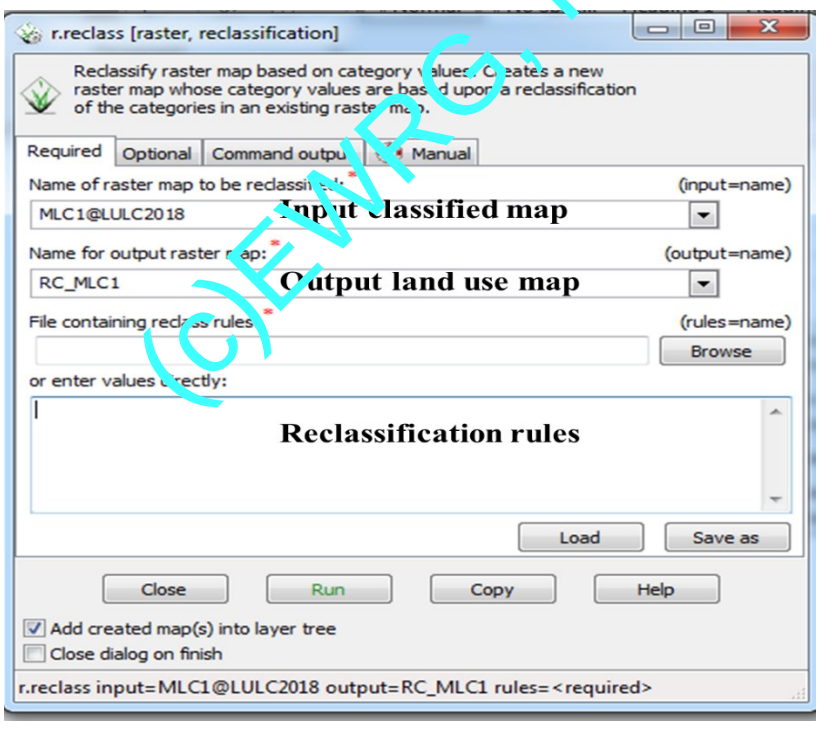




Reclassify the classified map to extract land use map. To do reclassification go to Raster, Change category values and lables, Reclassify

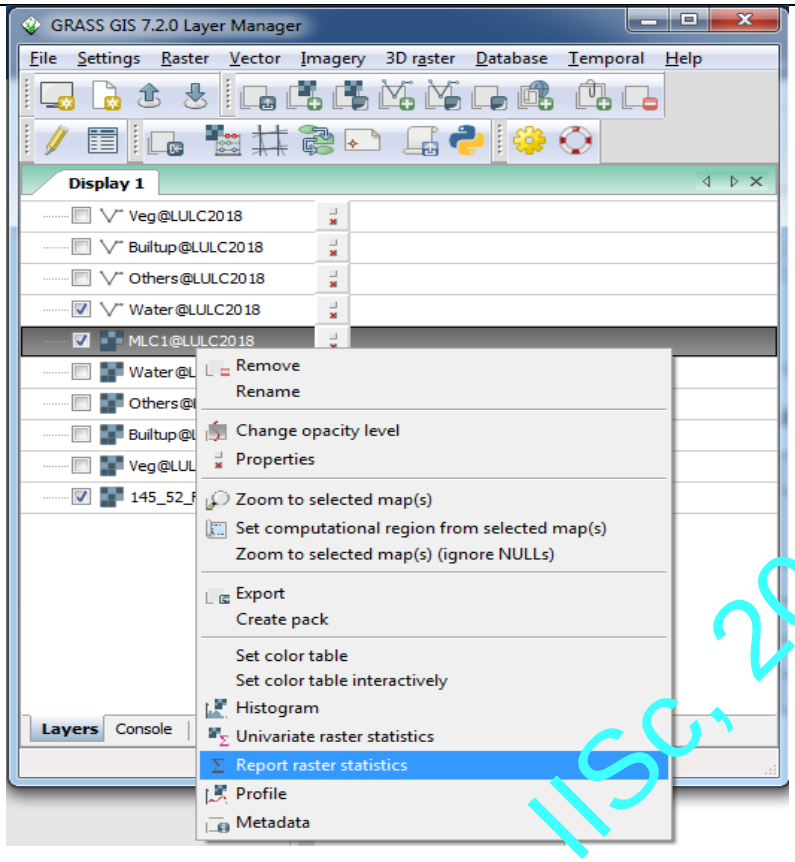


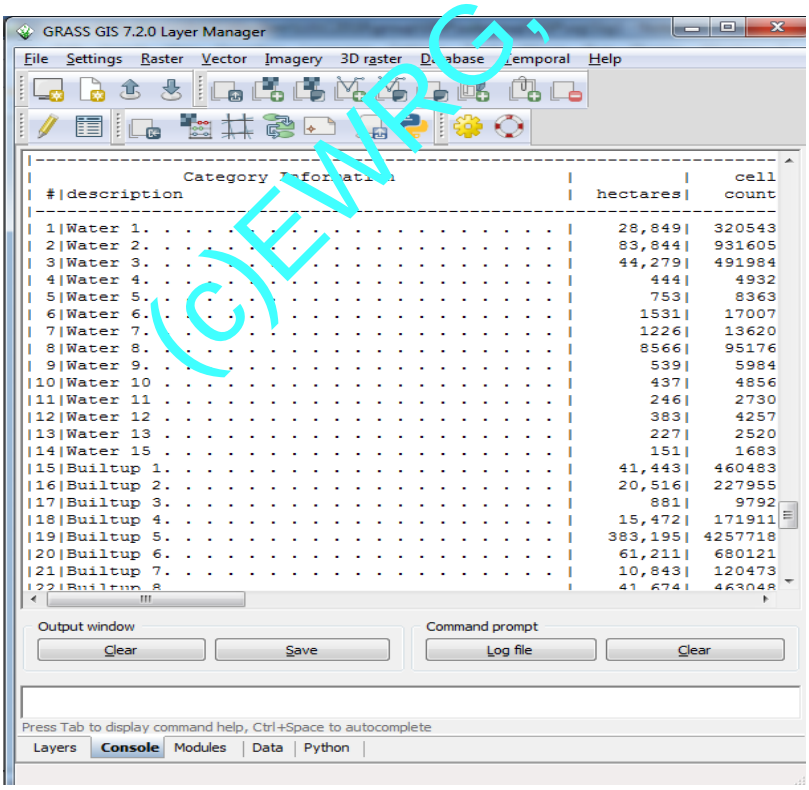
Provide input classified data (Example: MLC1), output as land use (RC_MLC1) and reclassification rules



Defining reclassification rules, right click on the classified output click on raster teport and statistics. Check the class number

GRASS: Geographic Resources Analyses Support System (http://wgbis.ces.iisc.ernet.in/grass/)

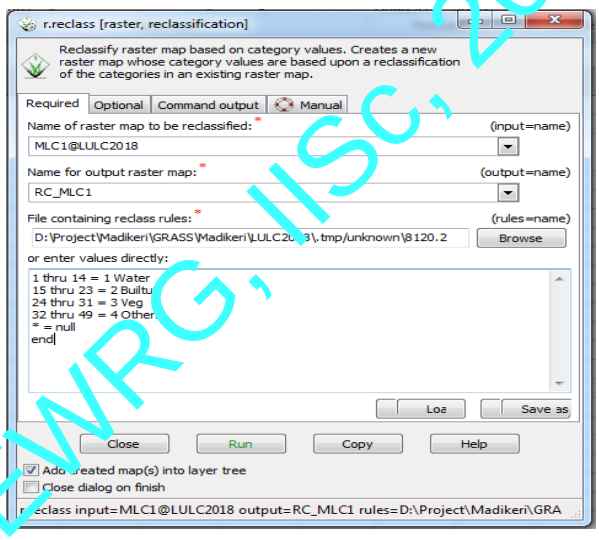




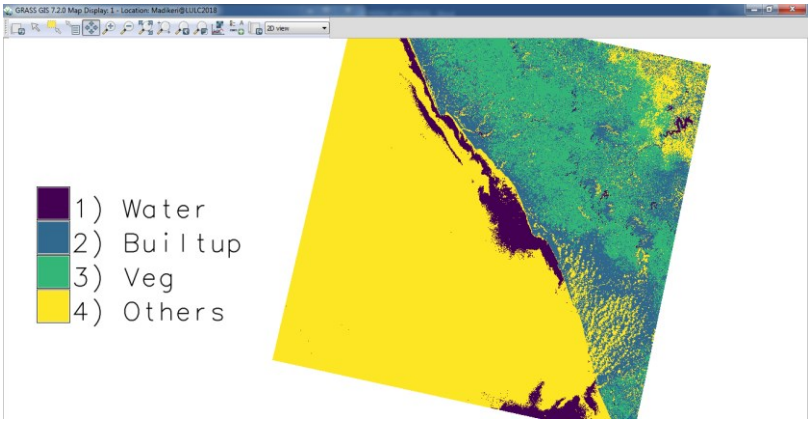
Based on the category information available, reclassify the classified data to obtain Land use map by applying reclassification rules

Classified image (Signature)	Reclassification rules
# Water1 to # water 15	1 thru 15 = 1 Water or 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 = 1 Water
#Urban 1 to # urban 8	16 thru 23 = 2 Urban
# Veg 1 to # Veg 10	17 thru 26 = 3 Veg
# Others 1 to # Others 12	27 thru 38 = 4 Others
After all signatures complete, Key as " * = null" and next line "end"	

The rules can be applied according to classification and land use classes present in signature. Apply reclass rules, run the program.



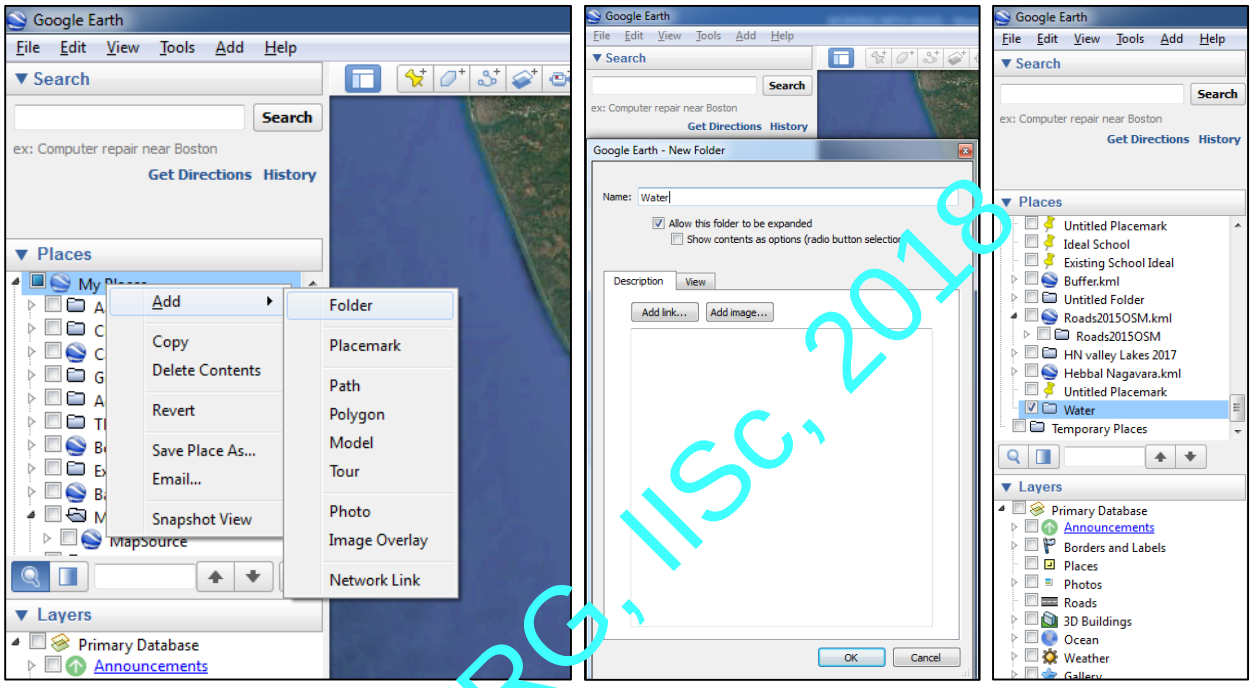
Land use map is developed as below. Since it has errors, collect additional signatures to achieve accurate map.



STEP 15) Classification Using Google Earth

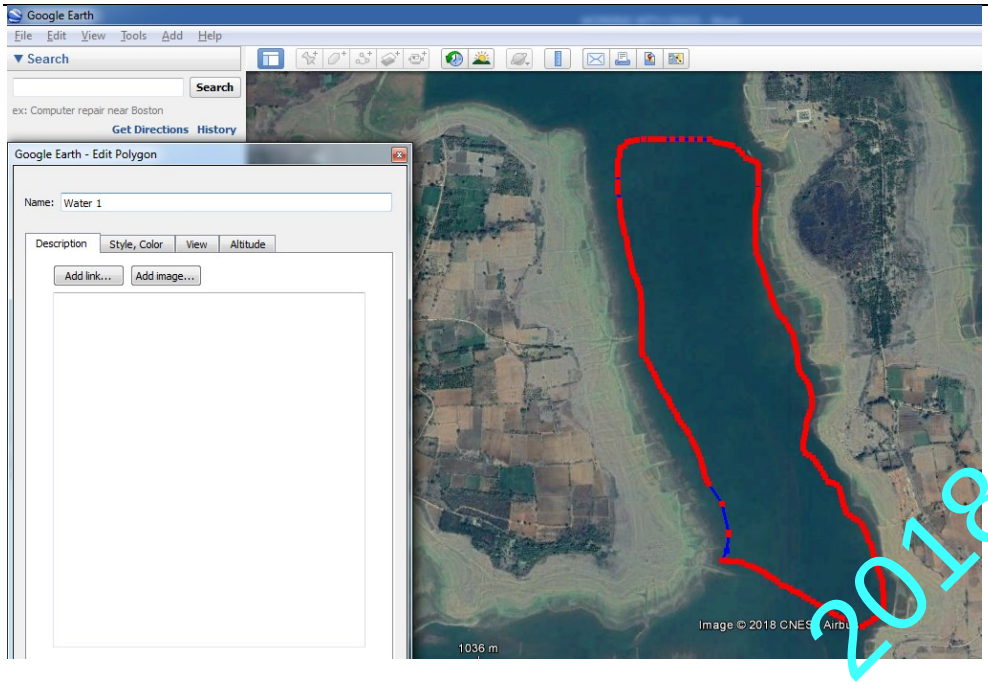
Install Google earth to your Work System and Open Google Earth, navigate to your study area.

Right click on My places, Add, Folder and name it with land use class name (Example Water) and click on ok.

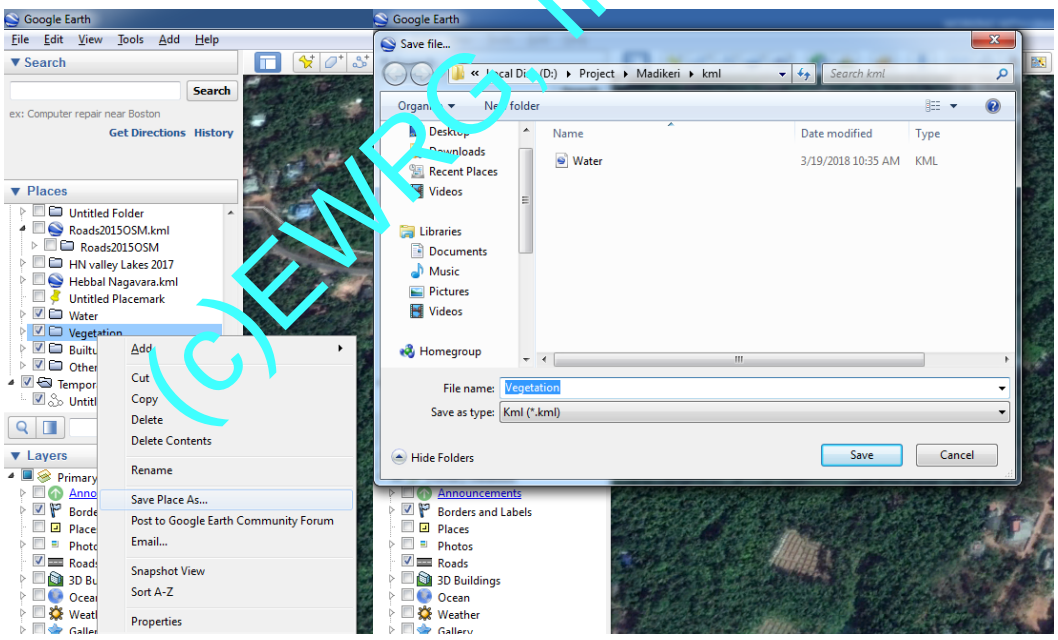


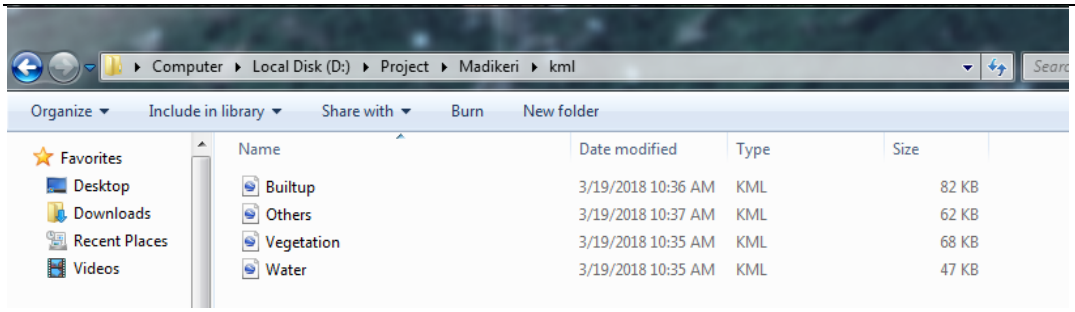
Click on Land Use Folder, Use Polygon feature tool, Name the polygon feature with class name and signature number Example Water 1, Water 2,…..

Digitize a training sites for the land use feature by clicking at various points within the feature, Click on Ok, Follow the same for multiple training sites and multiple land use classes. You can use Style/Colour to alter the properties of the polygon.

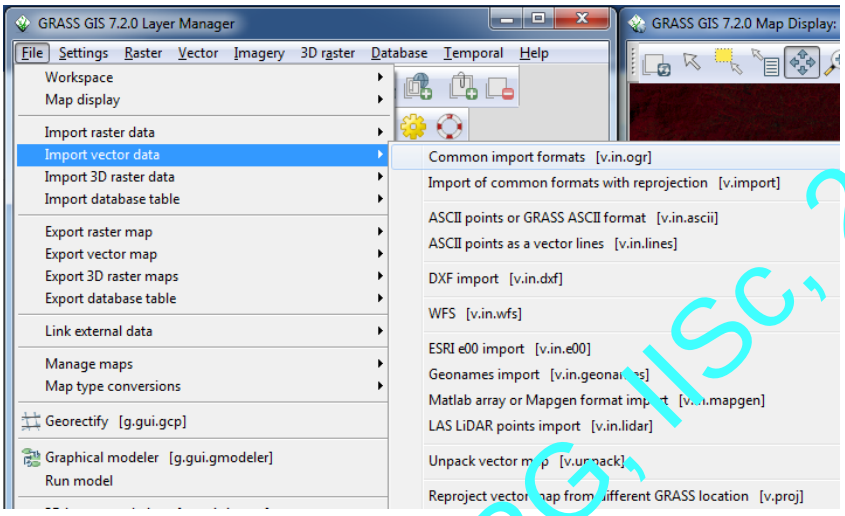


After Digitisation of all training data sites, right click on each land use folder and save as **kml**(Keyhole markup Language) file in a folder.

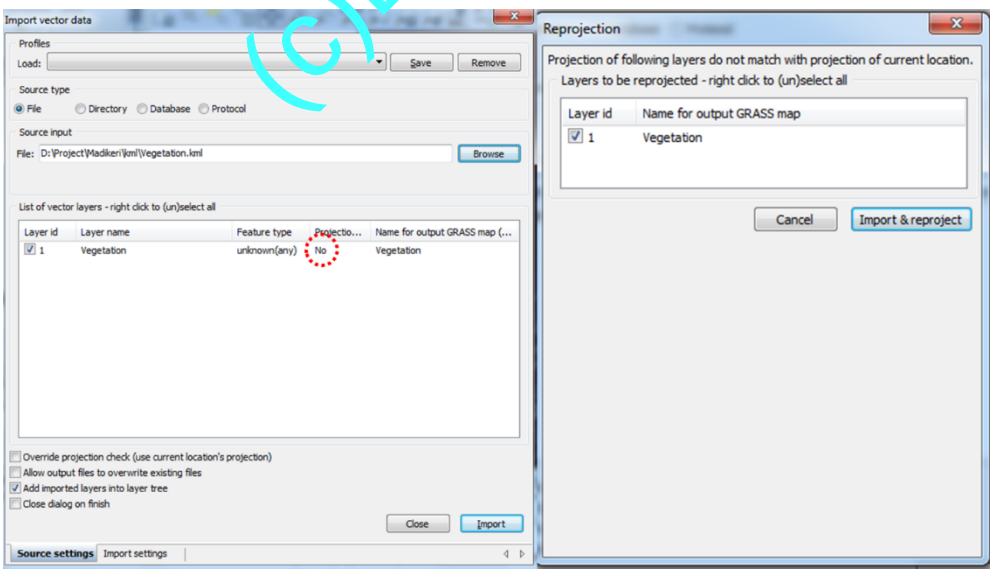




Import all these training sites into GRASS, as Vector: Go to File, Import Vector data, Common import formats



Since the kml files are in latitude longitude projection system, reprojection is necessary to match location projection. When you click on import, GRASS will automatically open reprojection tab. Import and reproject the kml files.

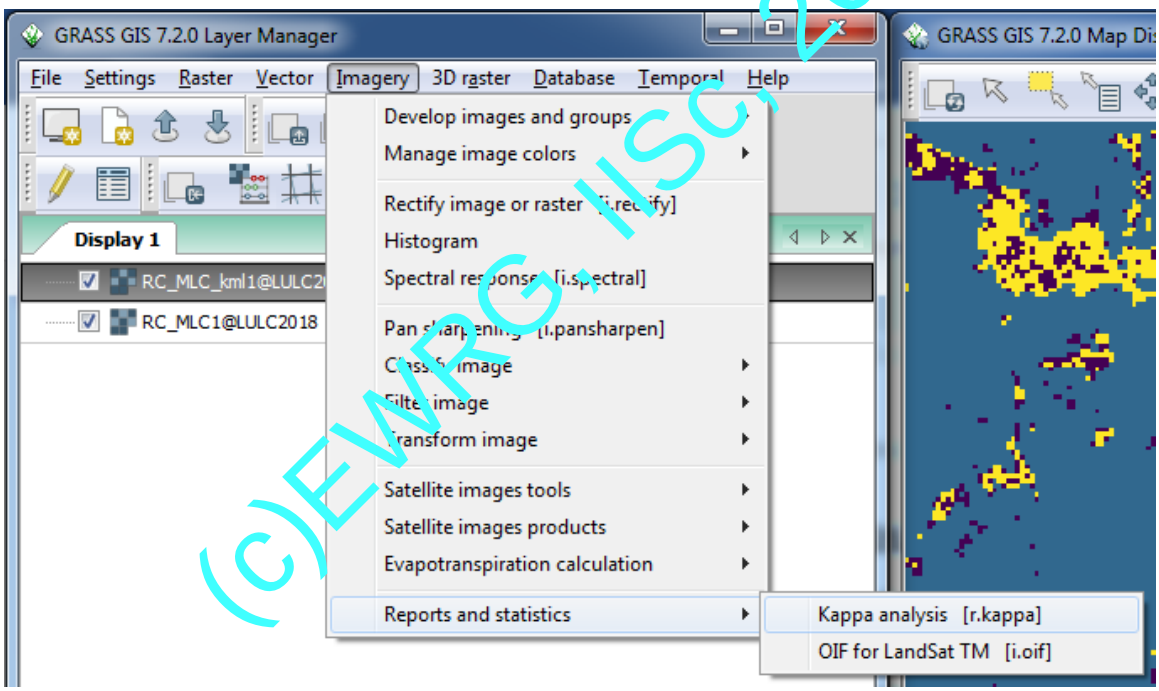


Training Data sites are overlaid on FCC and checked for errors, Edit erroneous data (training sites overlap of Multiple classes example Training sites of Vegetation may be overlaid on both Vegetation and Barren land on FCC; similarly, water training data on vegetation or other landscaps on FCC). Once Editing is completed, use these vector files to generate Signatures and Classify the satellite data into various land use classes.

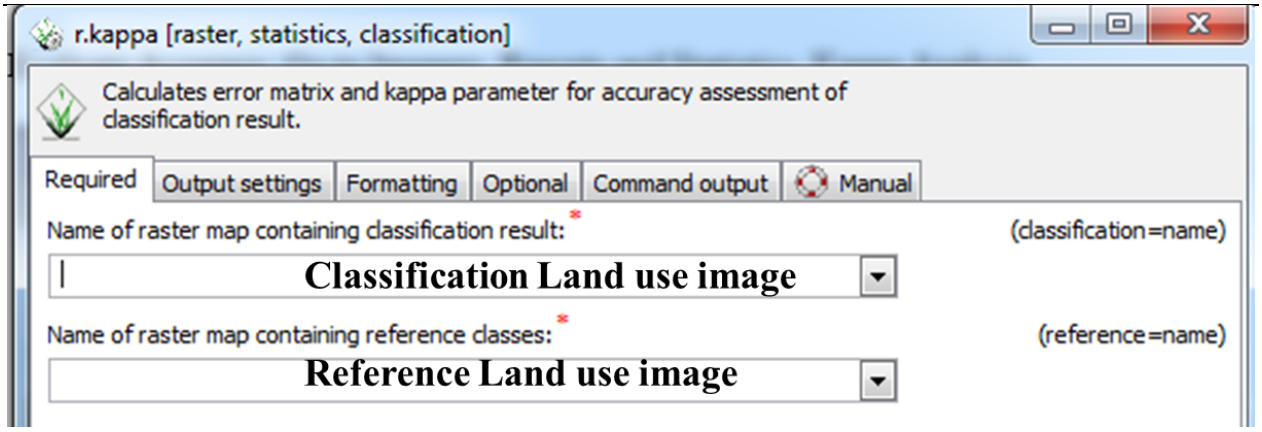
STEP 16) ACCURACY ASSESSMENT

To check the accuracy of a classified output, reference data is necessary. Since we have carried out Land use classification, we will assume that Land use classification done through Google earth as reference data.

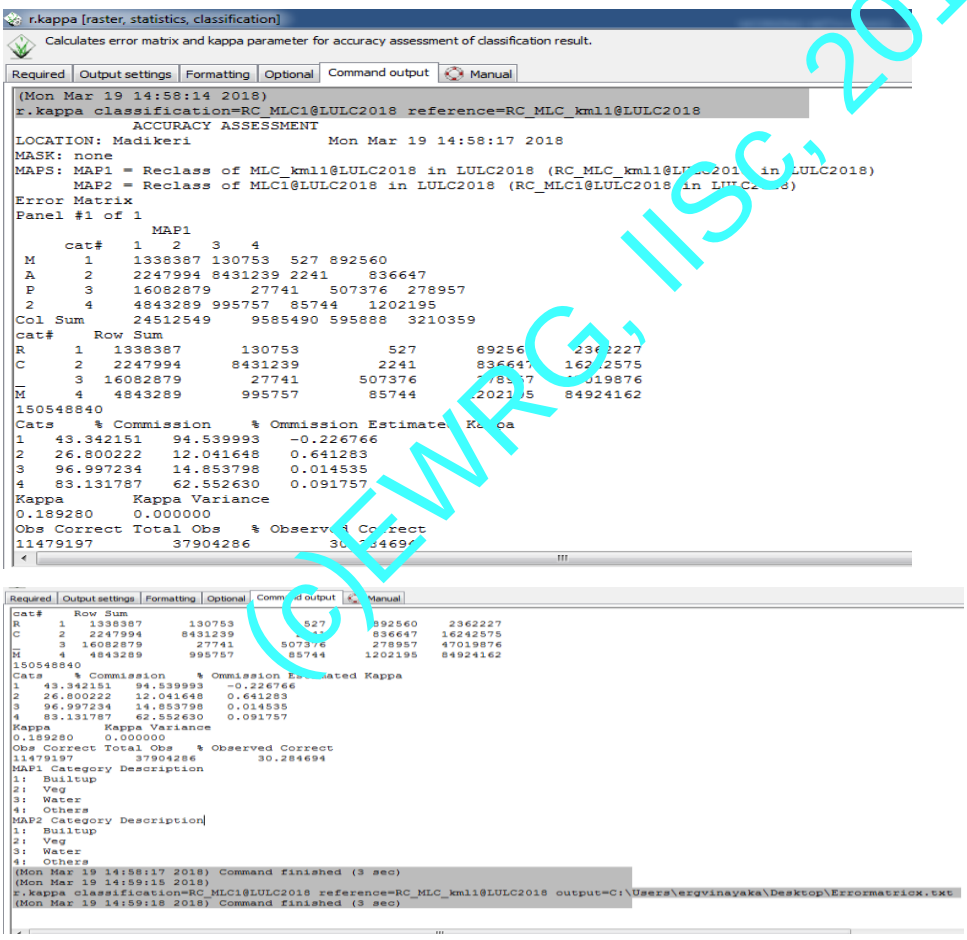
To Evaluate Accuracy, Go to Imagery, Reports and Statistics, Kappa Analysis



Provide Classified data information and reference data information,



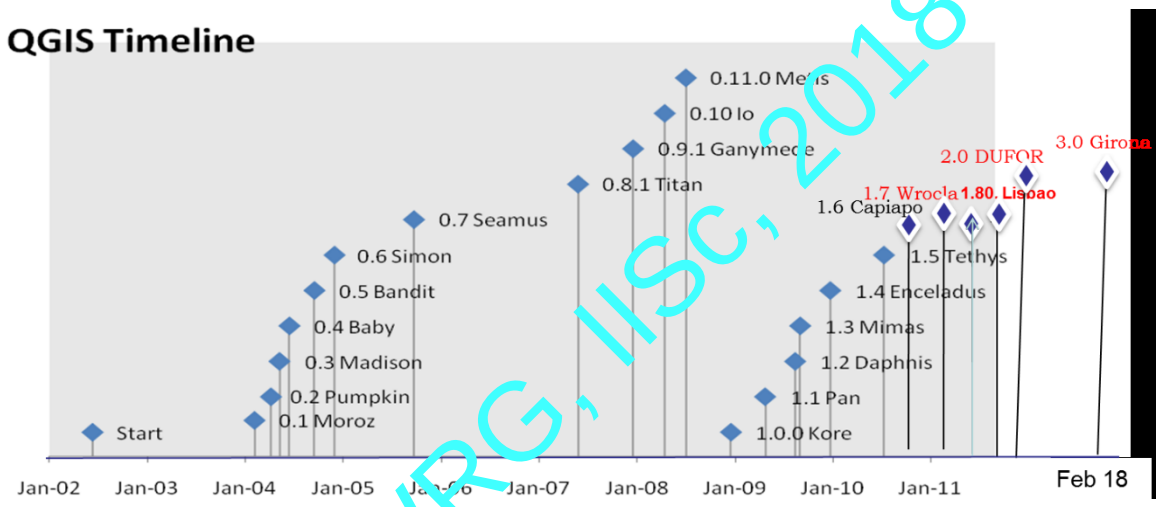
Click on Run, Check the Command Output tab for Accuracy information. Click on Save to save the output information.



Note: Signatures should be taken optimally to avoid inaccuracies; the signatures should be well distributed and cover at least 15% of entire area. Taking pure signatures would help to achieve better precision.

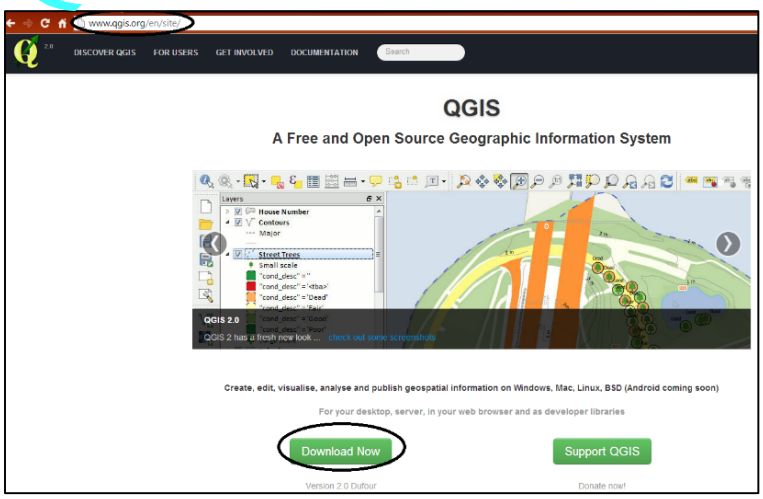
QUANTUM GIS (QGIS) – SPATIAL MAPPING TOOL

QGIS (http://qgis.org) is a Free and Open Source Geographic Information System for manipulating geographical data (vector, raster), statistical analysis. QGIS project was initiated on May of 2002 by Gary Sherman, established as a project on SourceForge. The first release was on July 19, 2002 and QGIS 3.0.0 'Girona' as the current version. QGIS is multiplatform GIS that runs on Windows, Unix, Linux platforms, macOS and Android. QGIS is a user-friendly GIS (https://www.qgis.org/en/site/forusers/download), providing common functions and features supports a number of raster and vector data formats. The plugin architecture provides access to new format support easily. QGIS is released under the GNU General Public License (GPL).



Installation:

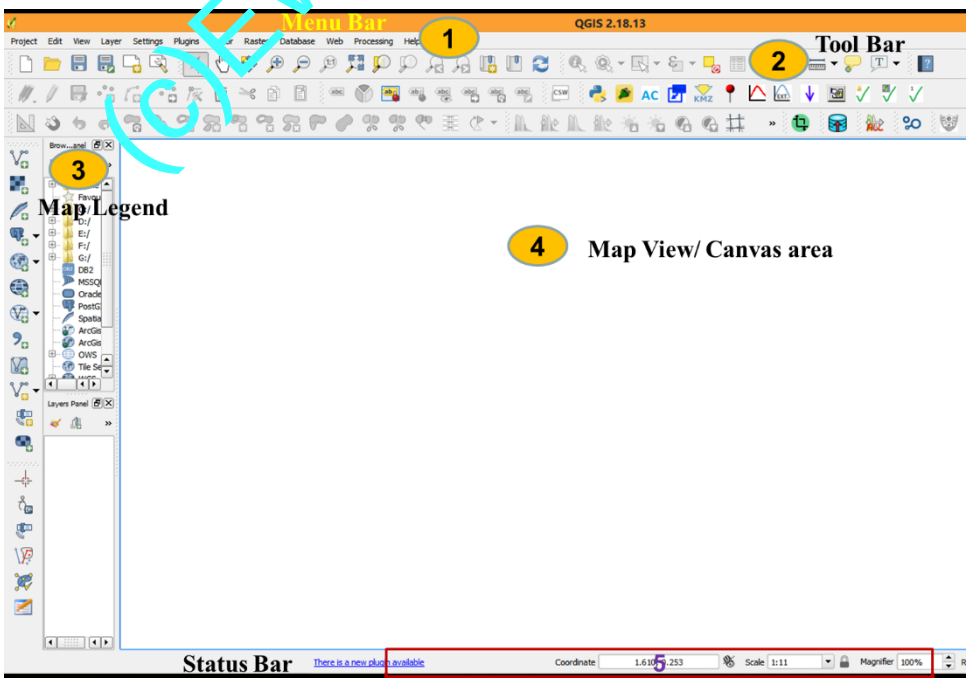
- Download from URL **https://www.qgis.org/en/site/index.html**
- QGIS main page will be opened as shown below.
- Download QGIS 2.18.17 LTR version



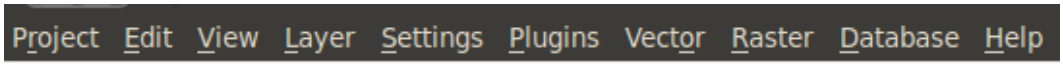
- Click on download now you will find the list of versions available.
- Download the latest stable (2.18.17 LTR) version.

- Then it will be downloaded. Locate exe file in your computer.
- Double click on QGIS-OSGeo4W-2.18.17-1-Setup-x86_64.exe or QGIS-OSGeo4W-2.18.17-1-Setup-x86.exe.
- You will get QGIS 2.18 folder on desktop with following options

  QGIS Desktop; QGIS browser; QGIS Desktop with Grass support; QGIS Browser with Grass; Qt designer et.
- Click on QGIS Desktop icon.
- **QGIS main** window will be opened and looks as shown



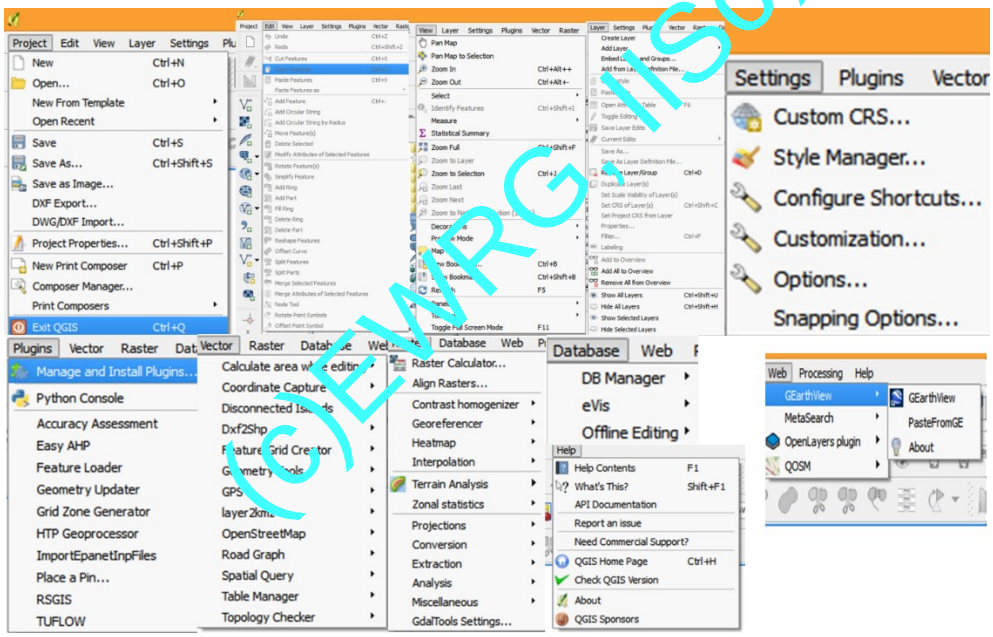
1. The menu bar provides access to numerous QGIS features (Project option to Help)\



2. The toolbars offer additional tools for interacting with the map. The toolbar provides access to most of the same functions as the menus, plus additional tools for interacting with the map. Hold your mouse over the item and a short description of the tool's purpose will be displayed. Every toolbar can be moved around according to your needs.
3. The map legend area sets the visibility
4. QGIS - maps are displayed in map canvas area
5. The map overview panel provides a full extent view of layers added
6. The status bar shows the current position in map coordinates

Each session can be saved as a "Project". The Print Composer helps in styling output images and saving thematic maps with layout and legends.

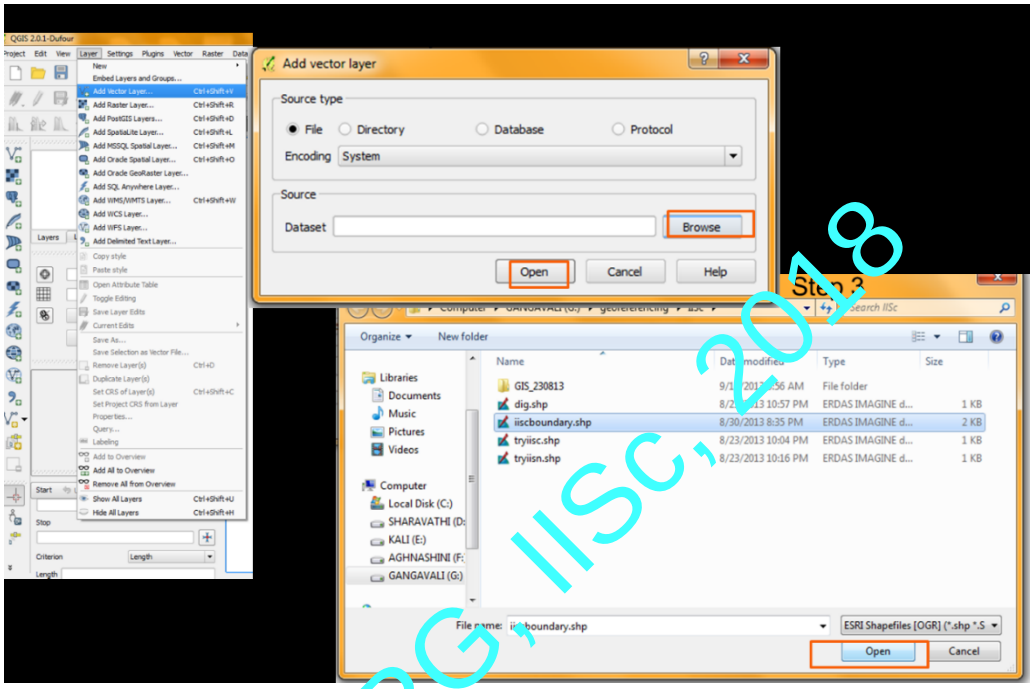
The following shows the different options available under each menu.



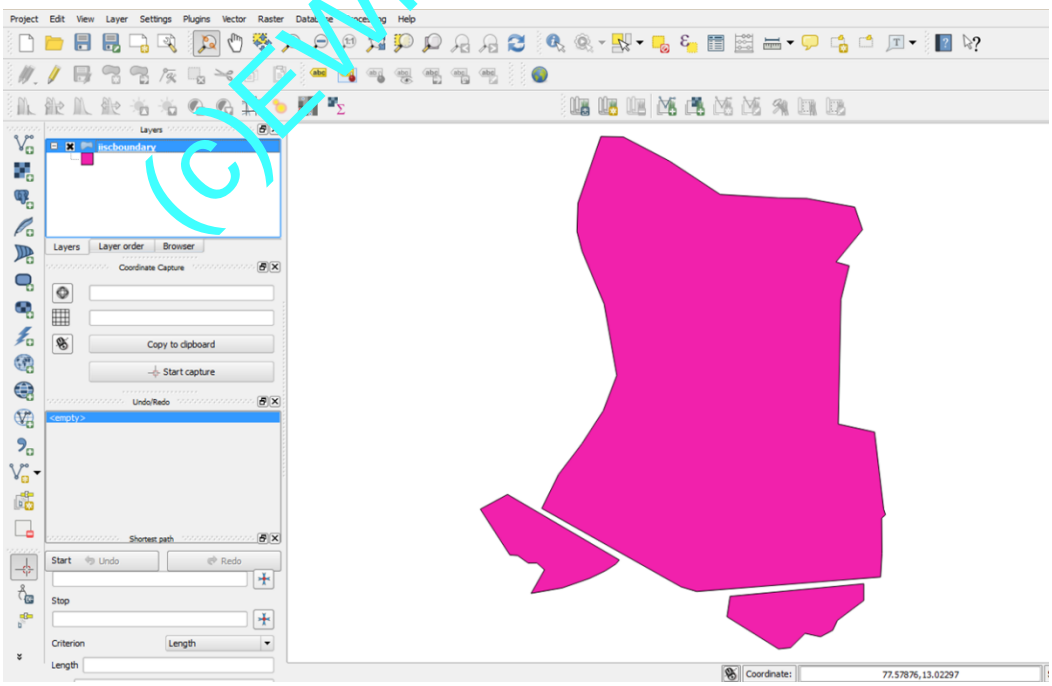
Working with Vector data

Vector files can be point, line, polygon forms store a description about any feature. QGIS support numerous vector data formats (Shape File, KML, Tab, MIF etc.). The most commonly used format is ESRI Shape File. To input vector data, click on Layer, then Add vector layer. Locate the vector file stored in your system, select "Filename.shp", then vector feature will be loaded. You can change projection by right click properties or save as option to save a new file

with you own projection. The global default CRS is EPSG:4326 - WGS 84 (proj=longlat +ellps=WGS84 +datum=WGS84 +no_defs). Options for global and project-wide CRS (Coordinate Reference System) for layers allows to define custom coordinate reference systems and supports on-the-fly (OTF) projection of vector and raster layers - Can display layers (with different CRS) and options for overlay. QGIS supports >2,700 known CRS. Definitions for each of these CRS are stored in a SQLite database that is installed with QGIS.

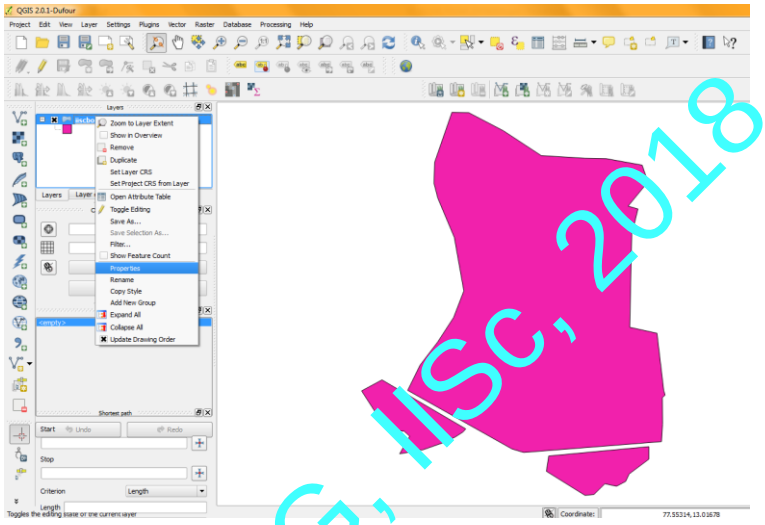


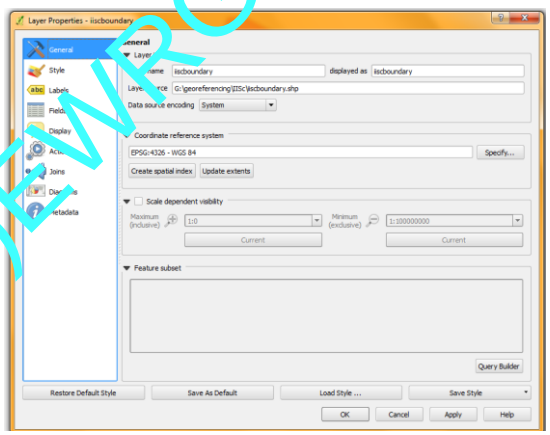
The selected vector file will be displayed as,

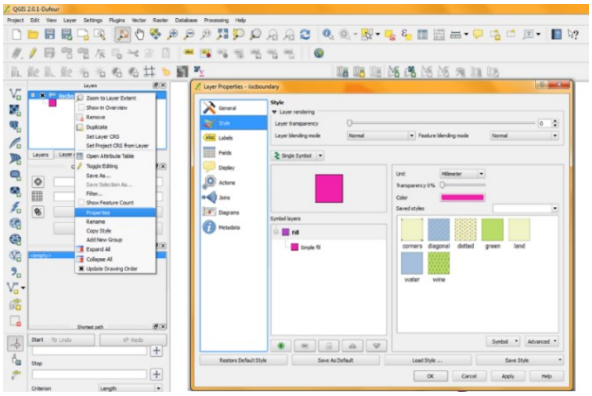


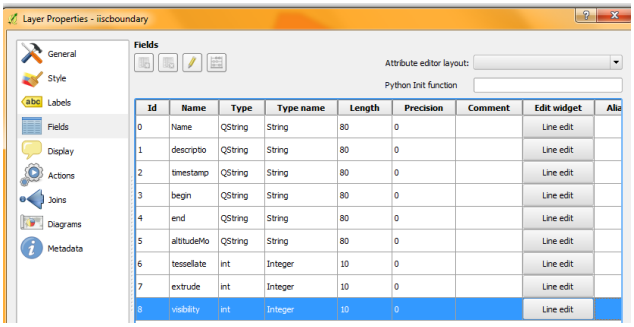
To improve performance then Right click on layer name select properties you will get options as, General, Styles, Labels, Attributes, Metadata, Actions, Joins, Diagram overlay.

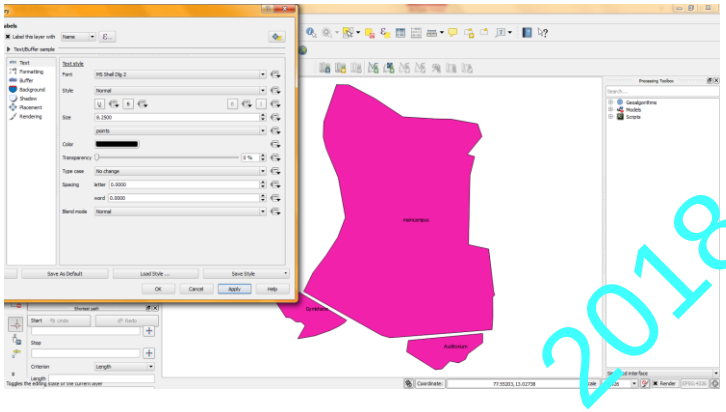
- General will provide layer details such as where it is stored(path), projection etc.
- Labels help to label features (Description) of vector file.
- Styles allow you to change colours, patterns etc.
- Attributes will provide type such as Text, Integer, Real etc.
- Metadata description about layer and history.
- Joins allows you to link with another layer or text data.







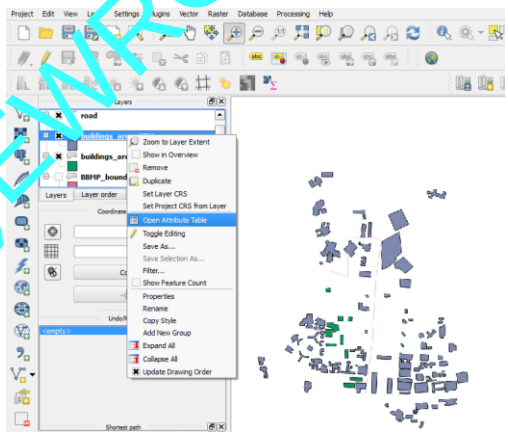




Database ingest-querying:

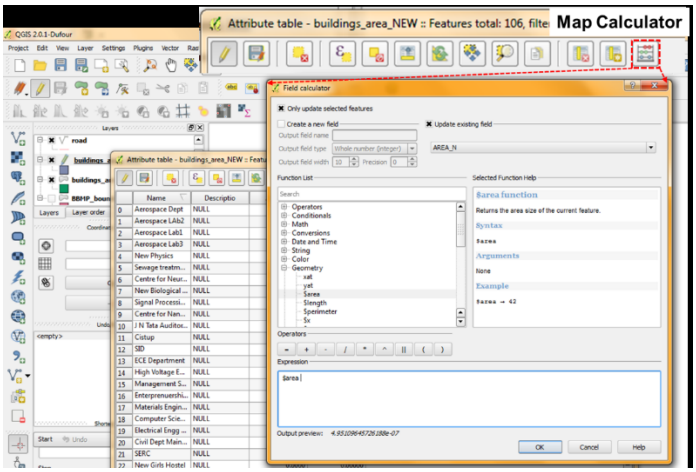
Data ingestion is the process of obtaining, importing and processing data. Process involves altering individual files by editing their content and fit into a larger document. Load vector file (Ex: IISc buildings shape file to see the Querying feature in QGIS).

Right click on Layer name and click Open Attribute Table

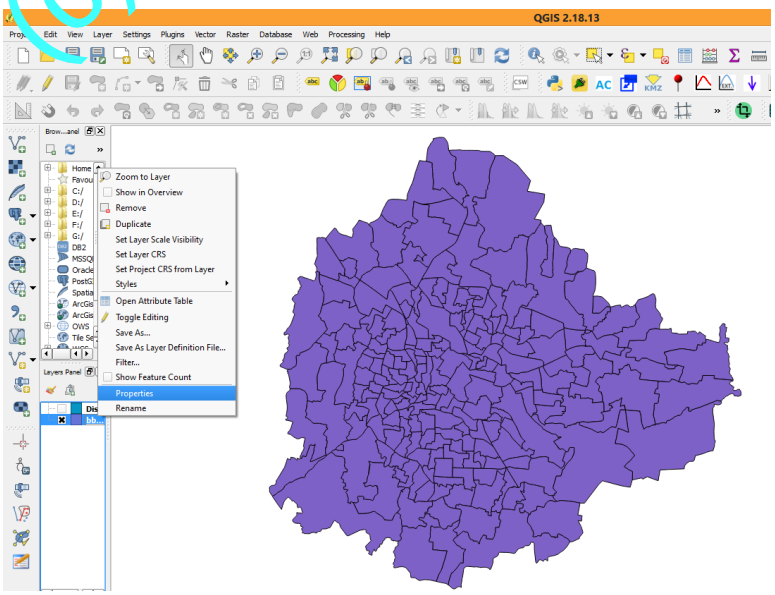


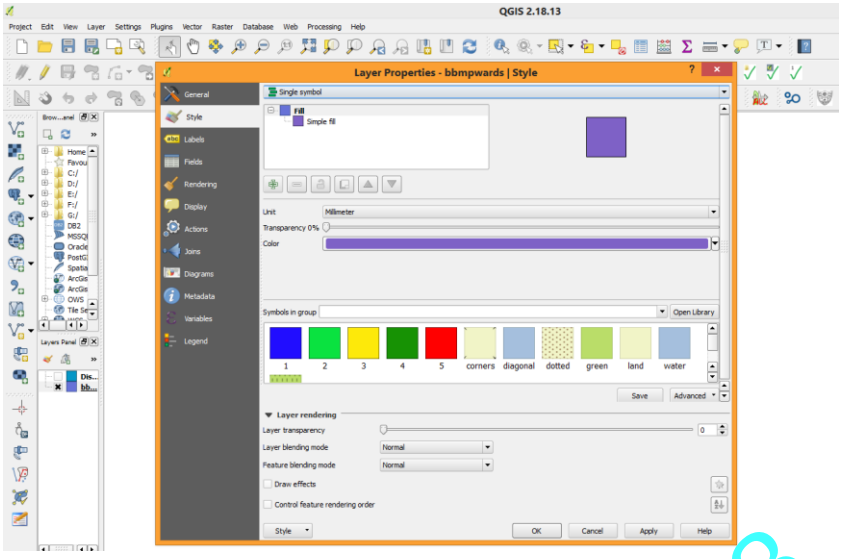
Attribute Table will be displayed with features already stored in the database. To compute area of buildings, click on Start editing (Pencil type icon) and click on Mapcalculator.

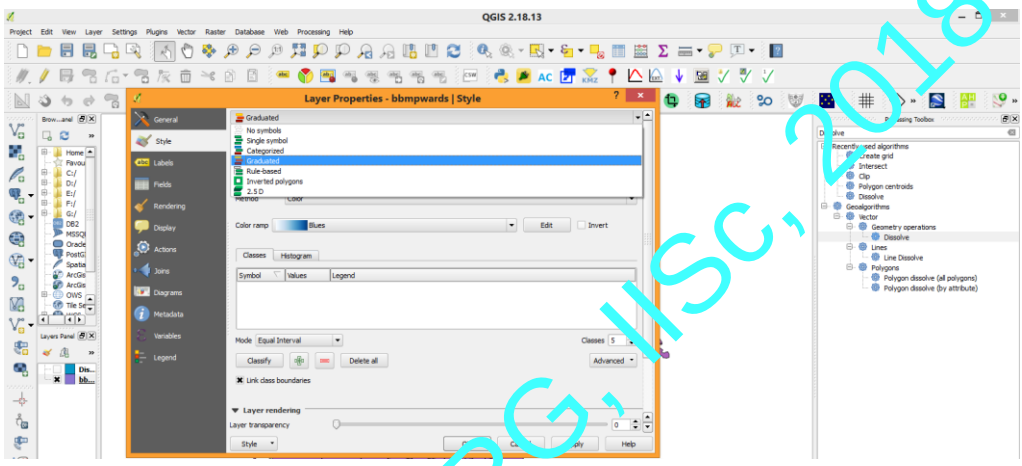
Add filed data type to be created to store data. Since Area is real value provide data type as Real with 2 precision width. Locate $Area under predefined Geometry functions. Click on it and press OK then Area will be computed stored in the Area column.

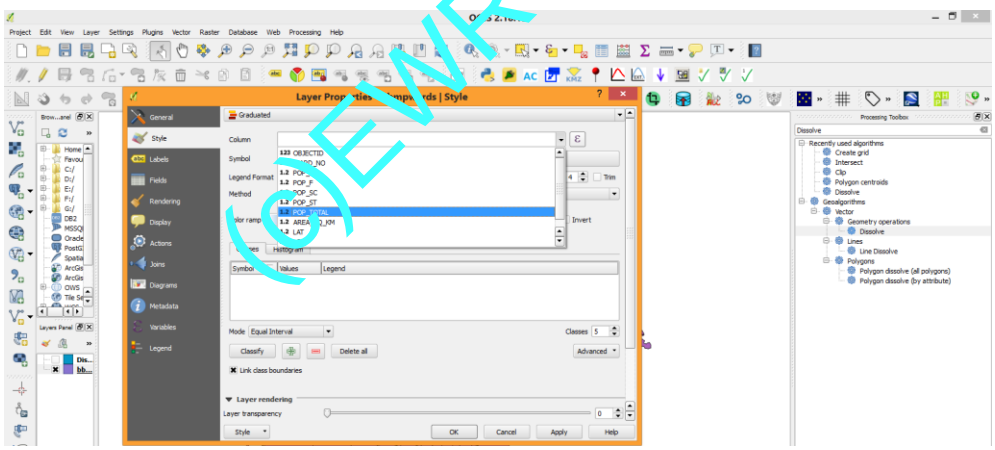


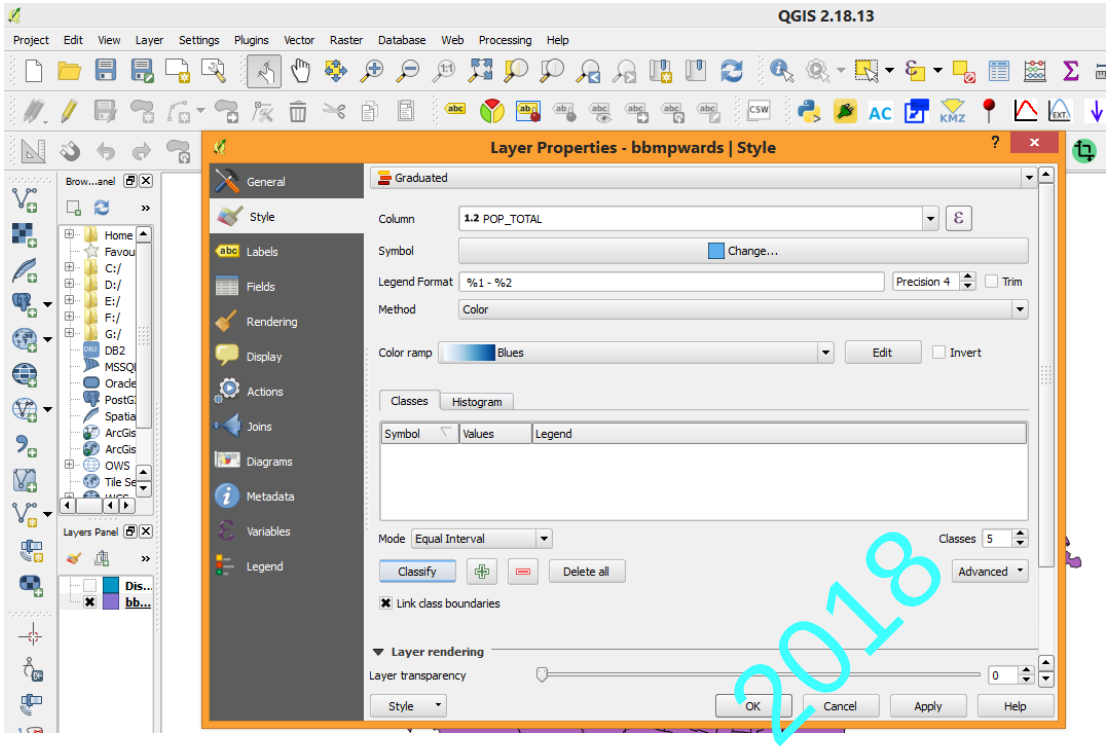
Creating Thematic Maps: Right click on BBMP Wards Vector file and see the attribute table byclicking Open Attribute Table. The layer has details such as Ward Name, Ward No, Population Male, Poulation Female, SC and ST population, Total Population etc. If we want to represent the Wards having population greater than 15000 and other categories in different colors, we use thematic map representation. Close Attribute Table. Right Click on Vector file name, click on Properties. Then Properties menu will show various options, click on Styling tool bar then by default Single Symbology will be shown click on that tab it will show the various options such as Single Symbology, Categorized, Graduated etc. Select on Graduated option. Then specify the column name to be used for Thematic map creation. Select Total Population column then click on Classify by default it will show 5 categories. If you want to reduce or increase you can specify. If you want your own ranges to be displayed click on the row1 and specify maximum break for each row. You can click on color symbol to change required color. You can also edit legend entry text to be shown as you wish. After all changes press Apply and click OK. Then the final output will be shown in Map Display.

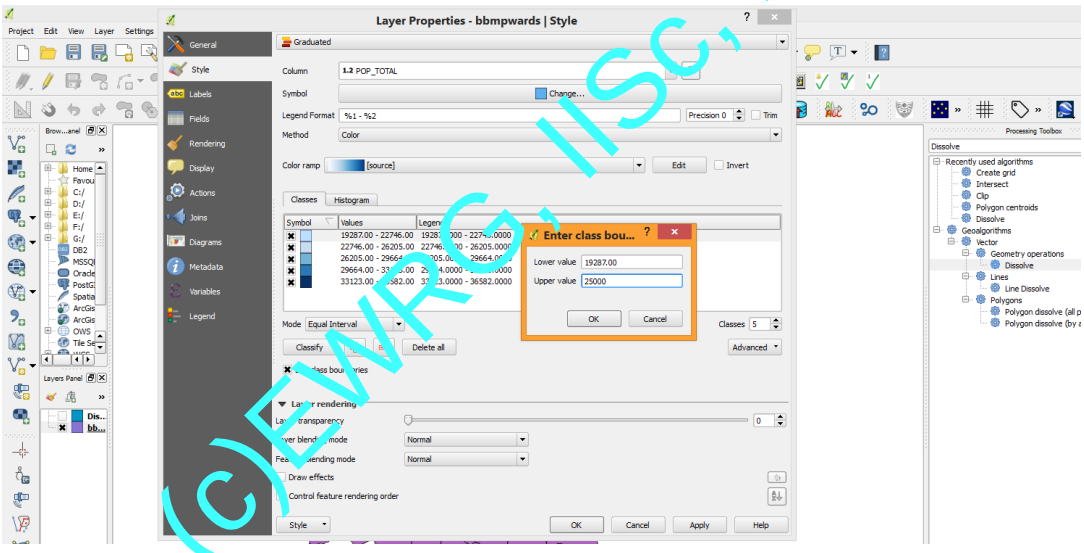


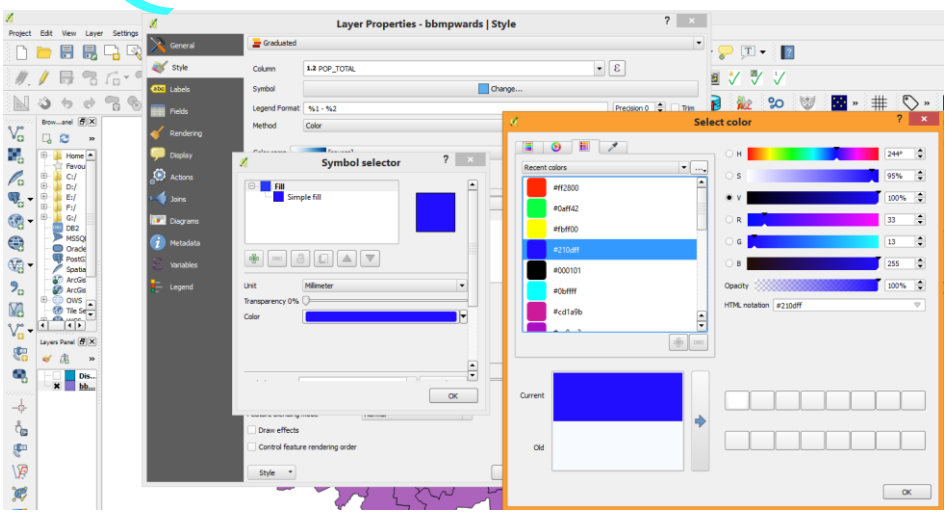


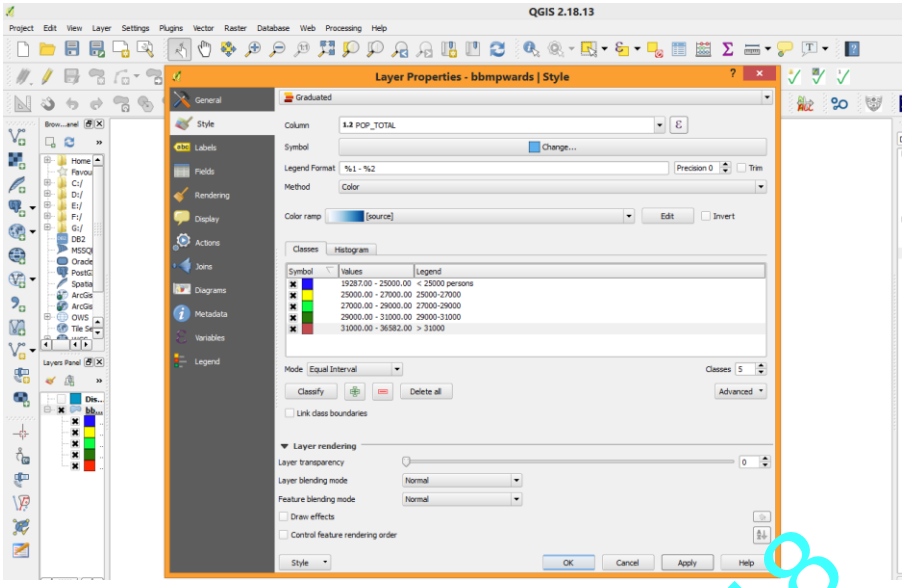


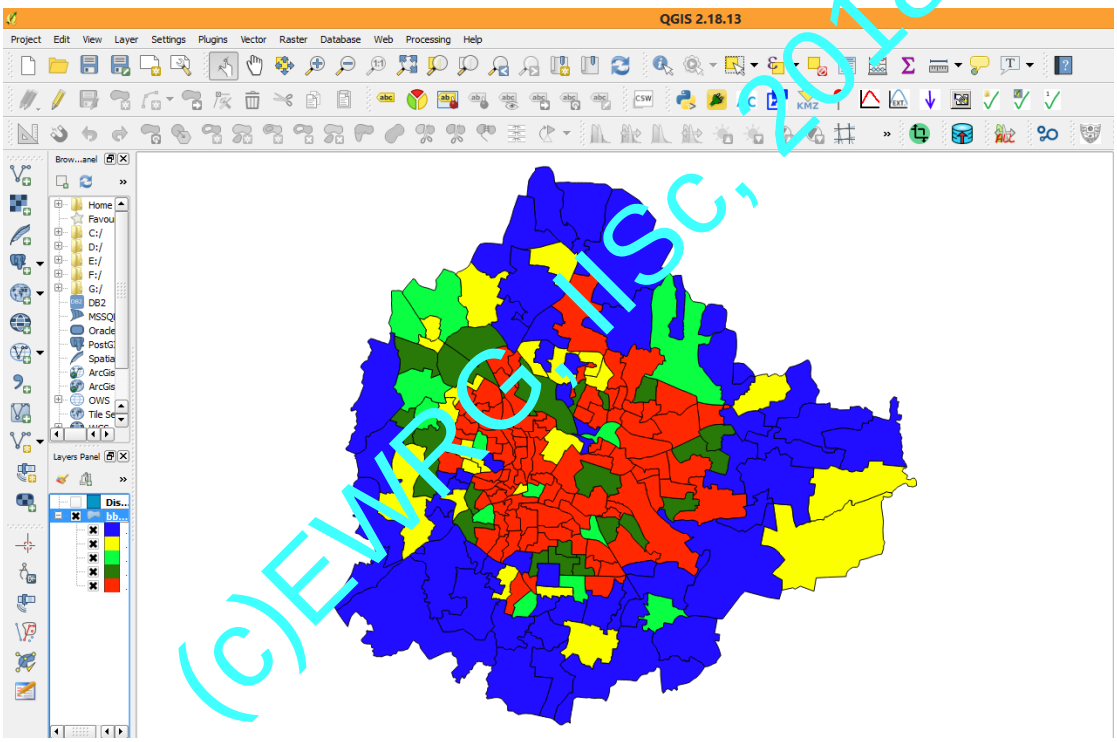










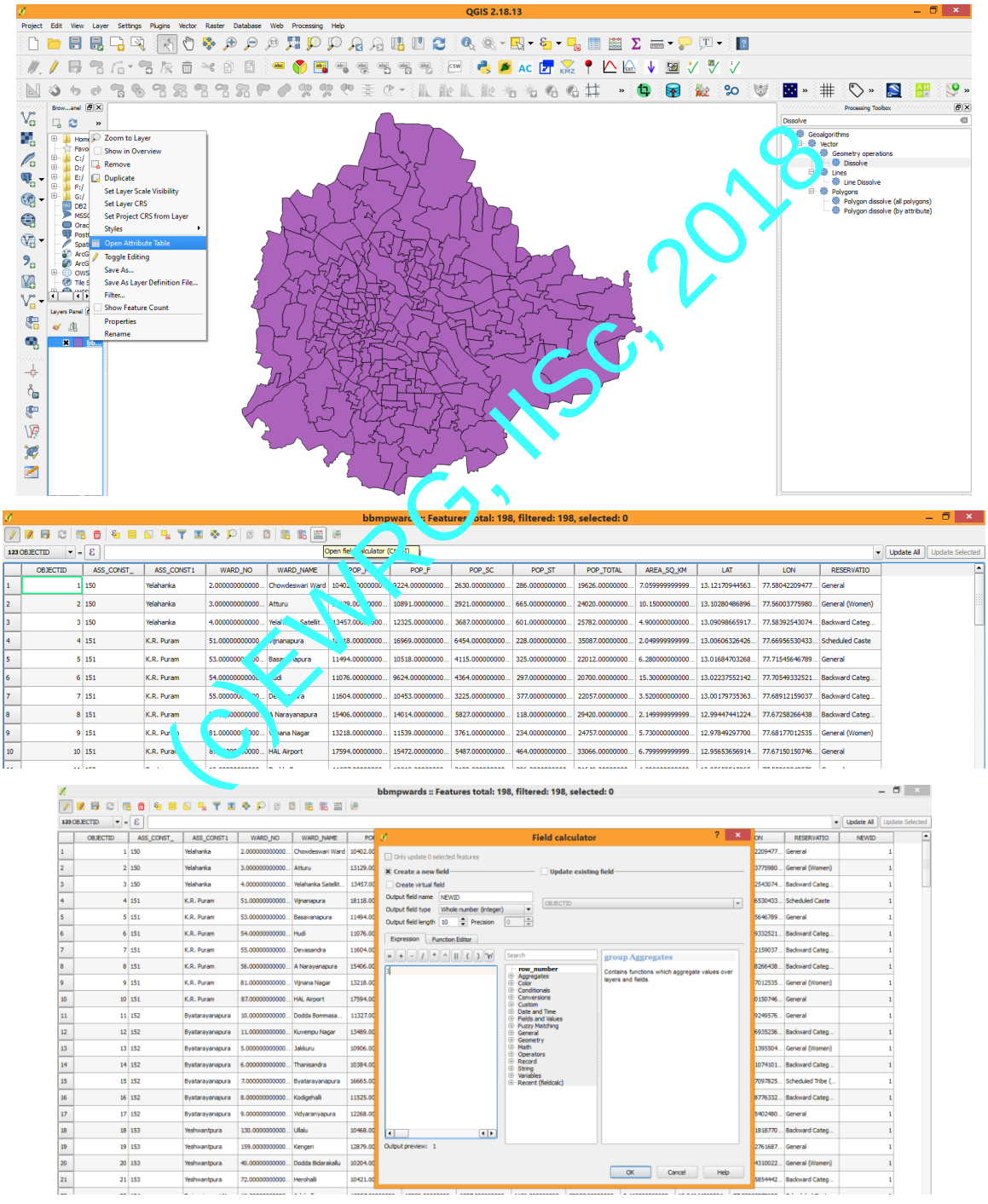


Use print composer option under Project section to save as JPG/PNG output file formats with Legend and Scale bar details.

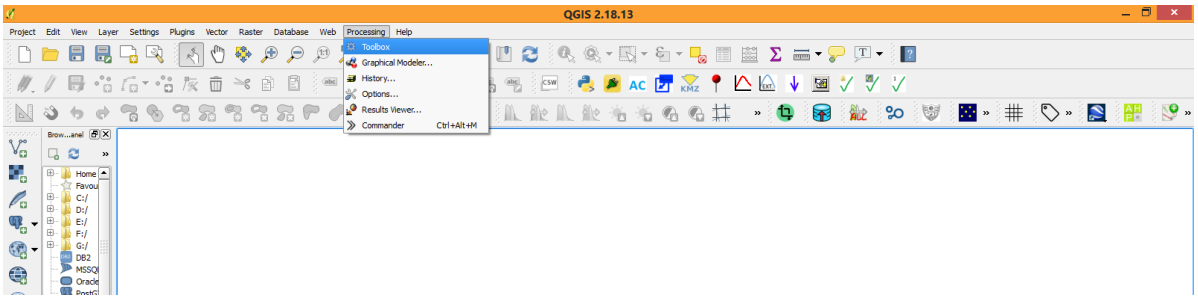
Print composer has

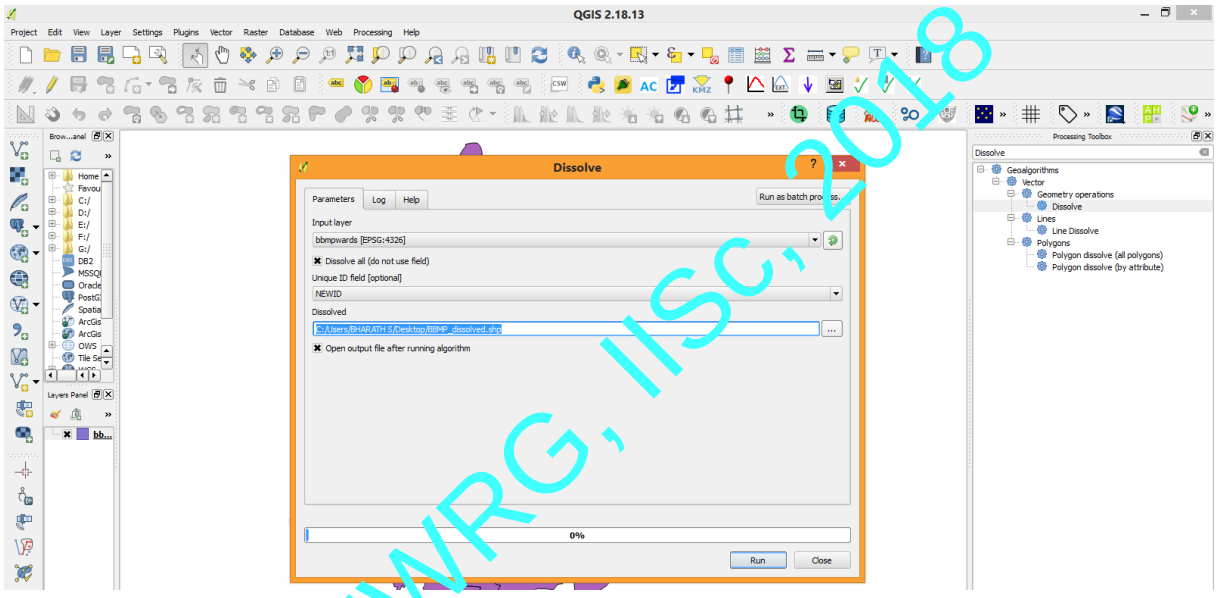
- Apply map, legend, north arrow and text
- Using external programms (inkscape) for finetuning.
- Lots of paper formats supported; Separate DPI settings
- Logo inclusion, legend, labels, northarrow
- PNG/SVG/PDF support; Adjustable drawing scale

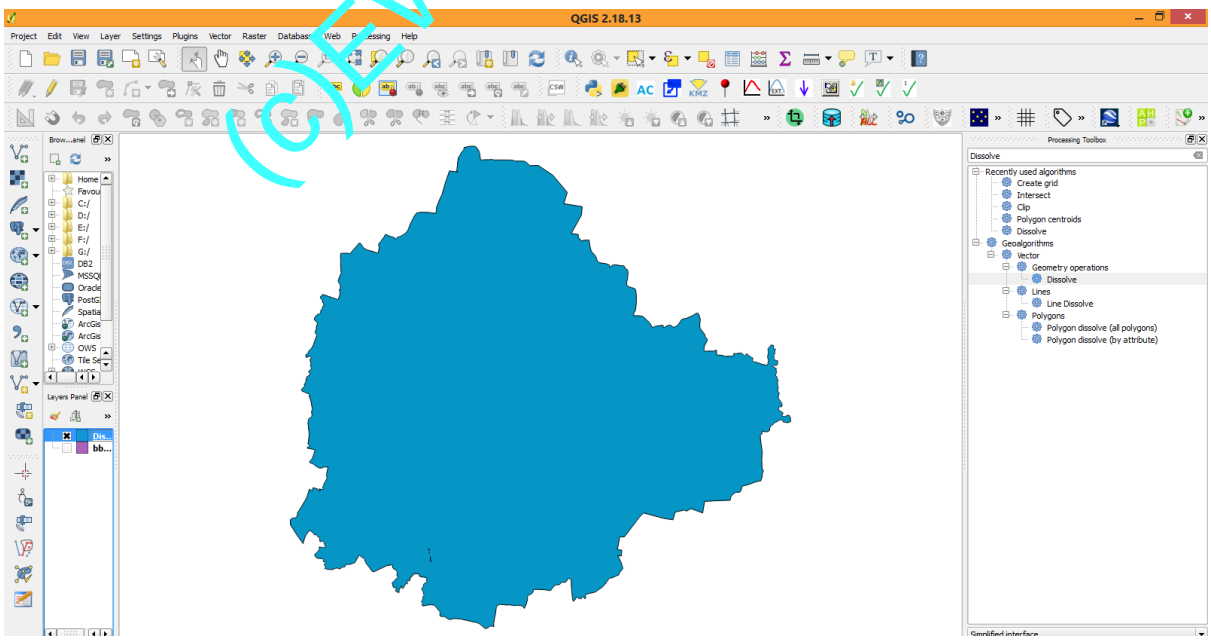
Dissolve: Dissolve tool is used to create a single vector boundary from a multiple vector files. For ex. we have provided BBMP ward boundaries file, to have a single BBMP boundary (Outer) then we will use Dissolve tool. For specifying a common field Right click on Layer name, Open Attribute Table. Click Toggle Editing then click on MapCalculator. Create a new field name as NewId, datatype as Integer. Just Type 1 in command operation section. Then a new field such as NewId has been created with all columns having Id as 1. Now stop Toggle Editing then save edits.



Click on Processing load tool box type "Dissolve", then Dissolve tool will be shown under Vector Geometry operations section. Click on Dissolve tool then Dissolve tool GUI will be opened. It asks to load vector file input then indicate the filed to be dissolved. Click RUN to dissolve operation, then output will be shown.

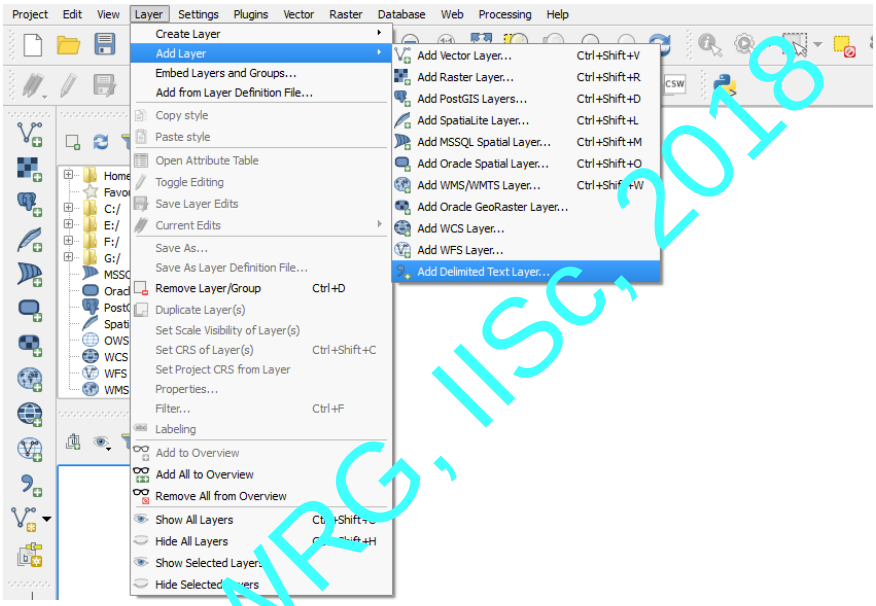


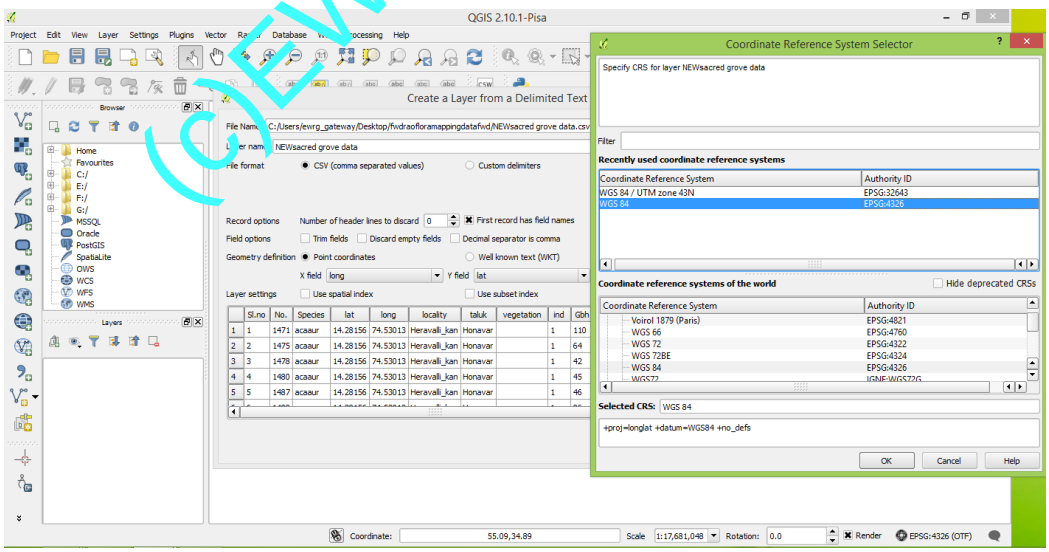




Interpolation: Interpolation is used to create continuous surface from discrete points. It is a process of using points with known values to estimate values at other unknown points. A lot of real world phenomena are continuous - elevations, soils, temperatures, rainfall etc. If we wanted to model these, it is impossible to take measurements throughout the surface. Hence, the field measurements are taken at various points along the surface and the intermediate values are inferred by a process called 'interpolation'. In QGIS, interpolation is achieved using the built-in Interpolation plugin. First import vector file or CSV file to be interpolated. If you are importing CSV then save it as Vector file.

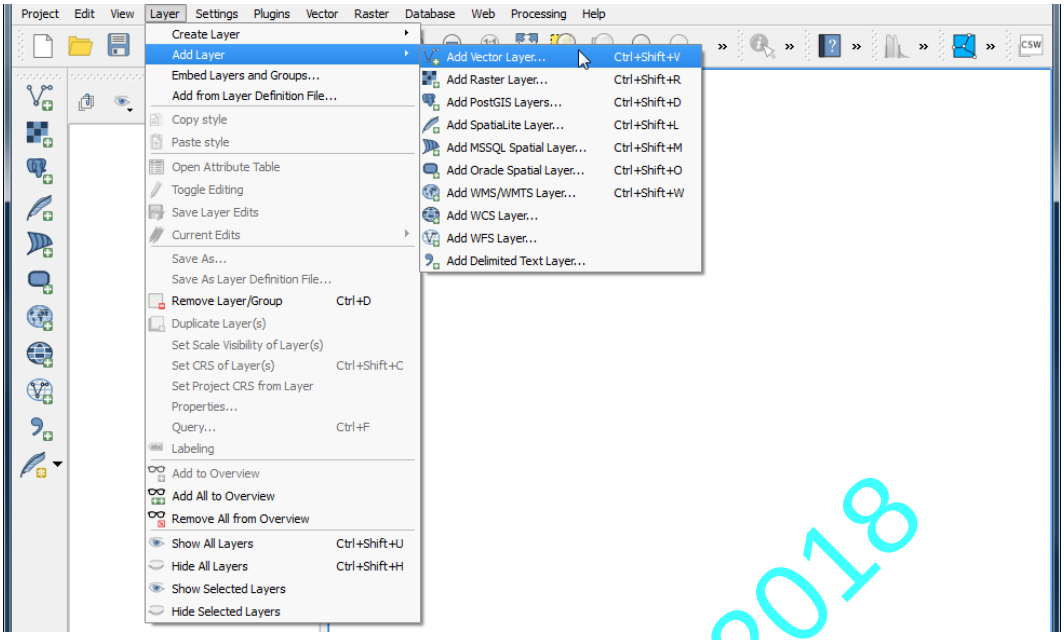
Importing CSV file



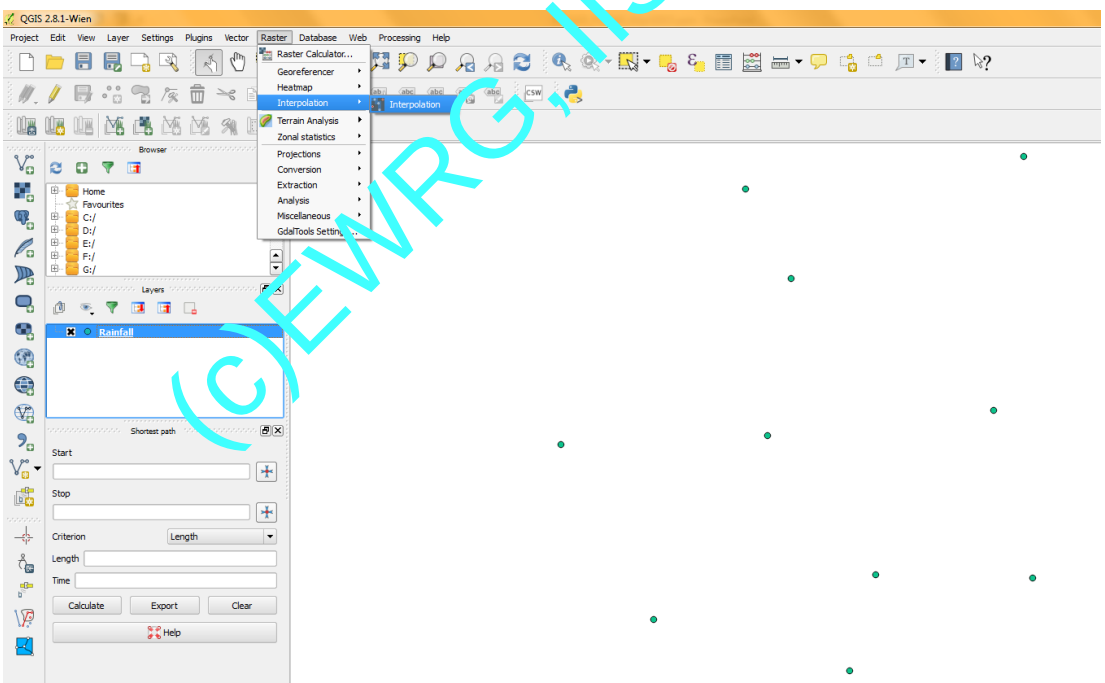


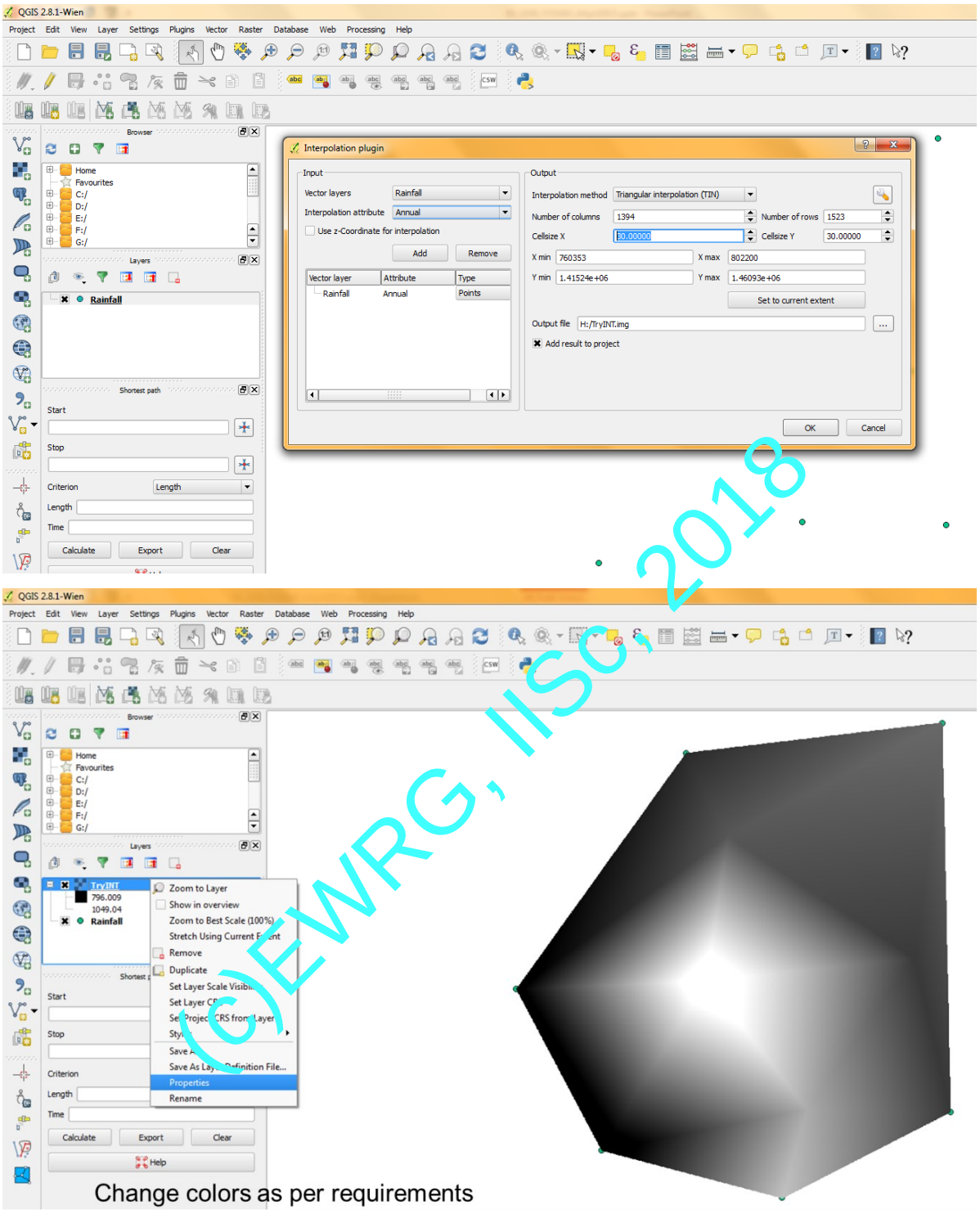
Then save as ESRI Shape file with "UTM Projection" by right click on layer name SaveAs Option.

Importing Vector file



Click Raster option in Menu bar then click Interpolation and Interpolation. Provide Vector file name and column to be considered, raster cell size (30 m) and output file name.

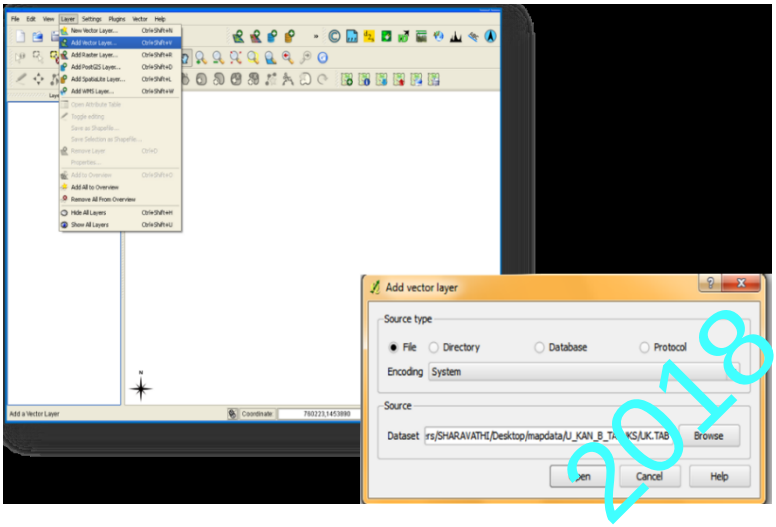




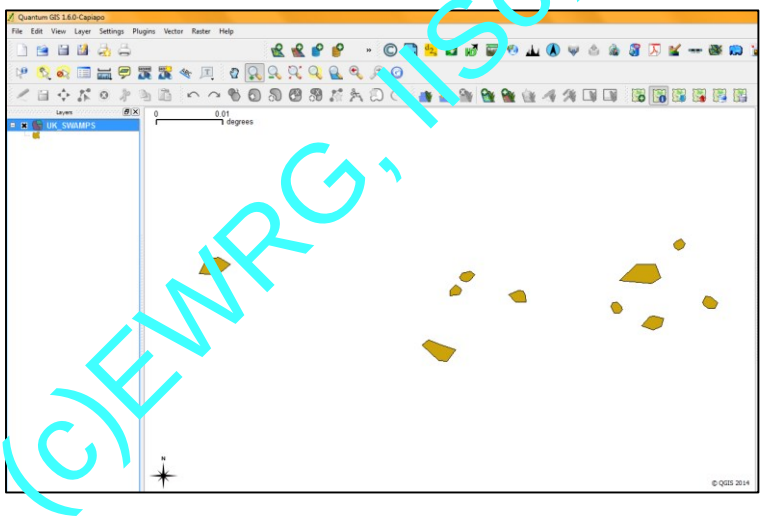
Run Zonal Statistic option available under Raster toolbar to compute ward wise Mean Rainfall.

Importing Google earth data:

- To load a vector file, click on **Layer menu** in menu bar select Add Vector Layer, a dialogue box will be displayed, which allows to traverse through the file system and load a kml file which you have created using Google earth or other formats of vector data.



- The layer will be displayed in the map canvas area.

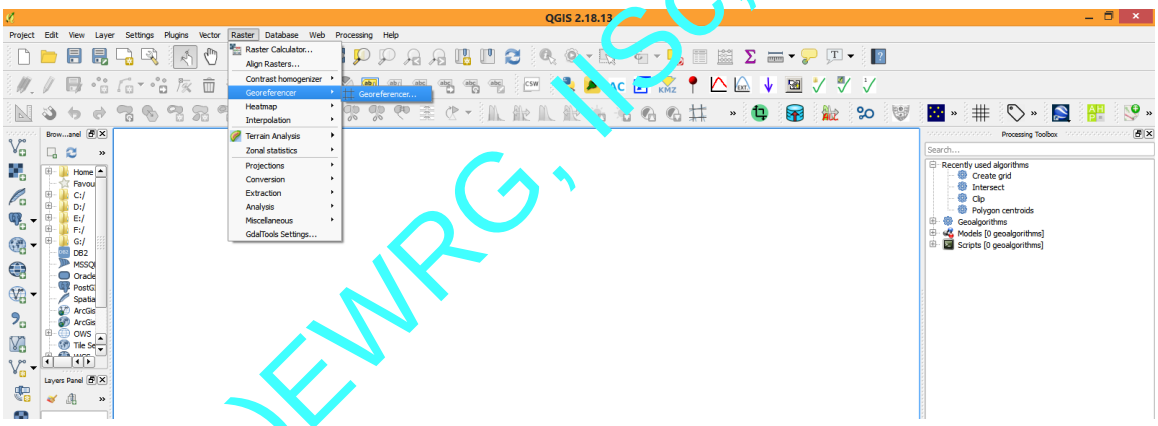


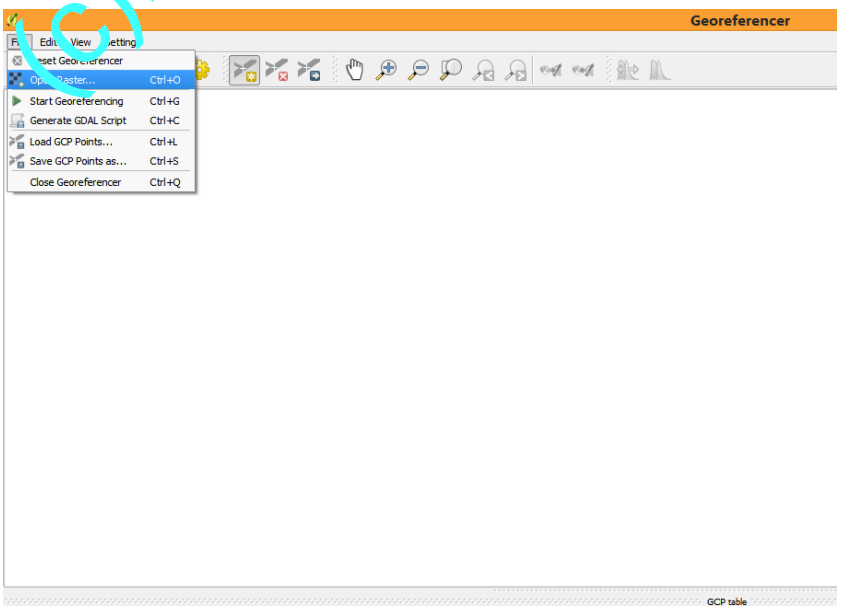
- Right click on the layer and select properties to check the attributes, colors etc.
- QGIS supports a number of Symbology renderers to control how vector features are displayed
- Labels tab allows to enable labelling features and control a number of options related to fonts, placement, style, alignment and buffering.
- Right click on the layer click save as option to create a ***shape file*** and specify co-ordinate reference system to be saved (CRS), then specify output file name.
- Import the shape file and continue to work with it. So you can edit the features and compute the area etc.

Working with Raster data:

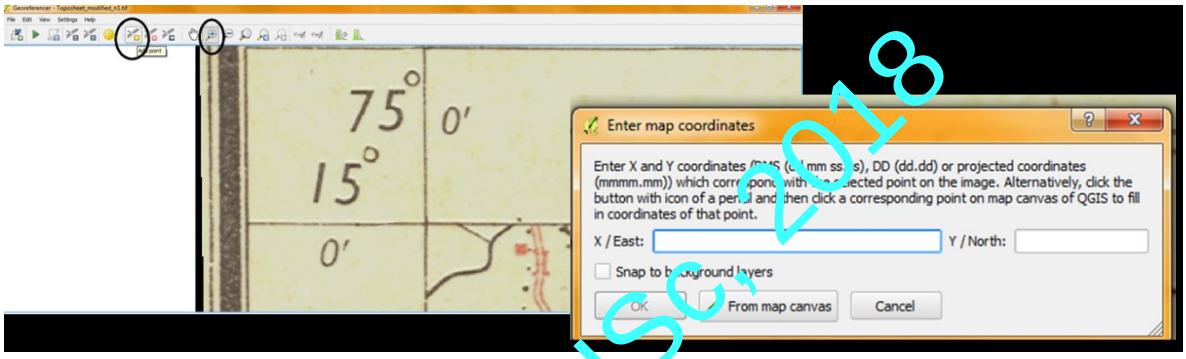
Geo referencing

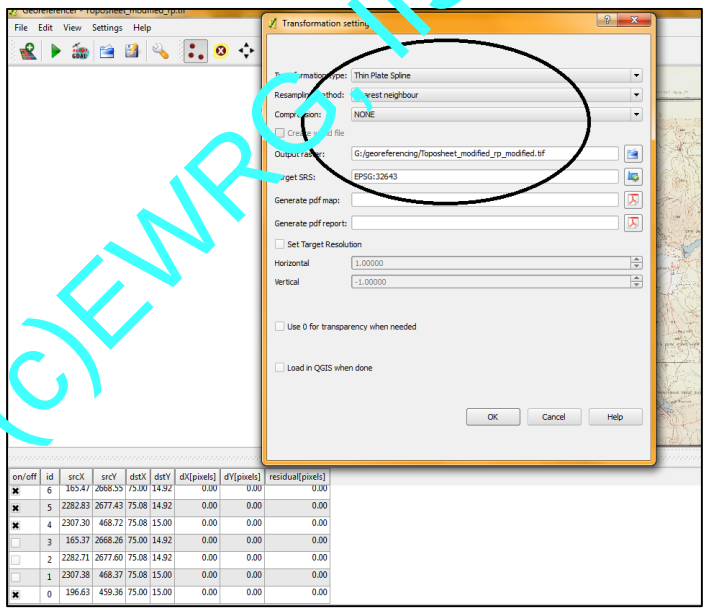
- Geo-referencing is the process of assigning real earth coordinates to the digitised maps, so it can be viewed, queried, and analysed with other geographic data.
- To start geo referencing an unreferenced raster, we must load it by clicking Georeferencer option in the **Raster** menu bar and click on **Georeferencer**.
- The Georeferencer window will be opened click on **File** menu and click Add raster layer. The raster will show up in the main working area of the dialog. Once the raster layer is loaded, we can start to enter reference points.
- Using the Add Point button (Edit→ Add points), you can add points to the main working area and enter their coordinates. Click on a point in the raster image which you want to assign co-ordinates and enter the X and Y coordinates manually. With the move button option, you can move the GCPs (Ground control points) on map, if they are at the wrong place. X should be longitude and Y should be latitude.

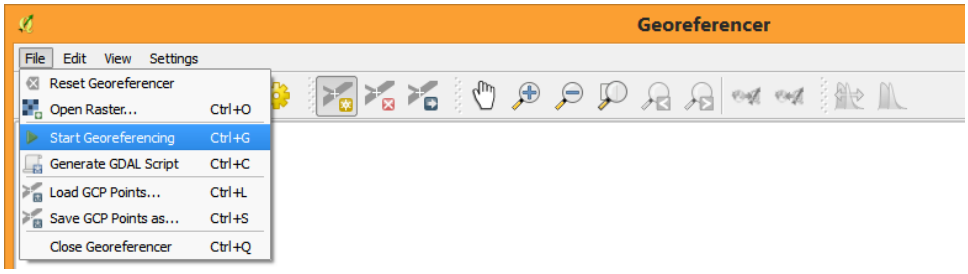




- Continue entering points. You should have at least 4 points and the more coordinates you can provide, the better the result will be. There are additional tools on the plugin dialog to zoom and pan the working area in order to locate a relevant set of GCP points.
- After entering GCP's click on Settings option in Georeferencing menu bar select Transformation Settings option. A drop box will be displayed and select options as shown in the below image. Specify output file name and transformation parameters and projection system then click OK.
- Click on File menu and Select Start Georeferncing option. The Georefrencing will be started.



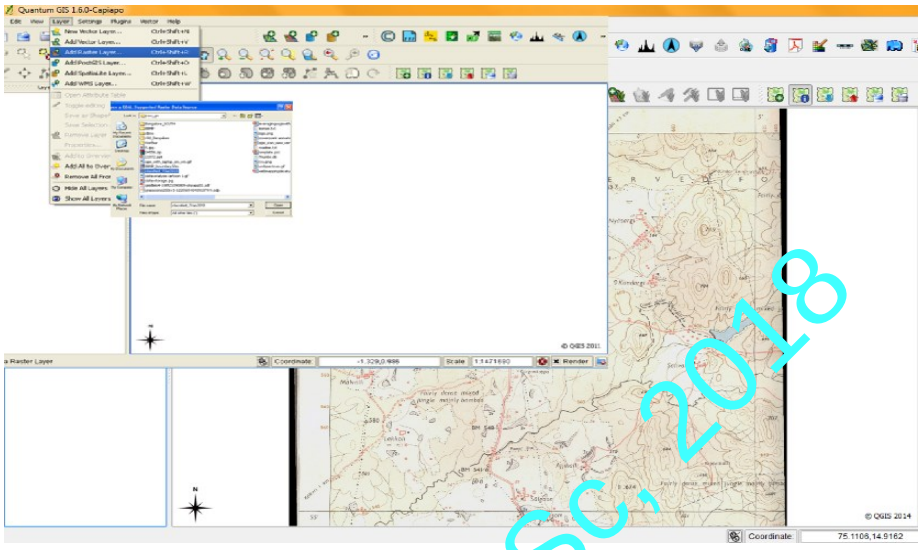




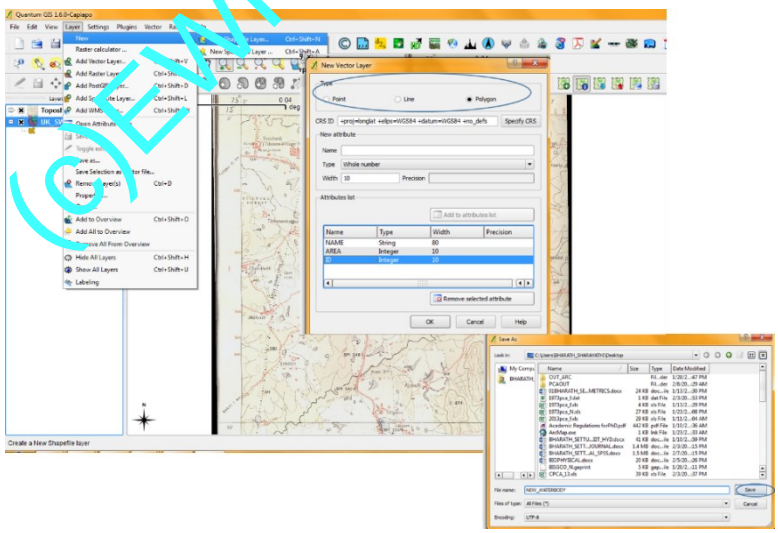
Digitising features (vector data) from Raster data:

Digitising features (water bodies) from Topo map:

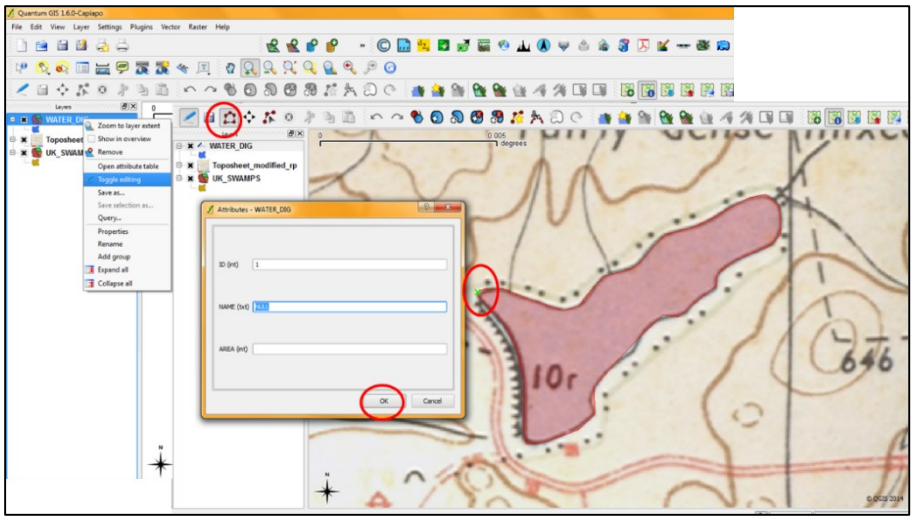
- Open the raster file you have geo referenced by clicking Layer→ Add raster layer option.
- The raster layer window will be open and load the saved layer. It will be displayed on Map canvas.



- To digitise the water bodies select Layer menu and click New→create new shape file layer option. Then new shape file layer drop box will open with options.
- Select polygon option and provide the attributes for it and save the file with a name. The saved new shape file will be loaded for creation of features.



- **Attributes** are entered as features to be created.
- Zoom to the feature you want to digitize by using zoom options. Right click on the vector layer you have created and select **Toggle editing** (pencil like symbol) option. Then tool bar will be highlighted. Click on **capture polygon icon** and start digitizing the water body.



- Enter the attributes and press ok. After digitisation click save layer option to save the modifications you made.
- To compute area of the polygon right click on the layer you digitised and click open attribute table and select field calculator select area option to compute area.
- The area will be shown in degrees. Convert it to Hectares by adding new column and provide the name for new column. Then select field calculator select the new column to be updated.
- Type the formula as AREA*110*110*10000 for getting in terms of Ha.

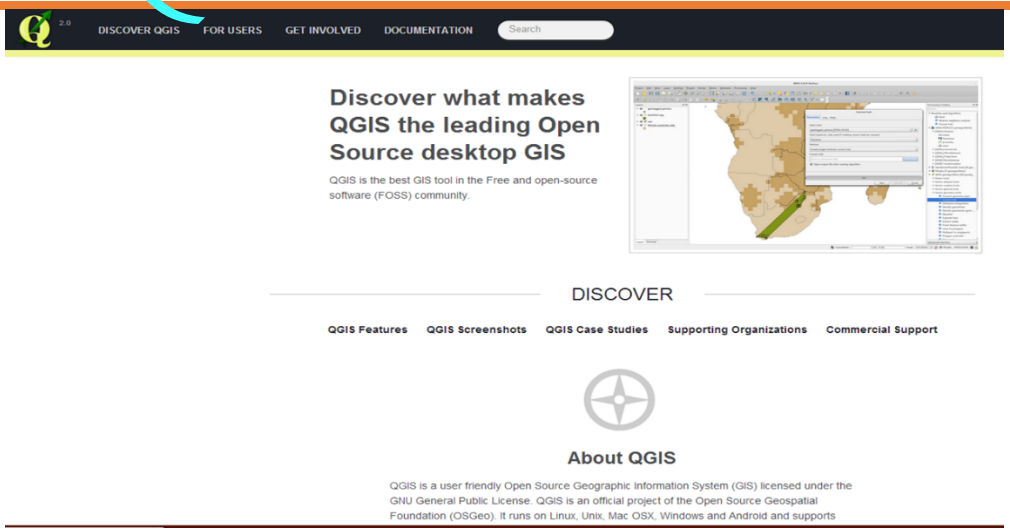
Help from QGIS:

QGIS has active community support, update and upgrades

http://wgbis.ces.iisc.ernet.in/biodiversity/

http://www.qgis.org/en/site/forusers/index.html#

http://www.qgis.org/en/docs/index.html



http://wgbis.ces.iisc.ernet.in/grass/

http://wgbis.ces.iisc.ernet.in/foss/

http://wgbis.ces.iisc.ernet.in/energy/water/paper/researchpaper2.html#f

http://wgbis.ces.iisc.ernet.in/biodiversity/pubs/ETR/index.htm

10.0 FEASIBLE SOLID WASTE MANAGEMENT

Solid Wastes in India pose a formidable challenge to urban managers today and it is roughly estimated that the country produces 30 million tonnes of urban solid waste annually (GOI, 1998). Share of urban population in country's total population is about 27 percent and per capita waste varies between 0.1 kg and 0.6 kg per day, with an average of 0.33 kg (Bhide, 1990). Prevailing management strategies are inefficient, because of its complexity, cost and lack of technology, and then ignore solid waste management's socio-economic and ecological characteristics. Improper management of these wastes leads to public health hazards, unaesthetic appearance, pollution of soil and water sources such as lakes, groundwater sources, etc. Most parts of India are inefficient in handling wastes in terms of lack of stakeholder participation and inadequate organizational framework. In order to improve the present practice and to avoid environmental degradation, an effort is made in this study to arrive at optimal solid waste management strategy as applicable to developing countries using a prototype model, which represents a typical urban system. With the help of identification of problems and analysis of those problems, optimal management strategies include effective implementation of all essential aspects of urban solidwaste management. Spatial and temporal analyses tools such as Geographic Information System (GIS) and Remote sensing data are of immense help in this regard.

Indian Institute of Science (IISc) campus, Bangalore, India was chosen for developing a feasible solid waste management model. IISc campus represents a cosmopolitan urban set up and the model developed for the campus can be replicated in any urban area in developing countries. Quantification of various wastes from different sectors through field investigations covering collection mechanisms, primary constituents, rates of generation, etc. were carried out. Apart from this, litter generated in vegetated area has been quantified through landuse analysis using field and remote sensing data.

Land cover analyses reveal that about 45% of the total area is under tree vegetation. Stratified random sampling strategy is adopted in order to quantify the litter produced in the campus through regular monitoring of study plots of 1 sq.m spread all over campus. Based on detailed field observations, strategies for quantification to arrive at the precise quantity of waste generated (attribute information), and effective use of GIS (various layers of spatial information) and optimal management strategy of all kinds of wastes is proposed. The management options are proposed with the help of available guidelines from literature, which were synthesized and modified according to the prevailing conditions. The proposed management strategy could be implemented in urban pockets irrespective of geographical area and population.

1. INTRODUCTION AND BACKGROUND

From the days of primitive society, humans and animals have used the resources of the earth to support life and to dispose wastes. In those days, the disposal of human and other wastes did not pose significant problems as the population was very small and the area of land available for the assimilation of such wastes was large. However, today, serious consideration is being given everywhere to this burgeoning problem of solid wastes. Rapid population growth and uncontrolled industrial development are seriously degrading the urban and semi-urban environment in many of the world's developing countries, placing enormous strain on natural resources and undermining efficient and sustainable development.

The purpose of the Solid Waste Management (SWM) exercise is to help improve poor practices of SWM that prevail in many low income countries where this subject has received scant attention compared to other aspects of infrastructure such as water supply and transport. It is a multi-disciplinary field embracing waste collection, transfer, haulage and disposal and its impact is wide. It is therefore important to take a broad view and not to consider disposal options within the narrow confines of a particular technology. This work is formulated from the available literature and gives particular emphasis to the principle of building on existing capacity of waste managing authorities.

An effort was made to study and suggest improved SWM practice for an area of about 180 hectares (Indian Institute of Science, Bangalore) whose waste generation resembles a typical urban community, equivalent to a ward under city corporation jurisdiction. The proposed strategies can be replicated in large communities and townships. Optimal SWM strategies for many kinds of wastes are proposed effectively with the help of field investigations and spatial analysis tools (Geographic Information System, GIS), constituting a framework for efficient planning for waste management. Suggestions involving source segregation, designing collection systems, recycling and reuse (usage of organic wastes for production of biogas and fertilizer), optimal routing of collection vehicles, appropriate design of community bins, effective stakeholder participation, hazardous waste management, safe disposal options, etc have been proposed.

1.1 SOLID WASTES

Any *solid material* in the material flow pattern that is rejected by society is called solid waste. Solid wastes arise from human and animal activities that are normally discarded as useless or unwanted. In other words, solid wastes may be defined as the organic and inorganic waste materials produced by various activities of the society and which have lost their value to the first user. As the result of rapid increase in production and consumption, urban society rejects and generates solid material regularly which leads to considerable increase in the volume of waste generated from several sources such as, domestic wastes, commercial wastes, institutional wastes and industrial wastes of most diverse categories. Wastes that arise from a typical urban society comprises of garbage *(Refer Annexure 1 for definitions)*, rubbish (package materials), construction and demolition wastes, leaf litter, hazardous wastes, etc.

1.2 SOLID WASTE MANAGEMENT (SWM)

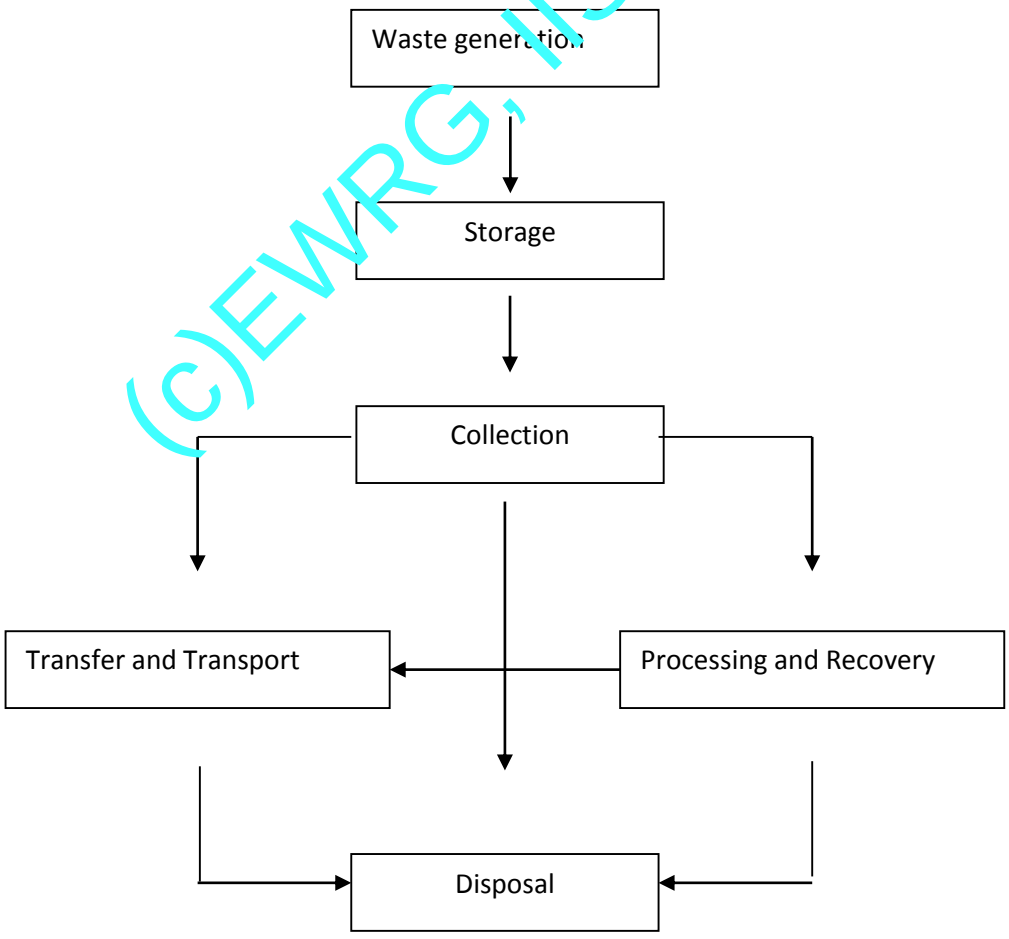
Management of solid waste may be defined as that discipline associated with the control of generation, storage, collection, transfer and transport, processing, and disposal of solid wastes in a manner that is in accord with the best principles of public health, economics, engineering, conservation, aesthetics, and other environmental considerations. In its scope, solid waste management includes all administrative, financial, legal, planning, and engineering functions involved in the whole spectrum of solutions to problems of solid wastes thrust upon the community by its inhabitants (Tchobanaglous, G. et al, 1997)

1.3 FUNCTIONAL ELEMENTS OF WASTE MANAGEMENT

To implement proper waste management, various aspects have to be considered such as

- source reduction
- onsite storage
- collection and transfer
- processing techniques
- disposal

The following flow chart shows the interrelationship between the functional elements in solid waste management.



1.4 OBJECTIVES OF GOOD MANAGEMENT SYSTEM

The day to day management of solid wastes is a complex and expensive activity. Disposal functions have to be sought for the future, the overall objective being to minimize the adverse environmental effects caused by the indiscriminate disposal of solid wastes. This is of paramount importance to health, environmental protection, natural resources management and sustainable development. Developed countries have adopted sophisticated management practices. Imparting the same in low-income countries is not economically, and technically viable and socially acceptable. However, the management strategies that are to be adopted for low-income countries should ensure maximum safety to the environment.

Management objectives: Management strategies should be in such a way as to perform the following functions

- Protection of environmental health
- Promotion of the quality of environment
- Supporting the efficiency and productivity of the economy
- Generation of employment and income

1.5 HAZARDS OF MISMANAGEMENT

Potential hazards of solid wastes are numerous to the living community when it is improperly managed. Solid wastes have the potential to pollute all the vital components of living environment (i.e., air, land and water). Some of the hazards caused by solid wastes are listed below, (Mansoor Ali et al, 1999).

- Environmental pollution from waste leachates and gas evolving from dumped solid waste.
- Air pollution from smoke by burning of waste And Health hazards to the people through inhalation of dust and smoke.
- Health hazards to waste workers and pickers through direct contact with waste.
- Chance of spreading of communicable diseases.
- Unaesthetic appearance
- Poor living environment

1.6 CAUSES OF MISMANAGEMENT

Poor management of Solid waste is a bane of urban society. The problem is severe in urban areas because, people from rural area are migrating at an alarming rate for want of employment and better quality of life. Absence of proper municipal amenities adds to the existing menace. Whenever there are sudden surges of population, municipal authorities are forced to take ad-hoc measures, which

compound the problem further. The situation should be turned over for good and it needs an organized and well-thought out approach. In short, the major causes of this dilemma are,

- Burgeoning population
- Industrialization and Urbanisation
- Uncontrolled Economic growth
- Unplanned development activities
- Lack of integrated and holistic approach
- Ignoring importance of socio-economic and ecological aspects

1.7 KEY CONSTRAINTS IN MANAGEMENT

Despite a large body of work on high technology options for waste disposal, there is very little material appropriate for low-income countries. It is observed that inappropriate, expensive and unmanageable disposal systems are being implemented in many places. Numerous technologies / options are available in SWM, among developed countries. Replicating the same in low-income countries is inappropriate / incompatible. The success of waste disposal practices depends largely on overcoming the following constraints,

- *MUNICIPAL CAPACITY:* The scale of task is enormous and regulatory authorities are able to collect only 60-70% of total waste generated (UNCHS 1994), so treatment and disposal inevitably receives less attention. Attempts are being made in a few instances to overcome this lack of capacity by privatizing this operation.
- *POLITICAL COMMITMENTS:* Solid waste management is much more than a technical issues; it has implications for local taxation, employment, and regulation of public and managing authorities. Any change needs political support to be effective. However, it is rarely a priority for political concerns unless there is strong and active public interest. This is viewed as a cost to the "public" without apparent returns.
- *FINANCE, COST RECOVERY AND RESOURCE CONSTRAINTS:* Deployment of a proper management system represents a major investment and it may be difficult to give it priority over other resource demands. Most of the waste management authorities are severely constrained by the lack of resource to finance their services. Since the collection and transport itself usually dominate SWM costs in developing countries, safe disposal invariably receives less attention where as in all other developed countries concentrate on all aspects of management.
- *TECHNICAL GUIDELINES:* Standards of planning and implementation in high-income countries may not be appropriate in low-income countries due to difference in climate, resource, institutions, attitude priorities, etc. However, relatively little appropriate guidance is available for low-income countries. Arising from this uncertainty, officials find themselves ill equipped to plan management strategies, which are both achievable and avoid unacceptable environmental hazards.
- *INSTITUTIONAL RESPONSIBILITIES:* Though managing wastes effectively is the responsibility of the municipality, there is no clearly stated vision of management (i.e. sufficient priority is not given to SWM). Existing vision is accompanied by a typical apathy to solid waste is an "*out of sight is out of mind*" attitude by the municipalities and public because of strict rule and regulations are not implemented just like as in prevention of emission of water and air pollutants. Waste management necessities the co-ordination of all authorities concerned and may involve departments that are accustomed to acting independently but the lack of accountability in all levels of

management. Among the authorities, the roles and responsibilities of different departments need to be clearly defined and accepted by all concerned. Some smaller towns may not have staff with specific responsibility for providing a solid waste management service.

- *INADEQUATE LEGAL PROVISIONS:* In most countries, the laws and regulations on solid waste management are outmoded and fragmented and hence are inadequate to deal effectively with the modern complications of managing wastes in large cities. Most of the laws deal with the general tidiness of the city streets, waste collection and their disposal at places away from settlements. Even these inadequate laws are not fully enforced. This aggravates the situation further.

1.8 NATURE OF THE PROBLEM

Solid waste management is a civic problem and it has to evolve optimally and continuously to serve the future generation. Solid wastes if unchecked can not only be a health hazard but will impart multidimensional threats, which include serious detrimental, environmental, social, and economic impacts. Solid waste management in developing countries is a complex issue as the types of wastes generated vary widely because of the varying localities with diverse population. The boundaries of the analysis of the "waste problem" are difficult to define. A complete and environmentally sound SWM requires effective contribution from all those who are involved in this problem. Everyone is part of the solid waste generation problem and everyone shall also be part of the solution of proper management i.e., solution depends upon collective human action and efforts.

1.9 MAGNITUDE OF THE PROBLEM

The trend of unsustainable patterns of production and consumption is increasing the quantity of the waste and the amount will increase four - fivefold by the year 2025 (Earth Summit-1992). As many as 5.2 million people, including 4 million children under five years of age, die each year from waste related diseases. The health impacts are particularly severe for urban poor. At present over 2 billion people will be without access to basic sanitation, and an estimated half of the urban population in developing countries is without adequate solid waste disposal services. Solid waste management operations currently absorb 30 to 50 percent of the municipal operating budgets in developing countries (Earth Summit-1992). Some of them have experienced a six-fold increase in solid waste disposal costs over the last decade. The costs are likely to double or treble by early next century. For these reasons, solid waste recycling and reuse has attracted considerable attention worldwide and numerous action plans to promote sustainable human settlement development focussing on environmentally sound management of solid waste have been initiated. Such actions call for an integrated approach to solid waste management.

2. INDIAN SCENARIO

The importance of proper solid waste management is one of the prime functions of the civic body, as insanitary management of solid wastes is a cause of much discomfort. Since waste management is the fundamental requirement for public health, Article 48-A of the Indian Constitution establishes the responsibility of the state to manage these wastes properly. On the basis of available data, it is estimated that the nine major metropolitan centres in India are presently producing 23,000 tones of solid waste

per day. As per recent estimates, Bangalore generates about 3,600 tonnes per day and the following table provides comparative details about garbage generated and cleared in nine major Indian cities (IIED, 1999).

Urban waste situation in some major Indian cities are:

Major cities	Garbage generated (tonnes per day)	Garbage cleared (tonnes per day)
Mumbai	5800	5000
Kolkata	3500	3150
Chennai	2675	2140
Delhi	3880	2420
Bangalore	2130	1800
Lucknow	1500	1000
Patna	1000	300
Surat	1250	1000
Ahmedabad	1500	1200

Source: India Today, 31st October, 1994

2.1 LACK OF STRATEGIC APPROACH OF FORMAL SECTOR

In most cities, the municipal service for the collection and transportation of urban solid wastes comprises three separate functions as follows,

a) sweeping, curbside and domestic waste collection from garbage bins
b) Transportation by handcarts to large or road collection points, which may be open dumps.
c) Transportation by vehicles to the disposal sites

Indian waste management system is starved of resources to tackle the increasing demands associated with growing urbanisation. Due to budgetary constraints, inadequate equipment and poor planning, house-to-house collection is very rare in India, particularly in certain low-income areas where waste is not collected at all. It is estimated that upto 30-40 percent (UNCHS, 1994) of disposed solid wastes are left uncollected. The areas, which are not serviced, are left with clogged sewers and litter which, create serious health problems for the resident population.

2.1 STORAGE

Storage of wastes before final disposal is done at three levels:

- *At source:* Solid wastes are often stored at the source until they are picked up by waste collectors (collection crew) or taken out to be thrown into an open space or a community bin.
- *At community level:* Community bins are used in crowded and narrow market areas, which is a common feature of most developing countries. Because of the high cost of door to door collection many waste management authorities have introduced community bins.
- *At transfer stations:* Transfer stations are established, for economic reasons in cities, which have long haulage distances to final disposal sites. Smaller collection vehicles bring in the wastes

collected at their source of generation or from the community bins and larger vehicles transport them away to final disposal sites. Transfer stations are also used as collection and sorting points for recycling materials.

2.3 COLLECTION METHODS

Most of the collection systems followed in India are:

Door to door collection: This system is used in narrow streets where a collection truck cannot reach individual houses. The house places the filled containers outside their doors when the waste collectors arrive. Some cities such as Chennai (Madras) and Chandigarh have implemented this in posh localities where influential people reside. On similar lines, Bangalore City Corporation (BCC) recently introduced door to door collection in some wards and management seems to be satisfactory.

Curbside collection: This method is used in wider streets, where the collection trucks can pass through conveniently. The house owners leave the waste containers at the edge of the pavement. The waste collectors collect the waste from the curbside or empty the containers into the vehicle as it passes through the street at a set time and day and return the containers as practiced in Kanpur (UNCHS, 1994).

Block collection: The collection vehicles arrive at a particular place or a set day and time to collect waste from the households. Households bring their waste containers and empty directly into the vehicle (UNCHS, 1994).

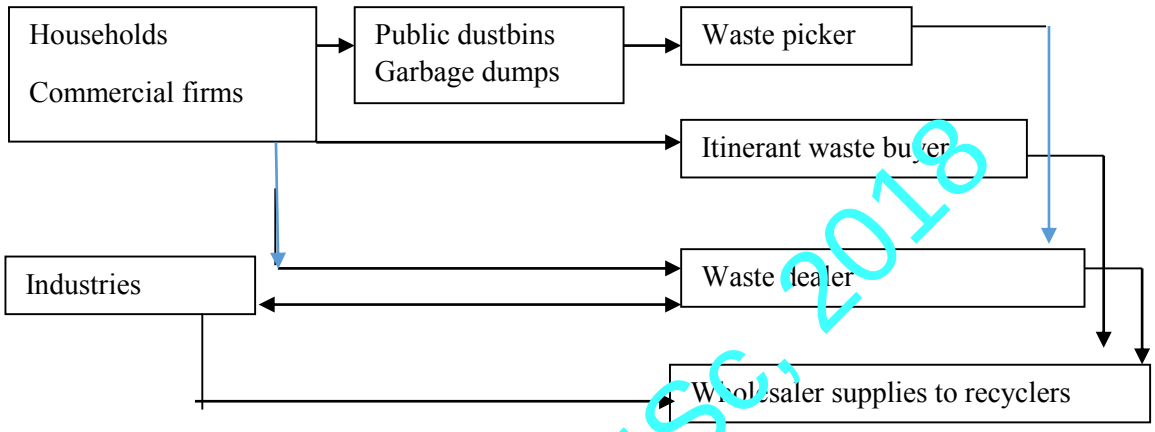
Community bins: Community storage bins are placed at convenient locations, where the community members carry their waste and throw it. (These bins are also called Delhi bins, since it was introduced first time in Delhi)

2.4 Comparison of collection systems

Collection Methods → / ↓ Sustainability Indicators	Door to Door Collection	Curbside Collection	Block Collection	Community Bins
Area improvement	√	√	√	X
Convenience of the people	√	X	X	X
Convenience of the staff	X	√	√	√
Handling the extra waste during festival	X	√	√	√
Frequency and Reliability	X	√	X	√

2.5 INFORMAL RECYCLING ACTIVITIES

The phenomenon of recycling by means of repair, reprocessing, and reuse of waste materials is a common practice in India. At the household level recycling is very common. Waste is accessible to waste pickers; they segregate it into saleable materials such as paper, plastics, glasses, metal pieces, textile, etc. Rag pickers segregate the wastes directly from the dumps and bins with no precautions and they are exposed directly to harmful wastes. The separated waste is sold to a small waste dealer, from where the waste is transferred to a medium sized dealer or wholesaler. All these activities are not regulated or monitored by any governmental organisation. Due to this informal segregation, volume reduction is achieved, while it ignores social, economic, environmental, and health aspects.



Source: IIED 1999, Informal Waste Management Recovery Process in India

2.6 TREATMENT AND TREATMENT OPTIONS

Waste collected by the formal and informal sectors is delivered mainly to three destinations. The remaining waste goes for disposal. First, high quality materials and used products are cleaned or transformed for reuse. A well-known example is the reuse of old newspapers for packaging material. Second, recyclable materials are traded for recycling purposes. As a result, a wide range of products is generated. Third, organic waste can be converted into compost, which, when used as manure instead of chemical fertilizer contributes to improved fertility of the soil.

Recycling & Reuse: The processes, by which materials otherwise destined for disposal are collected, reprocessed or remanufactured and are reused. Annexure 3 gives the list of commonly separated recyclable components in the municipal waste stream in India. The separation for recycling takes place at households, community bins, open dumps and even in final disposal yards. The recycling business is a complicated chain of operations and varies from place to place. The recycling and reuse (the use of a product more than once in its same form for the same or another purpose) sector of waste management in cities of Asian developing countries is potentially high. Its economic assessment is a difficult task since it is practiced in an informal manner.

Biogas: Biogas contains approximately 60:40 mixture of methane (CH_4), and carbon dioxide (CO_2) produced by the anaerobic fermentation of cellulose biomass materials - simultaneously generating an enriched sludge fertilizer - with an energy content of 22.5 MJ/m^3, clean gaseous fuel for cooking, for running engines for shaft and electrical power generation with little or no pollution. Many cellulose biomass materials are available in urban and rural solid wastes and may be utilized to produce eco-friendly renewable energy, contributing to the clean waste management. In India, biogas production is

currently practiced in many places in rural areas (with cattle dung) and few places in urban areas (with sewage).

2.7 DISPOSAL AND DISPOSAL OPTIONS

WASTE DISPOSAL OPTIONS

Final destination of solid waste in India is disposal. Most urban solid waste in Indian cities and towns is landfilled and dumped. A wide range of disposal options in many developing countries is available and some of them are listed below,

Non-engineered disposal: This is the most common method of disposal in low-income countries, which have no control, or with only slight or moderate controls. They tend to remain for longer time and environmental degradation could be high, include mosquito, rodent and fly breeding, air, and water pollution, and degrading of the land.

Sanitary landfilling: Sanitary landfill is a fully engineered disposal option, which avoids harmful effects of uncontrolled dumping by spreading, compacting and covering the wasteland that has been carefully engineered before use. Through proper site selection, preparation and management, operators can minimize the effects of leachates (polluted water which flows from a landfill) and gas production both in the present and in the future. This option is suitable when the land is available at an affordable price. Human and technical resources available are to operate and manage the site.

Composting: Composting is a biological process of decomposition carried out under controlled conditions of ventilation, temperature, moisture and organisms in the waste themselves that convert waste into humus-like material by acting on the organic portion of the solid waste. If carried out effectively, the final product is stable, odour-free, does not attract flies and is a good soil conditioner. Composting is considered when biodegradable waste is available in considerable fraction in the waste stream and there is use or market for compost. Centralised composting plant for sector may only be undertaken if adequate skilled manpower and equipment are available, hence at household level and small level composting practices could be effective which needs the people's awareness.

Incineration: Incineration is the controlled burning of waste in a purpose built facility. The process sterilizes and stabilizes the waste. For most wastes, it will reduce its volume to less than a quarter of the original. Most of the combustible material is converted into carbon dioxide and ash. An extensive sample programme conducted in India (Bhide and Sundaresan, 1984) reveals that most of the waste had a calorific value of just 3350 joules/g compared with 9200 joules/g in high income countries. Incineration may be used as a disposal option, only when landfilling is not possible and the waste composition is of high combustible (ie self-sustaining combustible matter which saves the energy needed to maintain the combustion) paper or plastics. It requires an appropriate technology, infrastructure, and skilled manpower to operate and maintain the plant. In Indian cities, Incineration is generally limited to hospital and other biological wastes and mostly others are either landfilled or dumped.

Composition of urban solid waste in Indian cities (% by weight)

City	Paper	Metal	Glass	Textiles	Plastics*	Ash & dust	Organic	Others**
Chennai	5.90	0.70	-	7.07	-	16.35	56.24	13.74
Delhi	5.88	0.59	0.31	3.56	1.46	22.95	57.71	7.52

Kolkata	0.14	0.66	0.24	0.28	1.54	33.58	46.58	16.98
Bangalore	1.50	0.10	0.20	3.10	0.90	12.00	75.00	7.20
Ahmedabad	5.15	0.80	0.93	4.08	0.69	29.01	48.95	10.39
Mumbai	3.20	0.13	0.52	3.26	-	15.45	59.37	18.07

Source: Planning commission on "Urban Solid waste Management in India", GOI (1995)

*Includes rubber and leather

**Includes bones, stones and woody matter

This data clearly shows that compositions of Indian waste stream collected from garbage bins are mainly of low calorific value with high moisture content. Hence, due to non-combustibility, Indian city waste is not suitable for incineration (Rajabapaiah, 1995).

Main objective of disposal options is to ensure maximum safety to the environment. Imparting processing techniques such as Gasification, Refuse derived fuel (RDF), Pyrolysis etc., require administrative, technical, political, social and economic support.

2.8 COMPARISON OF DISPOSAL OPTIONS

Disposal Options → / ↓ Sustainability indicators	Non Engineered Disposal	Sanitary Landfill	Composting	Incineration*
Volume reduction	X	X	X	√
Expensive	X	√	√	√
Long term maintenance	√	√	X	X
By product recovery	X	√	√	√
Adaptability To all wastes	√	√	X	X
Environmental adverse effect	√	√	X	√

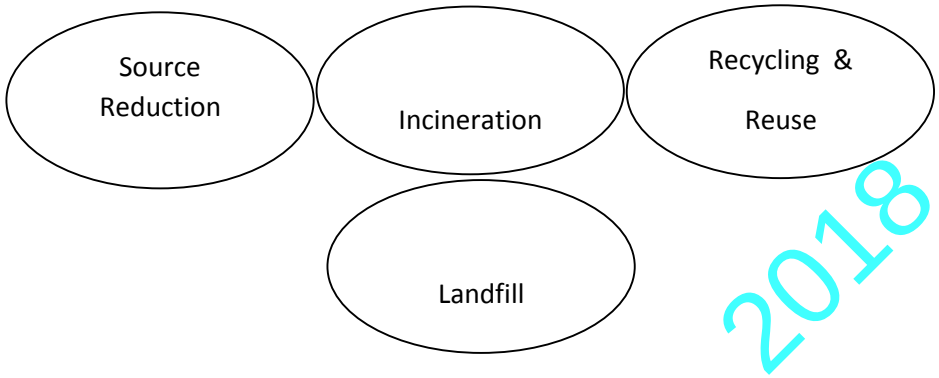
*Incineration with energy recovery

3. ACTION PLAN

3.1 SIGNIFICANCE OF INTEGRATED APPROACH

Management of municipal waste to be effective requires an integrated approach involving components such as source reduction, recycle, reuse, incineration, etc.

The best management practice does not rely on a single processing technique and disposal option, since merit and demerits associated with all prevailing techniques. Final strategy needs to combine various techniques depending upon the constituents in the waste stream. Healthy environment demands an integrated approach that involves complementary use of a variety of practices to handle the solid waste stream safely and effectively with the least adverse impact on human health and the environment. Hence, planning (by various level of government and waste management industry) to be effective has to address the current and future problems faced by the communities and manage municipal solid waste in a safe and efficient way. An integrated approach (EPA, Solid waste dilemma, 1989) for waste management consists of some or all of the following components,



Management practices have to match particular waste stream constituents and select those that are best suited, in order to reduce toxins and quantity and safely extract useful energy or material prior to final disposal.

3.2 ENVIRONMENTALLY SOUND MANAGEMENT

Environmentally sound management goes beyond the mere safe disposal or recovery of wastes that are generated and seeks to address the root cause of the problem by attempting to change unsustainable patterns of production and consumption. This implies the application of the integrated life cycle management concept, which represents a unique opportunity to reconcile development with environmental protection. United Nations Centre for Human Settlements (UNCHS, 1994) emphasizes on the following four programme areas, which will vary according to the local socio-economic and physical conditions, rates of waste generation and waste composition.

To accomplish these, the management strategies are required to focus on the following:

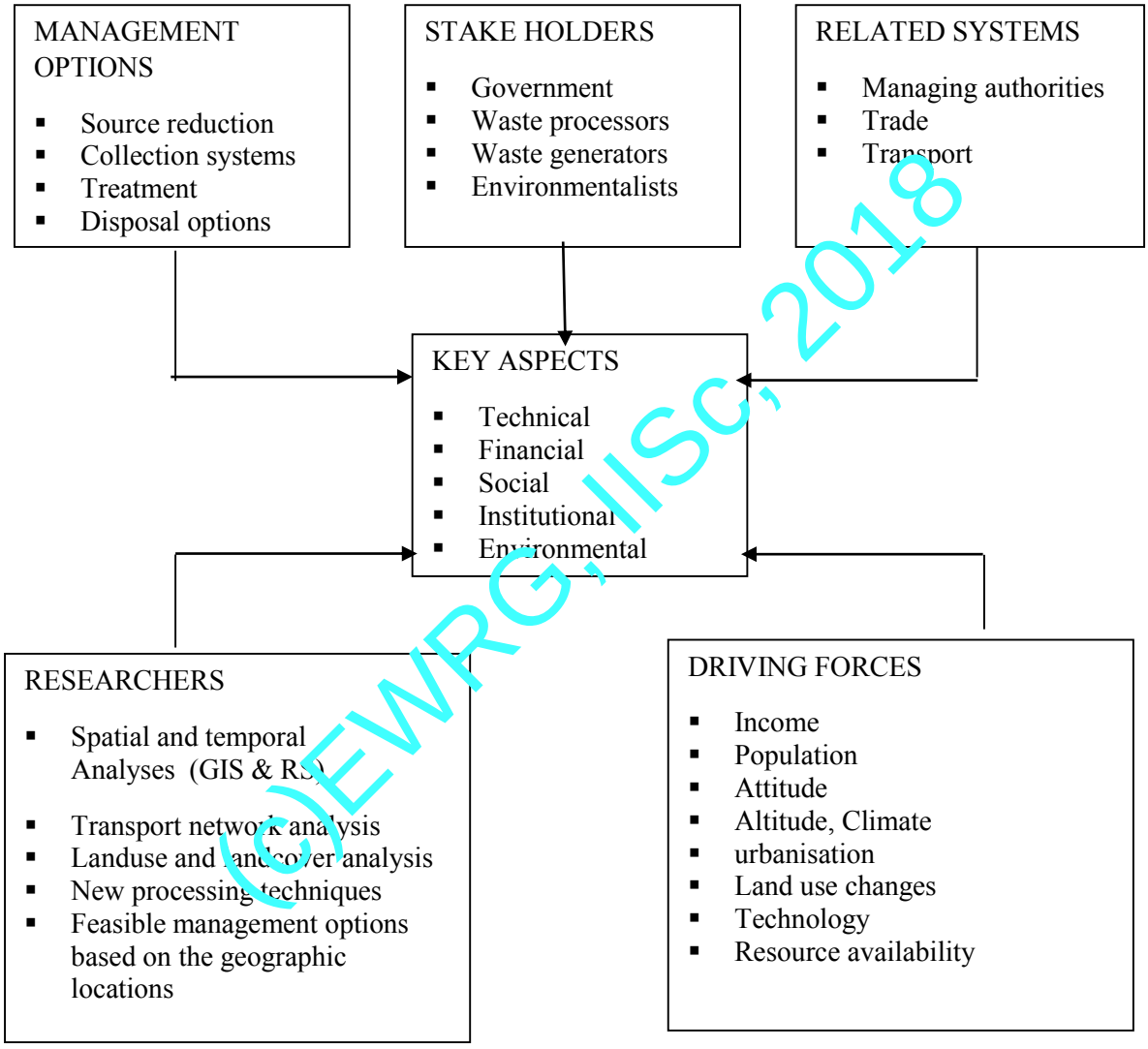
- Minimizing waste production
- Maximizing environmentally sound reuse and recycling
- Promoting environmentally sound waste disposal and treatment
- Extending waste service coverage

1. Increase the waste planning and management information (both technical and educational) available to states, local communities, waste handlers, citizens and industry, and increase data collection for research and development.
2. Increase effective planning by waste handlers, local communities and states.
3. Increase recycling by government and by individual and corporate citizens.

4. Increase source reduction activities by the manufacturing industries, government and citizens.
5. Reduce the risk from municipal solid waste combustion in order to protect human health and the environment.
6. Reduce risks from disposal facilities in order to protect human health and the environment.

Fulfilling these aspects helps in overcoming constraints such as, increased waste generation rates and concerns over human health and environment.

3.3 FRAME WORK FOR PLANNING, POLICIES AND GOVERNANCE



The overall framework needed for the effective solid waste management is illustrated in the above chart.

The integration of all components present takes place at various levels to arrive at feasible management. All components of this framework are intended towards the key aspects of SWM, which are

Technical aspects include the following issues:

Technical

- Regular monitoring of variation in quantity and composition of waste
- Regular review of strategies and rectifying discomforts
- Use and implement effective containers and collection systems
- Use and implement effective component separation techniques
- Improvement in processing techniques
- Studies on cost analysis of recycling activities and minimization of total cost involved in management.

Institutional

Institutional roles and responsibilities concentrate on

- Efficient and proper monitoring of operations
- Management through stakeholder involvement
- Incentives to public participation and efficient workers
- Innovations and whole hearted participation

Financial

The financial aspects are

- Ability to finance the implementation
- Operation and maintenance of the system
- Financing and cost recovery
- Economic sustainability and financial viability of waste management options.

Social

Social aspects include

- No adverse social impact
- Avoiding waste picking creating alternate opportunity
- Ensuring better living condition and sanitation.

Environmental

Environmental issues are

- Protecting from negative forms of environmental impact
- Avoiding environmental risks
- Protecting from long-term environmental hazards

3.4 STAKEHOLDERS PARTICIPATION

The critical element is the consultation of common goals and implementation involving all stakeholders. Owning and identifying with the system and its components role is substantial which influence contemporary project design and sustainable management. The common factors that influence non-effective stakeholder participation are as follows,

- Lack of commitment of higher levels of government to the waste management
- Lack of co-operation with Non Governmental Organisations (NGO) by government and public (Bhuvaneswari Raman, 1991)
- Lack of personal interest of concerned local government officials
- Lack of Community Based Organisation (CBO) involvement

Collaboration with all stakeholders, especially with waste generating agents is very crucial, implying integration between the formal and informal recycling agents. For example, the segregation of household waste at source would reduce the burden significantly. Stakeholder participation helps in achieving segregation at source and improves the recycling and reuse of wastes. Appropriate incentive helps in effective participation by stakeholders.

3.5 PUBLIC EDUCATION

Motivating the public to support the solid waste management program, which includes diverse culture, range of human mentalities and thoughts, requires interpersonal approach. Public education programmes aid in

- Explaining the necessity of public participation
- Raising awareness about waste management needs and concepts
- Advocating adoption of the desired waste management system /attitude.

Policy interventions are possible through active participation of the public. Public education and incentives would help in this regard. Public awareness also helps immensely in lobbying to ensure the government machinery implement the decided management plans.

Several stages of public education **are:**

AWARENESS: Information about solid waste, health hazards, necessity for feasible management, role of public in management and optimal management strategies. Program planners through variety of methods explain the program in effective manner.

INTEREST: After people have been made aware of waste management issues, they seek more information. Public education helps in answering the queries and provides more information.

TRIAL: Participants and individuals try the programs at this stage and this proves to be very decisive. An adequately staffed and properly trained clearinghouse or hot line is a useful tool to answer questions and provide additional information.

EVALUATION: Participation increases when program requirements are easy to follow. At this stage individuals decide whether to participate or not. For even well promoted programs, initial participation

is about 50%. Periodical evaluation and monitoring help in streamlining program requirements and in further improvement.

ADOPTION: Education components in the program usually focus on reinforcing program participation. Ongoing education programs solicit constructive feed back and provide new program information when necessary. Public support and participation would continue to grow for well thought out and implemented programs. This helps in adoption of management practices.

MAINTENANCE AND ADAPTATION: Incentives and education while keeping participation rates high also help in maintaining the system thereby ensuring long term sustainability. Users adapt the system to their convenience.

3.6 PUBLIC INVOLVEMENT

The effective waste management is a continuing process of public education, involvement, implementation and evaluation. Among these, key issue is wholehearted public participation, which has to face several interwoven components:

PEOPLES' CONCERNS: People concerns about waste management which include costs, aesthetics, odour, littering, social issues of handling etc. have to be put on the public agenda, which fascinates the public involvement there by effecting the management methods.

INVOLVEMENT: Representatives of various interest groups (regulatory officials, individuals from neighboring communities, local waste management experts, stakeholders, representatives from environmental and business groups) are to be encouraged to participate. Bringing representatives of interest groups together and providing a forum for communication is an important need for long-term sustainability of the program.

ISSUE RESOLUTION: Interest groups make their points of agreement and disagreement clear to each other and to program planners. The various groups then attempt to understand and resolve points of conflict, which is the most important issue for the sustainability of practice adopted.

ALTERNATIVES: Participants make a list of available alternatives, including taking no action. At this stage participants may use the different criteria to analyse comparative economics, environmental impacts, and other aspects of each alternative which helps in arriving at a most viable alternative.

CHOICE: At this stage, the decision-making body decides all alternative /or a group of alternatives to implement in a participatory manner. The decision-makers are required to communicate the reasons behind their choice by explaining the necessary trade offs and the anticipated impact of the chosen alternative or alternatives on the communities.

RISK ANALYSES: Economic and environmental consequences of each alternative are discussed in such a manner, the public understands the results of choosing one alternative over another to avoid future annoying of public.

IMPLEMENTATION STRATEGY: While implementing the suggested or agreed alternative, the steps necessary to carry out the program are described and potential adverse impacts are mitigated, if possible, which helps in coordinating the public and beginning of the programme successfully.

EVALUATION AND MONITORING: The managing authorities continually evaluate the model and solicit input from affected groups. Ongoing evaluation and monitoring helps provide an information base for making future waste management decisions and understanding the system health.

4. SPATIAL ANALYSES TOOLS - APPLICATION TO ENVIRONMENTAL PROBLEMS

Spatial and temporal analyses tools such as Geographic Information System (GIS) and Remote Sensing data (Satellite information) are playing a pivotal role in management of natural resources, urban planning, etc. since last two decades.

GIS play fundamental role in the application of spatial data to any environmental modeling with or with out remote sensing data. The integration of spatial data and corresponding attribute data which refer to qualities or characteristics of places with spatial and location information (data base management systems) with the help of computers have revolutionized environmental modeling. These developments have played a prominent role in rapid and reliable analysis of spatial data.

- Use of Geoinformatics in planning the alignments of linear features like road, railways and canal etc. have become quite popular on account of many commercial GIS and CAD software available in the market.
- Organizations like Survey of India, where the Digital Cartographic Data Base (DCDB) is already available in 1:250,000 scale, are using the Digital Elevation Model (DEM) for generating road and railway alignments and alternative route plans.
- Geoinformatics and related GIS technologies are already being activated for sustainable environment planning, hazard predictions, monitoring and planning of related mitigation programmes like predicting land slides, earth quakes, cyclones, natural resource management, water quality monitoring, routing and transportation applications etc.

4.1 GIS-INTRODUCTION

Geographical information system (GIS) is a systematic integration of computer hardware, software and spatial data, for capturing, storing, displaying, updating, manipulating and analyzing in order to solve complex management problems. GIS is used as a tool, which aids in analyzing the data obtained with reference to their geographic location (Strafaci, 1999). GIS aids as decision support system with spatial maps and attribute databases. GIS integrates maps with reports, graphs and photographs to present results into powerful tools for decision-makers.

4.2 GIS-COMPONENTS

Cartographic display system: This system allows users to select and extract a particular database or map output on the screen or printer etc.

Map digitizing system: This system enables users to convert existing paper maps to digital form, thus further aids in developing database.

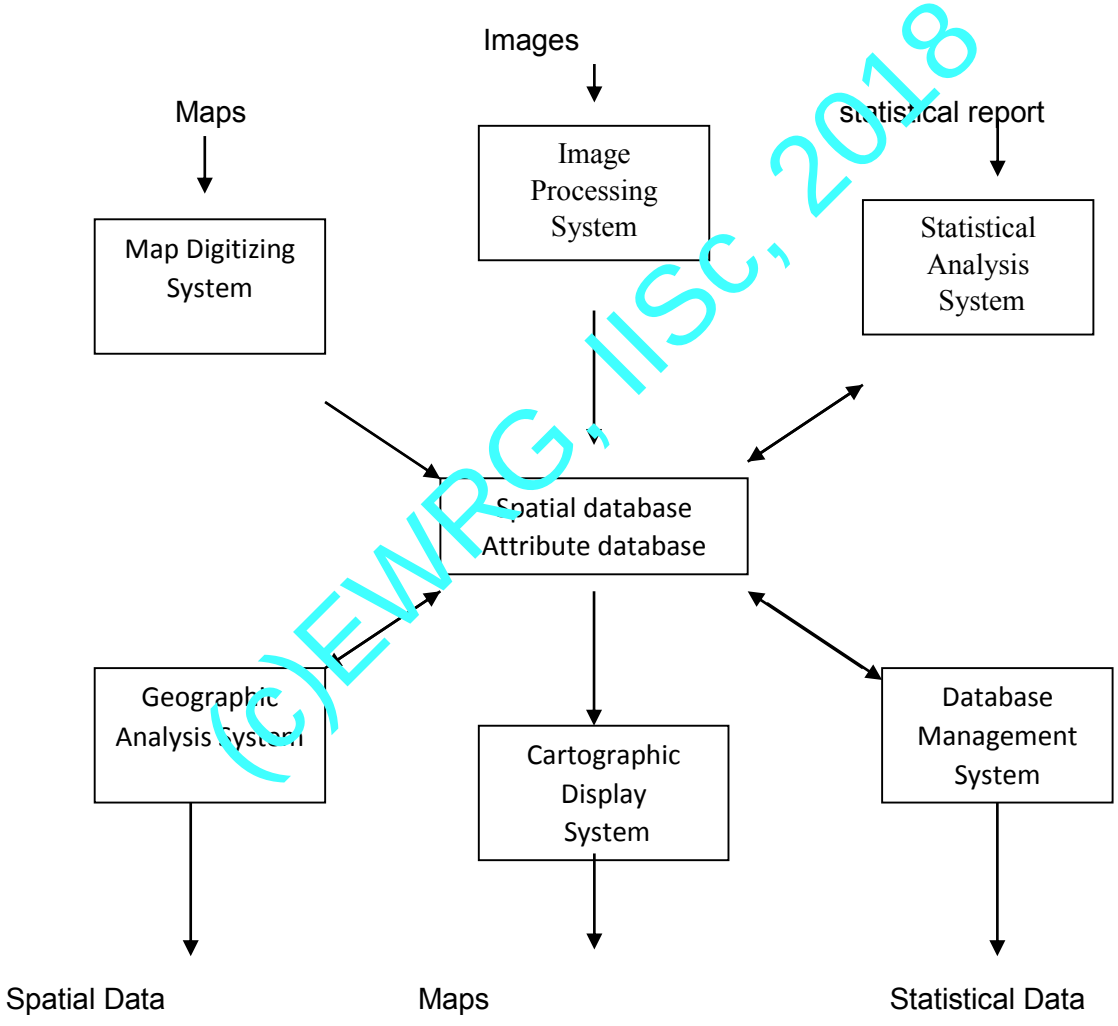
Database management system: This system has the ability to analyse the attribute data. Term "attribute" refer to qualities or characteristics of places with spatial and location information. Software, which

provides cartographic display, map digitizing and database query capabilities, are often referred to as automated mapping facilities management (amfm) systems (Ronald Eastman, 1997)

Geographic analysis system: This component has the ability to analyse the truly spatial characteristics. Term "spatial" refers to any two or three-dimensional data whether or not it relates directly to the surface of the earth.

Image processing system: It helps to analyse and classify the remotely sensed images (digital images) according to various classification techniques, which could be interpreted with the help of training data.

Statistical analysis system: This helps in statistical analysis of spatial and temporal data which is required in scenario analyses.



4.3 GIS TASKS

Import data: Probably the most time intensive step in setting up a GIS is obtaining spatial and attribute data sets in a consistent format and scale. Spatial maps used till now in paper format (by many agencies) are converted to geo-referenced digital format through scanning, digitization and geo referencing techniques. This can be updated with the latest information through satellite information. Attribute data may be entered manually or may be imported from preexisting sources.

Database Management: GIS is essentially a spatial map linked to attribute database. It manages the underlying spatial and attribute data in a Relational Database Management System (RDBMS). Relational databases store various layers of information in tables and are linked together by common fields.

Querying and Data Analysis: Performing queries is the most useful and powerful analytical capabilities of a GIS.

Visualisation of Data: Visualisation is one of the vital capabilities of GIS, helps to display results of query and in creation of high impact visuals, which are easy to interpret.

5. BEST STRATEGIES BY NESTING ESSENTIAL ASPECTS, FRAME WORK AND GIS

- *VIABLE STRATEGIES:* Strategic approaches for SWM is integration of available data, guidelines and framework and elimination of the constraints. Main objective of SWM is to arrive at a proper storage with least negative environmental impact, efficient collection system, engineered processing and disposal (according to constituents present in the waste stream). Analysis of spatial data i.e., landuse and land cover pattern, transport network, collection network etc., along with information related to quantity and quality of wastes (through GIS) enable the authorities involved in the solid waste management to come out with feasible options.
- *POSSIBLE SOLUTIONS:* Arriving at viable strategies and wise decisions enables the authorities to handle the waste effectively and remove discomforts to public. Utilization of available technology and expert involvement in the management could fulfill the aspirations of public and authorities. The data available on waste generation, sources, local conditions for collection system and capacity of managing authorities help in designing a proper management system, thus eliminating problems related to storage, collection, and disposal.

7. CASE STUDY- Indian Institute of Science Campus

STUDY AREA: IISc (Indian Institute of Science) campus is chosen for developing a feasible SWM strategy. The campus limits are enclosed within 13.01055^0 to 13.02083^0 latitude and 77.55944^0 to 77.57388^0 longitude. The area falls in the 57G/12 of Survey of India (SOI) toposheets of scale 1:50000, 57/G of scale 1:250,000.

IISc is located in the northern part of Bangalore City having lush vegetation and campus has green canopy of trees covering the buildings. The campus, consisting of five bounds, covers an area of 180 hectares. The main campus covers around 150 hectares. The elevation at IISc campus varies from 914 m to 942 m (from mean sea level). The natural terrain of the campus is rolling and provides good

natural drainage. Eastern part of the campus forms the major portion of the catchment area of Sankey Lake located to the Southeast of the campus (Fig 1). A large drain running all along the eastern side of the campus forms the main feeder to the Sankey Lake. Fig 2 provides the boundary of IISc with geo co-ordinates while Fig 3 maps the buildings and Fig 4 refers to road network.

This study explores the present waste handling practices within the IISc campus with various interdisciplinary activities (40 departments, 400 faculty members, 800 supporting staff, 1500 students and 450 residential quarters) representing a typical urban community. The institute has all kinds of wastes arising from various sources like residential, commercial, educational, open area and vegetative area.

7.1 NATURE OF WASTES

The nature of the waste generated within the campus comprises of,

- Domestic wastes (food leftovers, vegetable peels, plastic, house sweepings, clothes, ash, etc.)
- Waste arising from educational, administrative and commercial buildings (paper, plastics, glasses, etc.)
- Hazardous wastes arising from laboratories, health Centre (Radioactive chemicals, hazardous chemicals, infectious wastes, etc.)
- Waste arising from road cleansing (leafy matter, dust, construction & demolition wastes, etc.)
- Waste from vegetated area (litter, garden trimmings, tree cuttings, mowing etc.)

7.2 PRESENT SCENARIO OF SOLID WASTE MANAGEMENT IN THE CAMPUS

Generation: Campus residents and visitors involved in academic, administrative and commercial activities produce considerable quantity of wastes. Generation of wastes varies with season, academic and social activities and time. During the festivals, seminars, etc the generation rate is considerably high.

The campus has 45% of vegetative cover through out the year (Murari, 1999) and litter production is quite high. Litter production varies with season and type of tree species. Quantification of litter entailed a detailed field survey along with land cover and land use analyses.

Storage: Waste bins of various types are distributed all over the campus in different locations to ensure the waste is not dumped on the roadside. Different types of waste bins namely cylindrical concrete bins (CON), small wooden bins (SB), cubic concrete bins (CUB), masonry hut bins (HUT) and stone bins (STB) are in use. Hut bins are constructed at key locations where quantity of waste expected is quite high. Daily collection at hut bins constitutes about 20% of total solid waste in the campus. Figure 5 depicts the location and distribution of bins.

Small bins are provided to collect frequently generated wastes such as cigarette covers, envelopes etc. and are placed at strategic locations. Concrete bins, stone bins and cubic bins are provided at places,

where waste is expected regularly. In spite of all these, wastes are openly dumped on the ground at various locations for varying periods of time (Fig. 5).

Collection: Campus solid waste management is handled by the Estate Office. Initially, collection was done by workers employed by estate office with the help of one tractor and a pick-up mini-truck. Total crew size is six members and two drivers (to operate in two shifts). Four loads of waste were taken and the daily crew operated in two shifts (morning two and afternoon two). Recently (November 2000) the collection was entrusted to Bangalore Development Authority (BDA) recognized waste collection agents. Two truckloads are taken out daily and the crew size is 8 workers and 2 drivers. The frequency of collection from each bin is now 1 to 3 days (i.e., all bins are cleared once in 1 to 3 days). Collected wastes are dumped and burnt at common dumping site about 12 kms away from IISc. With this approach, while the institute environment is kept reasonably clean but valuable resource (70% of which is fermentable organic waste) with a significant plant nutrient load is being lost. This could have been converted to wealth through appropriate technologies available at campus.

Mostly community bin collection mechanism has been employed. The domestic waste is collected with all other wastes arising from other activities, which increases weight of waste to be transferred. In some localities such as duplex, E-Type, D-Type and Tunga residential staff quarters (Fig 3), door to door collection has been attempted recently. Collection charge per household per month is Rs.15. Regular street sweeping and roadside garden trimmings are done and wastes are dumped in bins and sometimes in drainage also.

Transferring: Transferring the waste from dustbins to vehicles is done manually with the use of spades, rakes and similar equipment and transferred to the collection vehicle. Inadequate precautions are taken while handling harmful wastes such as glass, biological wastes etc. The route followed currently is the one convenient to driver rather than from the collection point of view or from type and composition of wastes. All sensitive bins are not given priority in this method of collection. There is a need to evolve an optimal route evolved on the basis of waste composition and quantities generated in each bin. Till November 2000, collected waste was transferred to dump yard (located in North-eastern side the campus). These dumped piles were frequently burnt. Today, by entrusting the responsibility to BDA recognised contractors, waste is transferred to BDA's dumping yard near Madivala, Bangalore. Wastes dumped in dump yard were frequently burnt which caused both health hazards from toxic fumes and organic resource loss. This necessitates the wise use of organic wastes and environment-friendly disposal options. Damage to the ecosystem and the immediate environment has to be accorded the highest priority in deciding this options.

Disposal: Both in the past and in the present, inadequate attention has been paid to engineered disposal and its practice. Waste is simply dumped on the ground, open to the atmosphere as followed elsewhere without appropriate treatment and resource recovery practice.

Waste picking: Waste is accessible to waste pickers, who segregate re-saleable matter (paper, plastics, glasses, metal pieces etc.). Rag pickers segregate the wastes directly from the dustbins without any protective gloves and are exposed directly to harmful wastes. Due to this informal segregation, some volume reduction is achieved. However, such segregation disturbs the aesthetics of the collection system as wastes are littered all around the place.

Food wastes (food leftovers, vegetable peels, etc.) from various messes, used as animal feed are collected by agents regularly. Fresh surplus food is transferred to schools.

Source segregation: An attempt was made to segregate paper and plastics in the academic area by providing separate bins in all rooms in selected departments [Centre for Electronic Design and Technology (CEDT) and Centre for Ecological Sciences (CES)] for inmates to dispose plastic and paper in separate dustbins. From small dustbins in each room, wastes are then transferred to big containers located at common place, so that the contractor appointed by the institute can collect the waste. Segregation at individual level has been working reasonably well while at next stage (transferring to big container and then collection by a contractor), the practice has come to an end, due to lack of monitored collecting mechanism at IISc.

Hazardous wastes: Wastes that cause potential hazards to humanbeings and animals are referred to as hazardous wastes. Generally hazardous wastes can be classified into three categories namely, radioactive wastes, biological wastes and hazardous chemicals. At IISc, radioactive chemicals are used by various departments generally as radiotracers. Radioactive substances like Tritium, Phosphorus (^{32}P), Sulphur (^{35}S), carbon (^{14}C), Iodine (^{125}I), etc are used. The Institute has designed an innovative method to dispose radioactive wastes in an environmentally sound way in concrete silos with least or no harmful effect on eco-system. On the last Thursday of every month, wastes collected from individual departments are put into appropriately labeled containers and sealed and placed at radioactive waste disposal site. These are ensiled according to conventional practices of handling low-level radioactive wastes.

Very few departments at IISc use hazardous chemicals. Hazardous chemicals such as solvents, carcinogenic chemicals, etc are used in about five departments. Used chemicals from various laboratories are given varying levels of importance with respect to disposal practices and they are often mixed with general liquid wastes. Hazardous chemicals such as solvents, carcinogenic chemicals, etc. rejected from various laboratories are given inadequate importance and they are often mixed with general liquid wastes. A few workplaces however use fume hoods to dispose of mildly carcinogenic solvents. Acids and alkalis are typically dispersed by dilution with water. Mutagenic substances used are few and used in very small quantities. However, sometimes they are disposed along with bottles, packing material and mixed with general solid waste stream.

Pathogenic hospital wastes (1-4 kg/week) (COMIND-SWM, 1999) and animal bedding material are disposed by a common incinerator.

Litter: Litter is usually the dried parts of plants fallen on the ground. The litter largely contains leaves, flowers, fruits, seeds and twigs. Litter can be a non-timber plant products (NTPP) too - an economically important waste and could be converted to wealth with proper management (currently collected litter is transported out of campus and is burnt, thus the valuable wealth is lost). This resource if managed properly would return valuable nutrient to the soil. However, burning bioresource in dump yard leads to air pollution and affects surrounding inhabitants.

The IISc campus is covered with good vegetation canopy throughout the year. The litter produced and litter collected by collection vehicle is about one truckload /day containing dry and green leaf litter. The case study explores the following important issues,

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INTEGRATED MANAGEMENT OF MUNICIPAL SOLID WASTE

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ABSTRACT

Solid waste management is associated with the control of waste generation, from its storage to disposal while satisfying the principles of public health and other environmental considerations. However, rapid population growth coupled with the increased rate of unplanned urbanization in Indian cities have led to the tremendous increase in the amounts of solid waste (MSW). Mismanagement of solid waste leads to public health risks, adverse environmental impacts and other socio-economic problems. The problems derived from solid waste have a unique and complicated character; they are not only a potential source of pollution, but they can be used as a secondary source of raw materials. Municipal solid waste management (MSWM) is considered a serious environmental challenge confronting local authorities and several city administrators have realized that the way they manage their solid wastes does not satisfy the objectives of sustainable development. Therefore, there is a move to shift from traditional solid waste management (SWM) options to more integrated solid waste management approaches. The selection of priorities regarding the solid waste management has direct economic and environmental impacts. This procedure concerns not only the environmental policy but also technological, economic and purchasing policies. However, the lack of adequate resources to implement the necessary changes is posing a serious obstacle. Environmentally sound solid waste management involves

1. Segregation of waste at source (separate organic and inorganic - recyclable, reusable fractions);
2. Door to door collection of waste with incentive based mechanism to enhance segregation at source: This entails (i) deploying appropriate mobile collection vans (for each locality) with an option to store segregated and unsegregated wastes, (ii) incentive of Rs 1 per kg of segregated organic waste and payment directly to the respective household account through bank transfer – Jan Dhan scheme with Aadhaar linkage, (iii) dis-incentive to unsegregated waste – individuals who refue to segregate needs to pay Rs 5 per kg of unsegregated waste. Revenue generation would encourage many households to switch over to segregation.
3. Collection trucks to have GPS (global positioning system) which would help in online tracking and also in reducing malpractices associated with waste management

4. Transparency in the administration though online availability of spatial information system, accessible to all including public.
5. Eradicating waste mismanagement lobby - nexus of contractors-consultants-engineers. Successful elimination of the mismanagement lobby would help in solving the waste problem in any city.
6. Setting up waste processing yards with decentralised treatment of organic fraction of waste in each locality (stop using parks and recreation spaces for this purpose).
7. Encouraging youth to take up innovative waste treatment options (suitable to handle Indian waste- rich in organic fractions)
8. Only inert materials shall go to landfill locations.
9. Implementation of SWM 2016, GoI and penalising the city administrator in-charge of city waste for dereliction of duties in cases of mixed waste reaching the landfill site or littering of waste's in city open spaces.

INTRODUCTION:

Small communities in the primeval societies used to bury solid waste just outside their settlement, discharge aqueous waste into the local waterbodies and release gaseous pollutants into the atmosphere. The increase in community size necessitated a more organised form of waste management to minimize the environmental impacts as the quantity of pollutants exceeded the system's threshold. The stabilization of health issues at personal levels gave impetus to the community health issues. The earliest records show that the city of Mahenjo-Daro (Indus Valley) had organised solid waste management processes, Crete had trunk sewer systems by 2000 BC and the burning of soft coal in kilns in 1285 BC was banned to mitigate air pollution. Health and safety issues have been focus of waste management since early years (Ramachandra, 2011). The general public is more concerned with the effects that waste has on the environment while for the waste managers and planners the cost of collection, processing and disposal gains importance with the growing problem. Thus different waste management practices gained utmost importance as human activities exceeded the assimilative capacity of the biosphere (Ramachandra, 2006). The Government of India introduced statutory waste minimisation, treatment and environmentally sound management to address the earth's dwindling resources and the growing mountains of waste (The Solid Waste Management Rule 2016, Government of India).

Over the last few decades, India is finding hardships in managing the wastes; this is due to the changing life styles of people and their negligence, urbanization and the improper planning of government in these activities. The physical and chemical composition of Indian city refuse shows that 80% of it is compostable and ideal for biogas generation, moisture content of 50-55% and carbon-nitrogen ratio of 25-40:1. The quantum of wastes being generated in India is increasing due to increase in population and it is now nearly 300-480 g/day. All the major cities of India is generating about 3500 tonnes of wastes per day on an average. The composition of the waste is 60-70% of it is organic matter and the recyclables ranges from 9.56% to 17.18%. Plastics had a quantum jump from 0.69-3.69% which is 500% increase in the past years which is hazardous for human environment and for ecology

(Ramachandra and Shruthi, 2007). The waste disposal methods used in India is 90% of them are dumped in low-lying areas outside city/town limits, which has no provision for treatment and leachate collection which is a huge disadvantage to the environment and damages the ecology severely by heavy metals entering underground water and landfill gas entering atmosphere etc. (Ramachandra and Shruthi, 2007; Shwetamala et al., 2014; Chanakya et al., 2015). Recycling is highly organised in India compared to other developed nations. 40-80% of plastics get recycled. However due to lack of government policies, incentives, subsidies, regulations, standards, et.c, the technology and quality of manufactured goods are still far behind its western counterparts. Nevertheless recycling has become a profit-making venture, though informal in nature. Health impacts are severe in India in the recent years due to negligence of municipal workers and absence of standards and norms for handling municipalwastes. Respiratory ailments, gastro-intestinal ailments, skin lesions, eye problems are found by a survey (Ramachandra et al., 2013). Environmental impacts include decrease in air quality, water quality, psychological stress, cancer incidence for those living near incinerators and land disposal facilities. Increases diseases due to mosquito breeding and due to chemical reactions of these waste, mutations are also happening in the bacteria which are also resulting in new kinds of diseases (Ramachandra et al., 2014). As human needs and activities overload the assimilative capacity of the biosphere, the debate on the sustainable waste management has become paramount. Advances in the environmental measurement techniques have shown that the current demand on the earth's resources is not sustainable and needs addressing immediately (Ramachandra, 2011; Ramachandra and Saira, 2003). Solid waste management has evolved greatly since its early days and it now considers an interrelated series of options aiming at waste source reduction, recycling, treatment and final disposal.

A system analysis approach has become necessary while considering many options available and a system model is desirable because of the interactions between many factors within a waste management system. In a system approach the problems are multidimensional and multidisciplinary and so the solutions must reflect this complexity. The multidimensional aspect includes the economic and environmental sectors. A systems approach requires a long-term perspective, and analysis may need to extend across geo-political borders (Ramachandra, 2006). Thus, systems analysis plays an important role for regionalization assessment of integrated solid waste management systems, providing the decision makers with breakthrough insights and risk-informed strategies.

Appropriate waste management policy should be on the principles of sustainable development, according to which society's refuse should not be regarded simply as something to eliminate but rather as a potential resource. Solid waste management facilities are crucial for environmental management and public health in urban regions. Due to the waste management hierarchy, one of the greatest challenges that organizations face today is to figure out how to diversify the treatment options, increase the reliability of infrastructure systems, and leverage the redistribution of waste streams among incineration, compost, recycling, and other facilities to their competitive advantage region wide. Techniques for solving regional waste problems inevitably have a large number of possible solutions due to variable population densities, incomes, multiple (actual and potential) locations for waste

management infrastructure, protected landscape areas and high value ecological sites. This requires creation of an integrated waste management plan that makes full use of all available technologies. This would entail an increase in material recycling and energy recovery, and landfill disposal option only for inert materials and residues from recovery and recycling as shown in Figure 1. In this context, SWM 2016 (Government of India) stipulate the reduction of the present levels of waste generation and the increase in energy and material recovery, which represent two of the most important future requirements for environmentally-sound waste management practices. Landfill is generally recognized as the final destination of the refuse that cannot be further segregated or recovered in any other way.

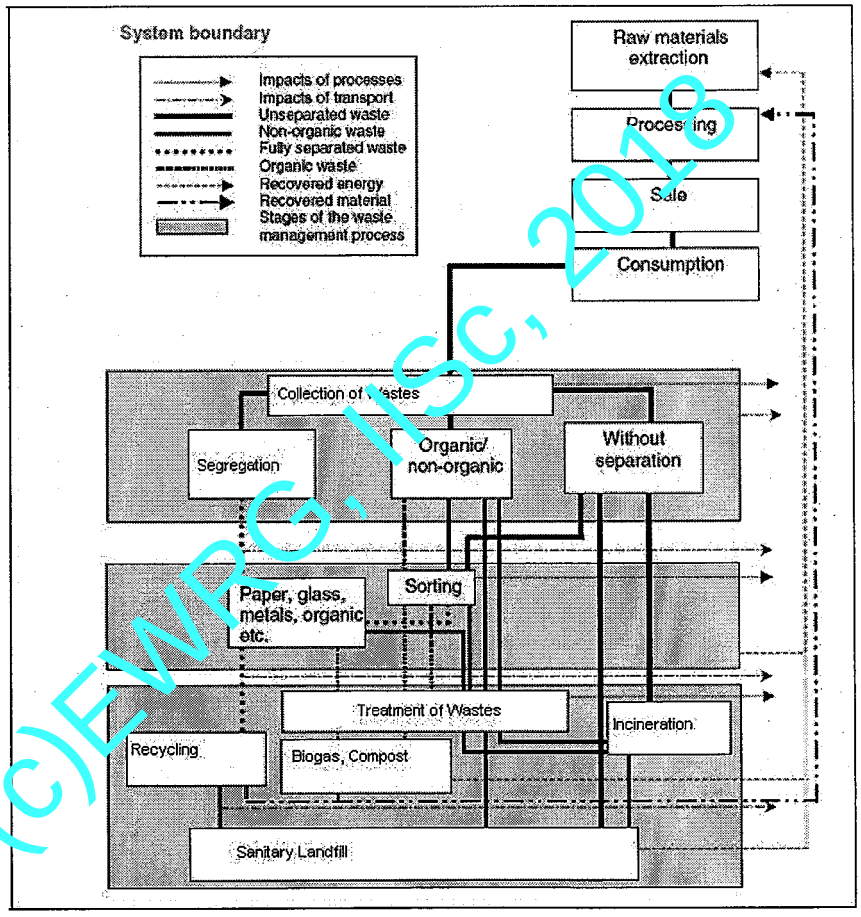

Figure 1: Material flow in the municipal solid waste management system

Despite the development of strategic planning models, the descriptions of source separation strategies of recyclables are usually insufficient to enable calculation of the amounts of materials separately collected. The amount of a material separately collected in an area depends on two factors: (i) the coverage of a collection system applied and (ii) the separation activity of waste producers, consisting of participation rate and separation efficiency. The coverage of a collection system is defined as the ratio of (a) the amount of a material produced in those properties where separate collection is available and (b) the amount of the material in question produced in all properties of the area. Participation rate is defined as the share of

people providing sorted material to bins in those places where this option is available. Separation efficiency is defined as the share of a material that is correctly separated by those participating in separation. In several strategic planning models, all of these factors have been ignored and the amounts of materials separated at the source are treated as input data. Solid waste management is particularly difficult and costly today due to the increasing volumes of waste and the need to control potential serious environmental and health effects of disposal. National planning for solid wastemanagement is necessary for the development and implementation of a very long-term and reliable action. The current situation, which gives rise to the indiscriminate dumping of wastes, has a serious impact on air, land and water pollution and causes a dramatic increase in health hazards in the urban environment. In many cities non-governmental and community-based organisations (NGOs and CBOs) have started developing neighbourhood waste collection services as well as initiating composting and recycling activities. These moves are backed up by municipal solid waste management and handling rules (The Ministry of Environment, Forests and Climate Change, GOI, 2016). Among other requirements, this rule demand source segregation and waste recovery, the local authorities in charge of municipal bodies have a statutory obligation to collect and dispose of household waste. Efficient planning for municipal solid waste (MSW) management systems requires accounting for the complete set of environmental effects and costs associated with the entire life cycle of the waste. Life cycle assessment (LCA) helps to evaluate the environmental burden associated with a product, process or activity and to consider opportunities that can effect environmental improvements. The International Organisation for Standardisation (ISO), a worldwide federation of national standards bodies, has standardised the framework on LCA. The main barriers include lack of awareness of the importance of using the life cycle concept, the quality of the data and a general lack of understanding of how to conduct the LCA correctly and interpret the results. The study indicated that integrated waste management would ultimately be the most efficient approach in terms of both economics and environment benefits (Ramachandra 2006; Ramachandra and Shruthi, 2007).

INTEGRATED SOLID WASTE MANAGEMENT SYSTEM: Integrated solid waste managemnt(ISWM) in its simplest sense incorporates the waste management hierarchy (Tchobanoglous *et al.*, 1993; Ramachandra 2006) by considering direct impacts (transportation, collection, treatment and disposal of waste) and indirect impacts (use of waste materials and energy outside the waste management system). It is a framework that can be built on to optimize the existing systems, as well as to design and implement new waste management systems. ISWM is also a process of change that gradually brings in the management of wastes from all media (solid, liquid and gas). The collection of recyclable materials from households can reduce the emission of greenhouse gases. The use of recycled materials in place of virgin materials in production also leads to reduction in the demand for energy. IWSM also includes the fundamental issue of governance. It stresses the need for local bodies to be more aware of people's concerns and for citizens to be more involved in civic affairs. This highlights the need to develop a sound management structure, seek technical and institutional support, and possibly work more closely with the private sector in reclaiming the full value of the waste resource in order to finance and support the collection schemes.

Planning integrated solid waste management: Any city or town will be in need of an effective solid waste management system to ensure better human health and safety.

The system needs to be safe for workers and safeguard public health by preventing the spread of disease. In addition to these prerequisites, an effective solid waste manage must be environmentally sustainable and economically feasible. It is quite difficult to minimise the environmental impacts and the cost simultaneously. The balance that needs to be struck is to reduce the overall environmental impacts of waste management as far as possible, within an acceptable level of cost. An economically and environmentally sustainable solid waste management system is effective if it follows an integrated approach i.e. it deals with all types of waste beginning from its generation to its disposal. The integrated approach must be based on a logical hierarchy of actions.

SOLID WASTE MANAGEMENT SITUATION IN BANGALORE: Many corporation wards inBangalore city are characterized by having a high degree of fermentable component in municipal solid wastes (MSW) from residential areas. These wastes are typified with low calorific value (800-1800 kCals/kg), high moisture content (50-80%, low net cal value), high proportion of organic matter (>60%) and low recyclable content such as paper, plastics, metals etc. The fermentable components of MSW are predominantly vegetable and fruit wastes that can range between 65 and 90% (Rajbaandiah 1998, Ramachandra and Saira 2003; Ramachandra 2006, 2011; Chanakya*et al.* 2007, 2009). As and when the city begins source segregation into fermentables, it is expected that a significant component of fermentable fraction will be produced and needs to be picked up on a daily basis. Only 68% of wastes generated is being collected by the agencies in Bangalore.

The quantum of waste generated in Bangalore city varies from 2300 to 3600 MT/day and the composition of waste is given in Table 1. The quantity is likely to grow in the next few years due to the increasing population and will present a formidable challenge to authorities unless an integrated approach is taken. As the daily per capita organic fraction of MSW production varies between 0.2-0.5kg (Ramachandra et al., 2013, 2014), depending upon lifestyles in the cities (indicated by city population). Thus, due to the small size of the total fermentable MSW generated at the household scale only composting and vermicomposting seem feasible at the household level. Many commercial and non-commercial devices for household composting and vermicomposting have been tried in Bangalore (Chanakya*et al.* 2007; Ramachandra 2006). Area or community scale options indicated above have been more successful in Bangalore and in various places in India. Area or zone wise collection has been shown to simplify collection systems and it enables collection of waste of similar composition (Sathishkumar*et al.* 2001). Leaf litter and garden waste, vegetable and fruit waste, domestic and kitchen waste, etc. thus are manually carted and treated at scales between 0.05-0.25 tpdscale. Composition of waste (Table 1) clearly shows the predominance of fermentable materials at all locations in the process of generation to its reaching the dump site. In the residential areas, parks and vegetable markets, the presence of a large fraction of fruit and vegetable waste (fermentable fraction, 70-90%) increases the moisture content of waste to

about 70-80% (Shwetmala et al., 2014). When composting of such high moisture feedstock is attempted by thestandard windrow method, there is excessive generation of leachates and its fermentation results in malodours. High levels of such waste arise even in the business districts where there is a concentration of fresh fruit juice vending shops in the area. Citrus fruit skins, pineapple cores, sugarcane bagasse, other fruit waste, etc. are generated in large quantities in certain pockets of the city. These form nearly 80% of the waste collected area (Sathishkumar*et al.* 2001). It is, therefore, important that such waste materials are treated rapidly in decentralized units and two options, namely, aerobic composting and biomethanation are available.

Table 1: Composition of municipal solid waste at different stages

Components (%)	Street bin, before rag picking	Street bin, after rag picking	Dump site	Bangalore overall
Fermentables	65	78	70	72
Paper	8	4	11.4	11
Miscellaneous	12	15	8.7	1.9
Glass	6	1	0.5	1.4
Polythene /plastics	6	1.9	9.1	6..2
Metals	3	0.1	0.3	1
Dust and sweepings	NA	NA	NA	6..5

The steps, in order of priority, which must be taken for Bangalore are given below:

i) Minimise the production of waste or source reduction: Source reduction is a basic solution to the garbage accumulation. Less waste means less of a waste problem. In many cases, source reduction can be done not necessarily by adopting a high technology but only by inculcation of better personal habits in the people. A reduction in the amount of waste can be achieved by change of consumption pattern and lifestyle, use of more recyclable materials, practice of waste segregation at source and change of manufacturing designs and packaging. Earlier studies indicate that nearly 20 percent reduction in waste generation is possible through simple housekeeping measure that requires no or marginal investment. Proper design and packaging of products with minimum volume of material and longer useful life can reduce the waste considerably.

ii) Maximise waste recycling and reuse: Though recycling of solid wastes is extensively practised in Bangalore, the full official recognition of the need for promotion of recycling is yet to come. It is only in recent years that the role of this sector has received some attention. Municipal authorities should actively support recyclables at source schemes by strengthening the informal sector, for example by the provision of sites for sorting of recyclables or perhaps by developing bonus schemes for the workers in the informal sector. There are considerable benefits of increasing solid waste recycling and reuse. Source separation and recycling of waste reduces the volume of the waste to be disposed. Promoting recycling as an alternative to the existing forms of waste disposal may be

economically gainful. Authorities may seek competitive bids as the recycling may be a profitable commercial operation generating a net income. Further, thousands of poor people may support themselves and their families by directly or indirectly participating in waste collection and recycling. Many organisations such as Clean Environs, Waste Wise and Centre for Environmental Education in Bangalore help street children and other unemployed people to collect waste from households and give them a right to sell it too.

iii) Encourage waste processing at decntralied levels: Organic waste in Bangalore constitutes around 70 percent and is therefore amenable to composting and biogas generation for energy. It is a form of source reduction or waste prevention as the materials are completely diverted from the disposal facilities and require no management or transportation. Diverting such materials from the waste stream frees up dumping space for the material that cannot be composted. Currently composting is provided for only two markets in Bangalore which should be extended to other markets, hotels, restaurants, and households. Composting is quite viable if there is a market for compost. Thus a better understanding of the process, benefits to the environment and public education can promote the practice of composting at least in the cities where sites and skilled manpower are available and markets can be developed. It is also essential to provide basic training and education of workers in technical, health, and safety aspects. City municipality should compost garden and park waste to reduce the quantum of waste for final disposal. Many resident associations in Bangalore have set up their own composting plants. Biogasification is an excellent option in handling the organic wastes. Once the MSW is segregated into fermentable and non-fermentable fractions, even at a >90% efficiency of sorting, MSW becomes amenable for biogas production. Biogasification has several advantages like net energy output and low odour emissions during treatment. Digested material, compost, with or without a post-composting stage, is safe for disposal as manure. A study carried out at Centre for Sustainable Technologies (formerly ASTRA) at Indian Institute of Science revealed that plug flow digesters are very good for biogasification of MSW as it is an excellent feedstock for biogas production and has a very high gas production (both gas production rate as well as specific gas production) to warrant viable decentralized treatment by anaerobic fermentation to biogas. It also requires very little pre-treatment.

iv) Promote safe disposal of wastes: Wastes are either burnt or dumped in open spaces and these practices should be restricted as they are deleterious to health and the environment. Landfilling occupies the lowest rung in the integrated waste management, though it is a better option than dumping the waste in open spaces. It relies on containment rather than treatment (for control) of wastes. The purpose of landfilling is to bury or alter the chemical composition of the wastes so that they do not pose any threat to the environment or public health. Landfills are not homogenous and are usually made up of cells in which a discrete volume of waste is kept isolated from adjacent waste cells by a suitable barrier. Commonly used barrier is a layer of natural soil (clay), which restricts downward or lateral escape of the waste constituents or leachate. Sanitary landfilling normally has a double liner to prevent leaching into the groundwater. Appropriate run-

off controls, leachate collection and treatment, liners for protection of the groundwater (from contaminated leachate), biogas recovery mechanism (landfill gas contains high percentage of methane due to anaerobic decomposition of organic wastes), monitoring wells, and appropriate final cover design constitute integral components of an environmentally sound sanitary landfill. Proper and regular monitoring should be done at landfill sites.

v) Spatial Decision Support systems: GIS-GPS-MIS systems have proved to be efficient spatial decision support systems (Figure 2) for revolutionizing the waste management systems in Bangalore. A management information system (MIS) aids to manage large amount of spatial and attribute data related to the wards and generate reports (daily, weekly etc) at various levels (city, zone, range etc.) with details of the waste, types of vehicles etc. In Bangalore, trucks are the only means of removing garbage and other waste materials from the city. These vehicles perform multiple trips in a day and it is essential to monitor and track these trucks to improve efficiency. In this regard, global positioning system (GPS) would be helpful and cost effective. It also helps in optimising truck routes thereby increasing the efficiency of the transport mechanism. Analysis of spatial data i.e. land use and land cover pattern, transport network, collection network etc., along with information related to quantity related to quantity and quality of wastes (through GIS: Geographic Information System) enable the authorities involved in waste management to come out with feasible options. These tools have been selected because 80% of information used by the health official has spatial components (city, zone, range and health ward level). Training can be imparted to its personnel in handling and updating the data.

The ISWM approach is designed to minimize the initial generation of waste materials through source reduction, then through reusing and recycling to further reduce the volume of the material being sent to landfills or incineration compared to the conventional approach of simply focusing on disposal of solid waste. Good municipal solid waste management practices require collection of critical information which is not just for keeping the records up to date but for taking corrective measures as well as proper planning for the future. There is also a need for integration and assimilation of information from various levels of jurisdiction. Thus, the strategic approaches for ISWM involve the integration of available data, guidelines and framework and elimination of the constraints. The main objective here is to arrive at a proper storage with least negative environmental impact, efficient collection system, engineered processing and disposal according to the constituents present in the waste stream. Analysis of spatial data, i.e. land use and land cover pattern, transport network, collection network etc., along with the information related to the quantity and quality of wastes (through Geographic Information System) enables the authorities involved in the solid waste management to come out with feasible options. To keep a city clean and maintain healthy environment, the administration has to adopt this approach and set goals for installations to reduce the amount of solid waste being generated, increase the solid waste diversion rate and comply with the existing regulations.

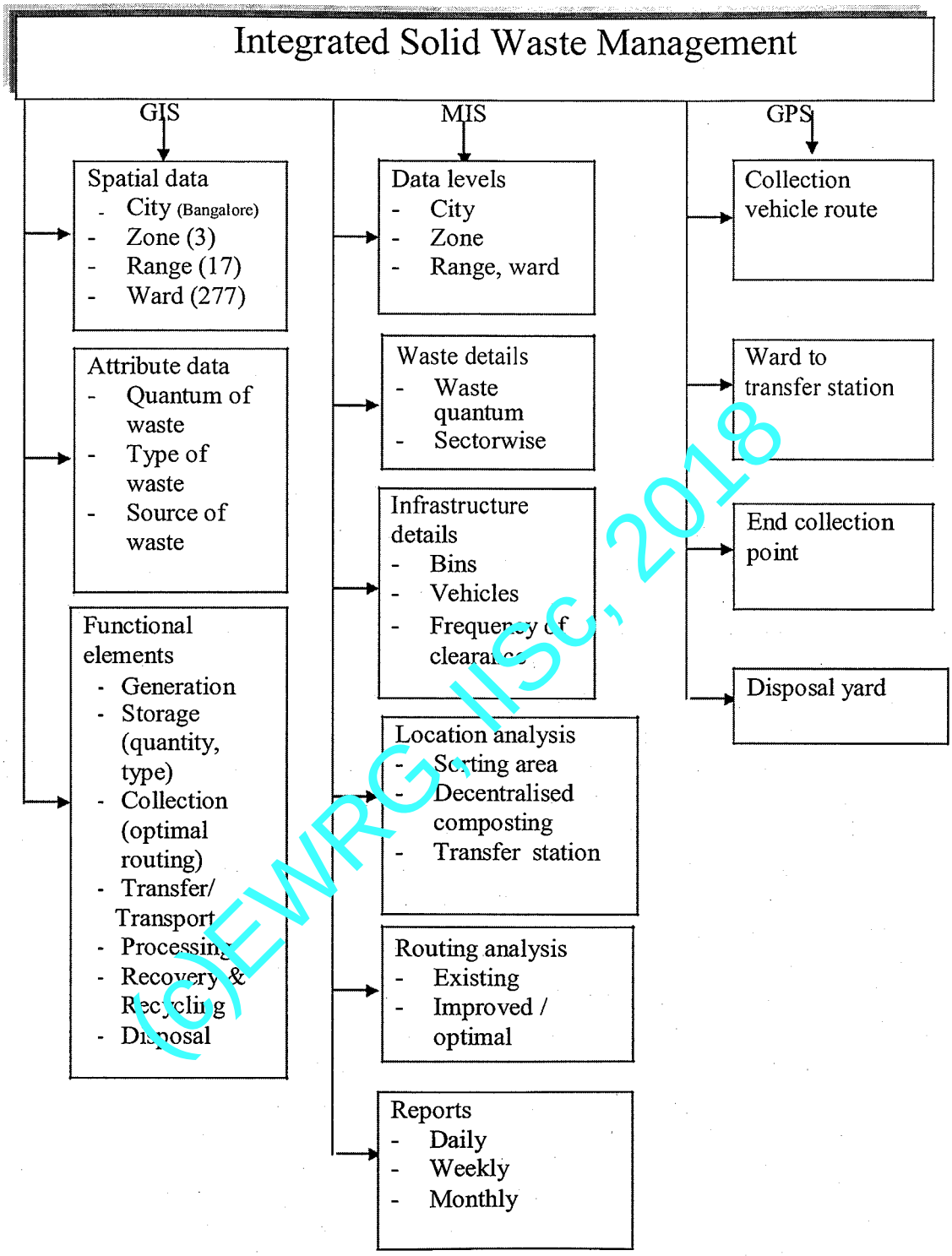

Figure 2: Integrated solid waste management using Geographic Information System (GIS), Management Information System (MIS) and Global Positioning System (GPS)

Focus of the ISWM program includes the following:

1. Assessment of present condition and organizational set up
2. Reduce, reuse and recycle solid waste to the greatest extent possible.
3. Cooperate to the extent practicable in recycling programs conducted by the civilian community (on installations that do not have recycling programs).

4. Pursue the use of joint or regional solid waste management programs and facilities with the government and non-government agencies.
5. Financial support towards infrastructure and maintenance
6. Facilitating community participation in solid waste management activities Intellectual input – research on design, materials, concept
7. Privatize solid waste management facilities or contract for waste disposal services, including recycling.
8. Divert 60% of non-hazardous solid waste from incineration and landfills. Integrated solid waste management programs can demonstrate an economic benefit (when compared with only landfill and incineration disposal).
9. Complying with applicable regulations regarding solid waste management and recycling.
10. Overall monitoring and coordination

CONCLUSION:

Rapid population growth coupled with the increased rate of unplanned urbanization in many cities of the developing world, led to the tremendous increase in the amounts of municipal solid waste (MSW). Mismanagement of solid waste leads to public health risks, adverse environmental impacts and other socio-economic problems. The problems derived from solid waste have a unique and complicated character; they are not only a potential source of pollution, but they can be used as a secondary source of raw materials. Municipal solid waste management (MSWM) is considered a serious environmental challenge confronting local authorities, especially in developing countries. Currently, several countries have realized that the way they manage their solid wastes does not satisfy the objectives of sustainable development. Therefore, there is a move to shift from traditional solid waste management (SWM) options to more integrated solid waste management approaches. The selection of priorities regarding the solid waste management has direct economic and environmental impacts. This procedure concerns not only the environmental policy but also technological, economic and purchasing policies. However, the lack of adequate resources to implement the necessary changes is posing a serious obstacle. The application of planning tools such as Geographic Information System and Geospatial modelling for integrated management of municipal solid waste aided to conserve both natural and man-made resources while achieving economic viability through sustainable options in management and averting ecological risks.

Developments in the waste management systems in Bangalore is slow paced nevertheless a sincere one; however it needs upgradation in the areas of processing and disposal. Political and financial hurdles and lack of cooperation by the public in general has created bottlenecks in improving it's efficiency. The potential of community participation, human resourcedevelopment and legal mandates has to be realised and subsequent changes brought about. Adoptions of latest spatial analytical technologies such as MIS-GPS-GIS system have to be taken into consideration while developing a waste management system for Bangalore. The study on IISc campus can be used as a model for the wards in Bangalore. However for any waste management to be successful, the government should step up and take the required initiatives. Even though financial constraints are a part of the system, the government can make a formal and sincere commitment for an integrated SWM approach, fully recognising the advantages of the existing informal recycling network. Waste recycling can be promoted

through consumer campaigns that will encourage citizens to co-operate in waste separation and to purchase recycled products. Also, waste authorities should encourage composting and biogas generation of wastes, which will reduce the volume of waste to be disposed of. Finally, no SWM can be effective without proper monitoring of its disposal activities. Therefore its effectiveness should be tested on a regular basis. Environmentally sound solid waste management involves

1. Enhance awareness among public about mishandling of waste;
2. Segregation of waste at source (separate organic and inorganic - recyclable, reusable fractions);
3. Door to door collection of waste with incentive based mechanism to enhance segregation at source: This entails (i) deploying appropriate mobile collection vans (for each locality) with an option to store segregated and unsegregated wastes, (ii) incentive of Rs 1 per kg of segregated organic waste and payment directly to the respective household account through bank transfer – Jan Dhan scheme with Aadhaar linkage,
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GHG emissions with the mismanagement of municipal solid waste: case study of Bangalore, India

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Abstract: Municipal solid wastes collected by the agencies dispose at identified disposal sites about 60%, while the balance are disposed-off at unauthorised disposal sites in an unacceptable manner, leading to the environmental consequences including greenhouse gas (GHG) emissions. Mitigation strategy necessitates understanding of composition of waste for its management in an environmentally sound way. The study revealed that the per capita waste generated is about 91.01 ± 45.5 g/day and household per capita waste generation was positively related with household size and income. Organic fraction in municipal solid waste based on the sample household's data is about 74.09 ± 34.94 g/person/day, which constitutes 82% with the strong recovery potential and conversion to energy or compost range. The total organic waste generated is about 231.01 Gg/year and due to mismanagement consequent emissions are about 604.80 Gg/year. Integrated solid waste management strategy is suggested to manage the organic fractions through technology interventions, which helps in mitigating GHG emissions with potential economic benefits.

Keywords: municipal solid waste; MSW; domestic sector; greater Bangalore; socio-economic factors; greenhouse gas; GHG emissions; integrated solid waste management; ISWM; India.

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1 Introduction

Solid wastes are any non-liquid wastes that arise from human and animal activities that are normally solid, comprising organic and inorganic waste materials such as product packaging, grass clippings, furniture, clothing, bottles, kitchen refuse, paper, appliances, paint cans, batteries, etc. produced in a society, which do not generally carry any economic benefits (Ramachandra, 2009, 2011; Getahun et al., 2012). Unplanned urban development coupled with rapid population growth and changes in the standard of living have led to the tremendous increase in the amounts of municipal solid waste (MSW) leading to mismanagement, which include mix of dry and wet wastes (due to insufficient segregation), dumping in drains and open spaces, disposal without treatment for energy or resource recovery. Municipal solid waste management (MSWM) is associated with the control of waste generation, its storage, collection, transfer and transport, processing and disposal in a manner that is in accordance with the best principles of public health, economics, engineering, conservation, aesthetics, public attitude and other environmental considerations. MSWM is considered a serious environmental challenge confronting local authorities (Ramachandra, 2011, 2012a) and current management approaches does not satisfy the objectives of sustainable development throughout the world (Thanh et al., 2011; Seo et al., 2004; Al-Khatib et al., 2010).

Major portion (70-75%) of MSW is organic (Ramachandra, 2009, 2011; Sathishkumar et al., 2011; Ramachandra et al., 2012b; Sharholy et al., 2007) and contribution of inorganic component is gradually changing and is likely to show further changes in the future. However, solid waste management (SWM) still has gaps due to lack of waste segregation at source level, treatment, re-use, recycling and appropriate disposal. Dumping of waste in open areas, roadside is also one of the common practices in developing countries. These approaches have led to public health risks, adverse environmental impacts, haphazard landfilling leads to depreciate the water quality and other socio-economic problems (Abushammala et al., 2009; Diaz et al., 1999; Chattopadhyay et al., 2007; Nickolas and Ulloa, 2007). The organic fraction of waste through treatment forms a secondary source of raw materials.

Treatment of organic fraction of waste alters its physical and chemical characteristics for energy and resource recovery. The important processing techniques include either composting (aerobic treatment) or biomethanation (anaerobic treatment). Composting through aerobic treatment produces stable product-compost which is used as manure or as soil conditioner. In metropolitan cities, compost plants are underutilised due to various reasons, most important reasons are unsegregated waste and production of poor quality of compost resulting in reduced demand from end users (Ramachandra, 2011). Vermi-composting is also practiced at few places. Biomethanation through microbial

action under anaerobic conditions produces methane rich biogas. It is feasible when waste contains high moisture and high organic content. Uncontrolled and unscientific disposal of all the categories of waste including organic waste leads to the environmental problems such as contamination of land, water and soil environment due to leaching of nutrients, etc.

SWM to be effective requires separation of waste at source level with the implementation of 3Rs (reduce, reuse and recycling), treatment of organic fractions of wastes at local levels and disposal at sanitary landfills (Ramachandra, 2011; Tadesse et al., 2008). The indiscriminate dumping, inadequate treatment and poor recovery of organic fractions in urban areas have caused adverse effects on the local ecology, environment (such as air, water and land pollution) and human health (Sharholy et al., 2005; Rathi, 2006; Ray et al., 2005; Kansal et al., 1998; Jha et al., 2003, Gupta et al., 1998; Singh and Singh, 1998; Kansal, 2000). The sustained dumping of solid waste without treatment has overloaded the assimilative capacity of the surrounding environment, necessitates environment friendly treatment and management of solid waste.

Appropriate waste management policy needs to be based on the principle of sustainable development, which considers the society's refuse as a potential resource. SWM facilities are crucial for environmental management and public health in urban regions. Techniques for solving regional waste problems inevitably have a large number of possible solutions due to variable population densities, incomes, multiple (actual and potential) locations for waste management infrastructure, protected landscape areas and high value ecological sites. Due to this, MSW management have received a great deal of attention as the country produces an estimated quantity of 50–600 million tonnes of urban solid waste annually. Environmentally sound waste management depends on various site-specific factors such as the characteristic of the waste, the efficiency of the waste collection and processing systems achieved by different waste management practices, availability of proximity of material for recovery from the waste stream, the emission standards to which waste management facilities are designed and operated, the cost effectiveness of the environmental obtained by different management practices and social performance of the community.

Table 1 Quantity of MSW generation rate in Metro cities

Sl. no.	*Name of city*	*Waste quantity (TPD)*
1	Greater Bangalore	1,800–3,600
2	Greater Mumbai	3,200
3	Ahmadabad	1,200
4	Kanpur	2,142
5	Lucknow	600
6	Chennai	1,819
7	Pune	1,000

Sources: Ramachandra (2009, 2011, 2016) and Chanakya et al. (2007)

The waste generation quantum depends mainly on the consumption patterns, seasons, lifestyle and socio-economic factors. The per capita waste generation is expected to increase annually by 1.33% (Pappu et al., 2007; Shekdar, 1999; Bhide and Shekdar,

1998). Table 1 lists the quantity of waste generated in the metro cities of India, which highlight that the waste quantity generation is high in Chennai, Greater Bangalore and Greater Mumbai due to the standard of living and urbanisation. However, waste generated is comparatively low in the Pune and Lucknow (Ramachandra, 2009; Chanakya et al., 2007).

Quantification and assessment of characteristics of waste through door-to-door survey during two seasons (dry season and wet season) in the Can Tho city the capital of the Mekong Delta region (Thanh et al., 2010) show that an average household solid waste (HSW) generation is about 285.28 g/person/day (including 283.10 during dry season and 287.46g/person/day). Statistical analysis reveal that household quantity waste is positively correlated with the population density, urbanisation level and negatively correlated with household size. Total greenhouse gas (GHG) baseline emission by the HSW is estimated as 153.41 tons per day carbon dioxide equivalent, while compostable and recyclable accounted 80.02% and 11.73% respectively.

Ramachandra and Varghese (2003) explored the possibilities of achieving sustainable management of solid waste using Bangalore as a case study. The strategies include community participation, human resource development, legislative mandates and adopting recent technologies like GIS-GPS and GIS System. Environmental audit of MSW management for Bangalore city was done by Ramachandra and Bachamanda (2007) by collecting the data from government agencies, field survey and interview with stakeholders.

Mismanagement of municipal solid waste is a vital source of anthropogenic GHG such as methane (CH_4), biogenic carbon dioxide (CO_2) and non-methane volatile organic compounds (NMVOCs), etc. (Ramachandra, 2009; Ramachandra et al., 2015; Thanh et al., 2010). Among these, Methane is considered as a potent

GHG having global warming potential (GWP) 25 times greater than that of carbon dioxide and concentration of atmospheric methane is annually increasing at 1–2% (Kumar et al., 2004a; IPCC, 1996). Emission of methane from landfill accounted 3–9% of the anthropogenic source in the world (IPCC, 1996; Kumar et al., 2004b).

The organic components in the waste dumps and landfills generate about 60% methane (CH_4) and 40% CO_2 together with other trace gases during anaerobic decomposition (Hegde et al., 2003; Jha et al., 2008). This would vary depending on the waste composition, age, quantity, moisture content and ratio of hydrogen/oxygen availability at the time of decomposition (Jha et al., 2008). Evaluation of the quantitative and qualitative characteristics of MSW in Allahabad city (Sharholy et al., 2007) through door-to-door survey show the average generation rate varies from 0.37kg/capita/day to 0.44kg/capita/day and the total quantity of MSW is about 500 ton/day.

Quantum of MSW has increased from 650 tonnes per day – tpd (1988) to 1,450 tpd (2000) (Ramachandra et al., 2012) and 3,000–3,600 tpd (2016) due to the increase in population with the expansion of spatial extent. The daily collection is estimated at 3,000 tpd with a per capita generation from 0.16 kg/d (1988) to 0.58 kg/d (2009). Table 2 and Table 3 list composition during different time period and physical composition at different levels. Among which, residence (household waste) is the foremost contributor to the total waste stream with a high proportion of biodegradable waste, i.e., 72%.Presently, a quasi-centralised collection system is employed in Bangalore and the waste collection system from households (HH) closely follows the MSW (handling and management) MSW (H&M) rules 2000, employing door-to-door collection. In most of residential area the provision of dustbin is removed to avoid the multiple handling of waste (Chanakya

et al., 2010; TIDE, 2000).The city has been facing severe shortage of landfills to dump garbage due to unplanned urbanisation. Bruhat Bangalore Mahanagara Palike (BBMP) is responsible for management of solid waste.

Table 2 Composition of MSW generation in Bangalore

Components	*Composition (% by weight)*			
	All over Bangalore, 1988	*All over Bangalore. 2000*	*IISc, residential area. 2001, 2015*	*All over Bangalore*
Fermentable	65	72	72.5	60
Paper	8	11	18	12
Miscellaneous	12	1.9		1
Glass	6	1.4		4
Polythene/plastics	6	6.2	9.5	14
Metals	3	1		1
Dust and sweepings		6.5		

Sources: Rajabapaiah (1988), TIDE (2000), Sathishkumar et al. (2001), Ramachandra (2016) and BMP

Table 3 Physical composition of MSW in Bangalore

Waste type	*Composition*						
	Domestic	*Markets*	*Hotel and eatery*	*Trade and commercial*	*Slums*	*Street sweeping and parks*	*All sources*
Fermentable	71.5	90	76	15.6	29.9	90	72
Paper and cardboard	8.39	3	17	56.4	2.49	2	11.6
Cloth, rubber, PVC, leather	1.39		0.33	3.95	0.54	0	1.01
Glass	2.29		0.23	0.65	8.43	0	1.43
Polythene/plastics	6.94	7	2	16.6	1.72	3	6.23
Metals	0.29		0.26	0.38	0.23	0	0.23
Dust and sweeping	8.06		4	8.17	56.7	5	6.53

Sources: TIDE (2000) and Ramachandra (2009, 2016)

During the early stages, a large part of the organic fraction of city wastes were sent to a compost plant situated outside the city limits Karnataka Compost Development Corporation (KCDC). In 1988, the city was producing 650 tpd, among this about 100 tpd of market wastes were taken back for direct application on the land and another 150 tpd was handled by KCDC. A large segment of decomposable was 'open dumped' along the various arterial roads at outskirts of the city (Rajabapaiah, 1988). This trend of open dumping had continued beyond 2000. Today as the wastes generated has increased drastically; most wastes are being openly dumped at about 60 known dumping sites and many unrecorded sites. Composting accounts for 3.14%, but with increase in urban solid waste, the number of compost plants has not increased. Among these, more than 35 sites

possess a mixture of domestic and industrial waste (Lakshmikantha, 2006). This highlights that the existing solid waste treatment methods in the city are neither efficient nor well-organised. Taking cognisance of the prevailing situation of waste mismanagement, The Government of India introduced statutory waste minimisation, treatment and environmentally sound management to address the earth's dwindling resources and the growing mountains of waste (MSWM, 2000; SWM, 2016).

Earlier studies concerning the MSW of Bangalore have mainly focused on various aspects of solid waste such as composition, generation and disposal. This includes various waste handling practices in Bangalore city (Sathishkumar et al., 2001), exploring options for handling wastes at decentralised levels (Ramachandra and Varghese 2003; Chanakya et al., 2009), comparative assessment of community bins and beneficial aspects of door to door collection systems, etc. These efforts have not captured the various factors that generate HSW, and its last stage of the life cycle. Further, the growing concern of GHG emissions necessitated the quantification of waste and GHG emissions with options to mitigate environmental implications. Estimation of the emission of methane from MSW disposal sites in India by using default, modified triangular methodology and by field investigation (Kumar et al., 2004b), show methane emission of 14.206 Gg, 7.667 Gg and 1.776 Gg respectively. The GHG emission from MSW management in Indian mega-cities, Chennai (Jha et al., 2008) based on IPPC tier I (default emission factors and other parameters as per IPCC guidelines) and tier II (applies country specific emission factors and other parameters) methods for estimating the CH4 emission for the year 2000 from Kodungaiyur (KDG) and Perungudi (PGD) landfill sites, showCH4 emission of 8.1 Gg (for KDG with the waste of 314 Gg) and 9.8 Gg (for PGD with the waste of 379 Gg) respectively. Emission fluxes were estimated by using Gas chromatography (GC-SRI, USA, Model 8610C) flame ionisation detector and with the knowledge of an area of landfills, CH_4 annual emissions of 0.12 Gg y^{-1}, N_2O emission of 1 ty^{-1} and 1.16 Gg y^{-1} CO_2 emission.

In this regard, objectives of the current study are to

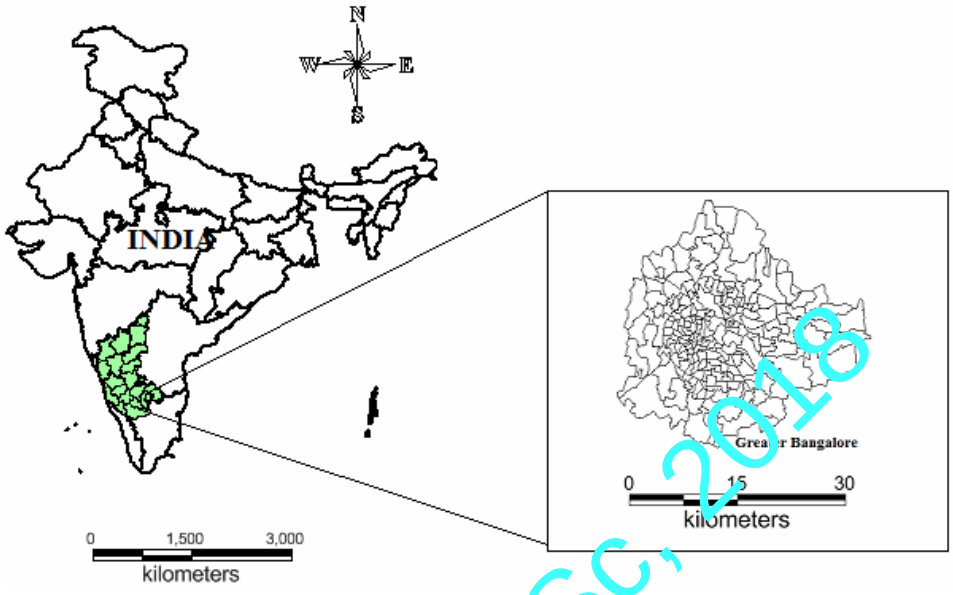
1 determine the composition of waste and the rate of generation of HSW
2 SWM being practised at household level
3 assess GHG emissions from the HSW
4 capture the role of various socio-economic factors that affect the generation, composition and management of solid waste.

2 Materials and methods

2.1 The study area

Bangalore is the administrative, cultural, commercial, industrial and knowledge capital of the state of Karnataka, India currently with a population of about 7 million and area of 741 sq. km. and lies between the latitude 12°39'00" to 13°13'00" N and longitude 77°22'00" to 77°52'00" E (Figure 1). It is situated at an altitude of 920 metres above the sea level where as the winter temperature ranges from 12°C–25°C, while summer temperature ranges from 18°C–38°C. Mean annual precipitation is 880 mm. (Ramachandra and Kumar, 2010, 2008; Sudhira et al., 2007).

Figure 1 Study area – greater Bangalore with the administrative wards (see online version for colours)



Bangalore city administrative jurisdiction was redefined in the year 2006 by merging the existing area of Bangalore city (221 sq. km) spatial limits with eight neighbouring urban local bodies (ULBs) and 111 Villages of Bangalore Urban District. The spatial extent of Bangalore now is 741 sq.kms with 198 administrative wards consisting of diverse economic and social back ground families (Ramachandra and Kumar, 2008, 2010; Sudhira et al., 2007). Bangalore city population has increased enormously from 65, 37, 124 (in 2001) to 95, 88, 910 (in 2011), accounting for 46.68 % growth in a decade (http://censuskarnataka.gov.in). Population density has increased from as 10,732 (in 2001) to 13,392 (in 2011) persons per sq. km. From 12st to 21st century the Bangalore grew rapidly due to intensified urbanisation coupled with improper planning and become one of the fastest growing cities in the world (Ramachandra et al., 2012).

2.2 Methods

Assessment of the spatial patterns in GHG emissions due to solid waste generated in the municipality involved

1 Primary survey of sample household chosen randomly through the pre-tested and validated structured questionnaire

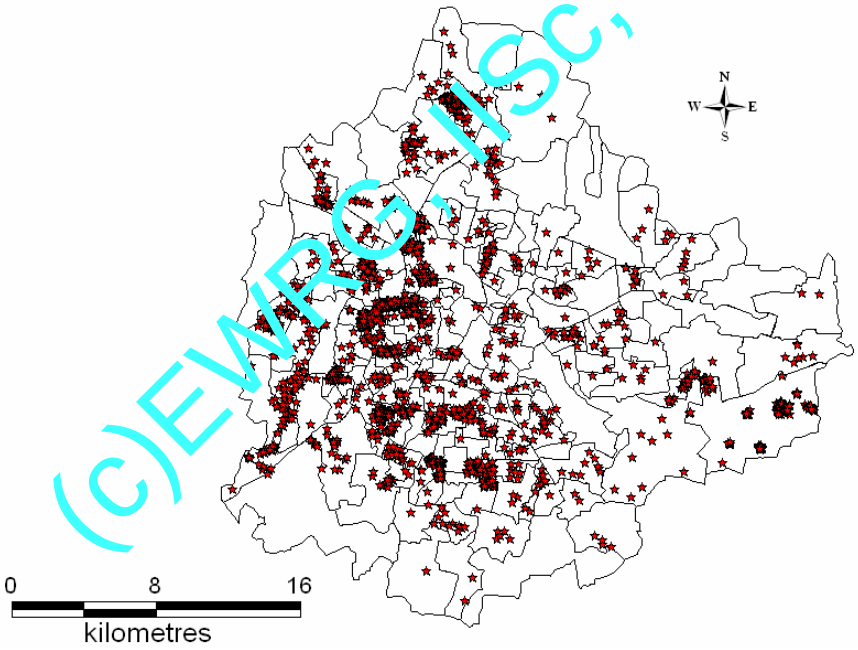
2 Compilation of ward-wise waste generation and composition data from the government agencies.

The survey at local levels (at ward levels – administrative units in a city to manage solid waste) helps to identify the problems and aid in evolving appropriate strategies for management of solid waste including the planning of household waste treatment options and its infrastructure.

3 Data collection

The structured questionnaire was designed to elicit information related to community attitude towards waste management behaviours and socio-economic factors. The questionnaire was pre-tested through a sample survey of about 60 households before taking up large scale survey. Multistage, stratified random survey of urban residences was conducted covering 1967 households during 2011–2012. These households represent heterogeneous population belonging to different income, education, and social aspects. Spatial distribution of 1967 households in eight zones (North, North East, East, South East, South, South West, West and North West) covering 138 wards is shown in Figure 2. The survey also considered parameters such as waste generation quantity, waste collection, time, frequency, number of persons involved in waste collection, collection is done, size of bin, distance of the bin from house, bin clearance time, transportation of waste, landfill site, distance of transportation of waste and socio-economic parameters such as income, household size, employment status, education level of the head of the family 1916 households responded to the quantity of solid waste generation per day.

Figure 2 Spatial distribution of residential houses in the surveyed area (see online version for colours)



4 Analysis method

Simple statistical analysis was done to assess the relationship between solid waste generation and socio-economic factors. Spatial distribution of houses and CO_2 equivalent emission from the wards of Bangalore were generated using GIS software MapInfo 7.5. In addition, the per capita generation rate was estimated using equation (1) and total

quantity of waste is computed using equation (2) (Shwetmala et al., 2012; Ramachandra et al., 2015).

$$\text{Generation rate (gram/capita/day)} = \text{Quantity of household waste (gram/day)/Population} \quad (1)$$

$$\text{Total quantity of waste (gram/day)} = \text{Generation rate (gram/capita/day)} * \text{ward population} \quad (2)$$

Mismanagement of solid waste, which are rich in organic components emits GHG such as CO_2, Methane (CH_4). The overall carbon footprint is calculated in terms of CO_2 equivalent emissions. The GWPs for the relevant greenhouse gases used were: 1 (CO_2), 23 (CH_4), which are used to convert emission of different gases to carbon equivalents. CO_2 equivalent emission from the solid waste is quantified through equation (3) (Ramachandra et al., 2015).

$$CO_2 \text{ equivalent emission} = (W * EF_{CO_2}) + (W * EF_{CH_4} * GWP_{CH_4}) \quad (3)$$

Where, W is organic waste (gram/day); EF is the emission factor (0.016 Gg/Gg of waste for methane, which is equal to the EF obtained from MTM reported from landfills of Delhi (Kumar et al., 2004b) and lower than the value reported from Chennai landfill site (Jha et al., 2008) and 2.25 Gg/Gg of waste for carbon dioxide), GWPCH4 is GWP of 23 for CH4.

5 Results

5.1 Analysis of quantity of waste generation

Quantification (measured using weighing balance) of waste generated per household based on the survey of 1967 households is about 772 kg per day. Table 4 lists the per capita waste generation composition along with descriptive statistics. It reveals that the per capita waste generated is about 91.01 ± 45.5 g/day and organic fraction is 74.09 ± 34.94 g/person/day. Per capita waste generated is positively related with household size and income. Table 5 provides the waste composition, which reveals that organic fraction constitute the major share (81.96%) followed by paper (12.69%)

Zone wise analysis indicates the variability of waste generated in each zone given in Table 6. The few notable factors which are responsible for the variations are change in the food habits, affluence, income and change in lifestyle. The average organic waste ranges from 66.24 ± 36.77 g/person/day (South East) to 78.84 ± 33.02g/person/day (East) and inorganic waste contributes about 24.71 g/person/day (South, North West) to 31.13 ± 34.19 g/person/day (East). The organic fraction (kitchen) was the largest component which accounts 82% of the total, paper waste is 13% next to kitchen waste. Earlier studies have reported (Chanakya et al., 2005) a relatively lower value, indicating the increase of organic fraction from 72% (in 2005) to about 82%. Higher proportion of organic fraction in MSW and open dumping in absence of appropriate treatment leads to the release of GHG. This necessitates quantification of GHG and appropriate measures to mitigate GHG emissions through the treatment of organic fractions in MSW. Studies

done in the neighbouring developing countries, show 66% (Sujauddin et al., 2008) and 90% of Organic waste (Bandara et al., 2007). Figure 3 illustrates the spatial distribution of per capita waste generation per day. It indicates that majority of households, i.e., 926 households generates 50 to 100 g of waste. 497 households generates 100 to 150 g followed by 214 households generates less than 50 g and 155 households generates 150 to 200 g. Table 7 compares city wise the physical composition of household waste, which reveals that MSW in Bangalore has a higher share of organic fractions compared to other cities. The most apt way to treat the waste rich in organic fractions is decentralised systems of either bio-methanation or composting.

Figure 3 Spatial distribution of per capita waste generation of sample (see online version for colours)

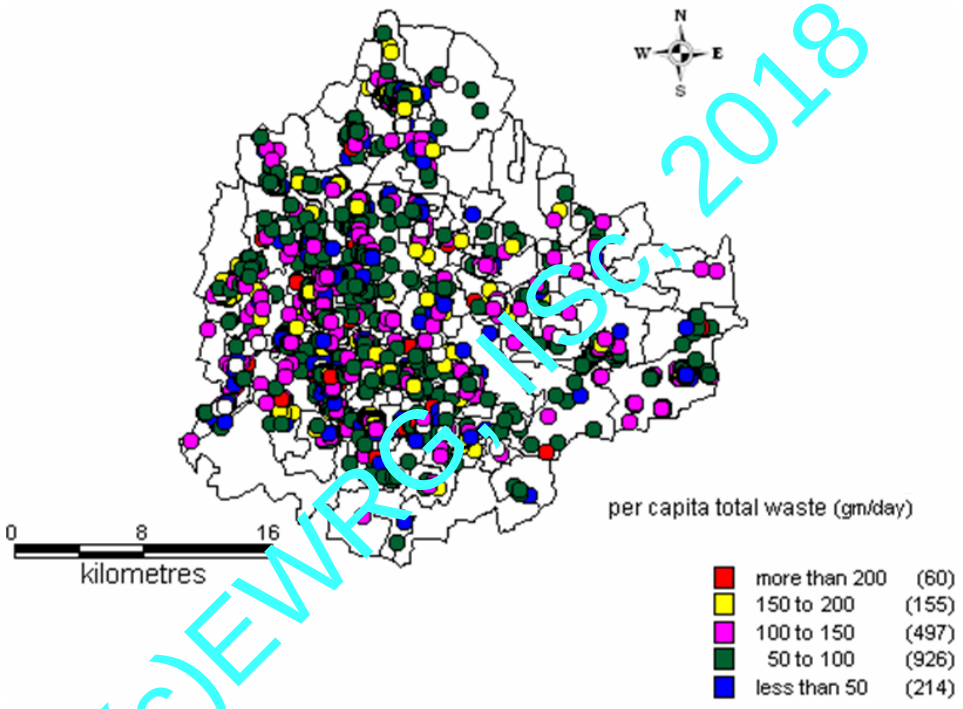


Table 4 Waste generation (g/capita/day)

	Mean	*Skewness*	*Std error*
Organic	74.09 ± 34.94	0.72	0.81
Paper	19.18 ± 22.22	2.88	0.65
Metal	10.66 ± 11.87	1.94	0.71
Glass	6.8 ± 5.01	0.69	0.39
Others	4.53 ± 1.74	5.11	0.04

Table 5 Percentage of composition of waste from surveyed area

Composition of waste	*Percentage of waste composition*
Organic	81.96
Paper	12.69
Metal	1.67
Glass	0.65
Others	3.02

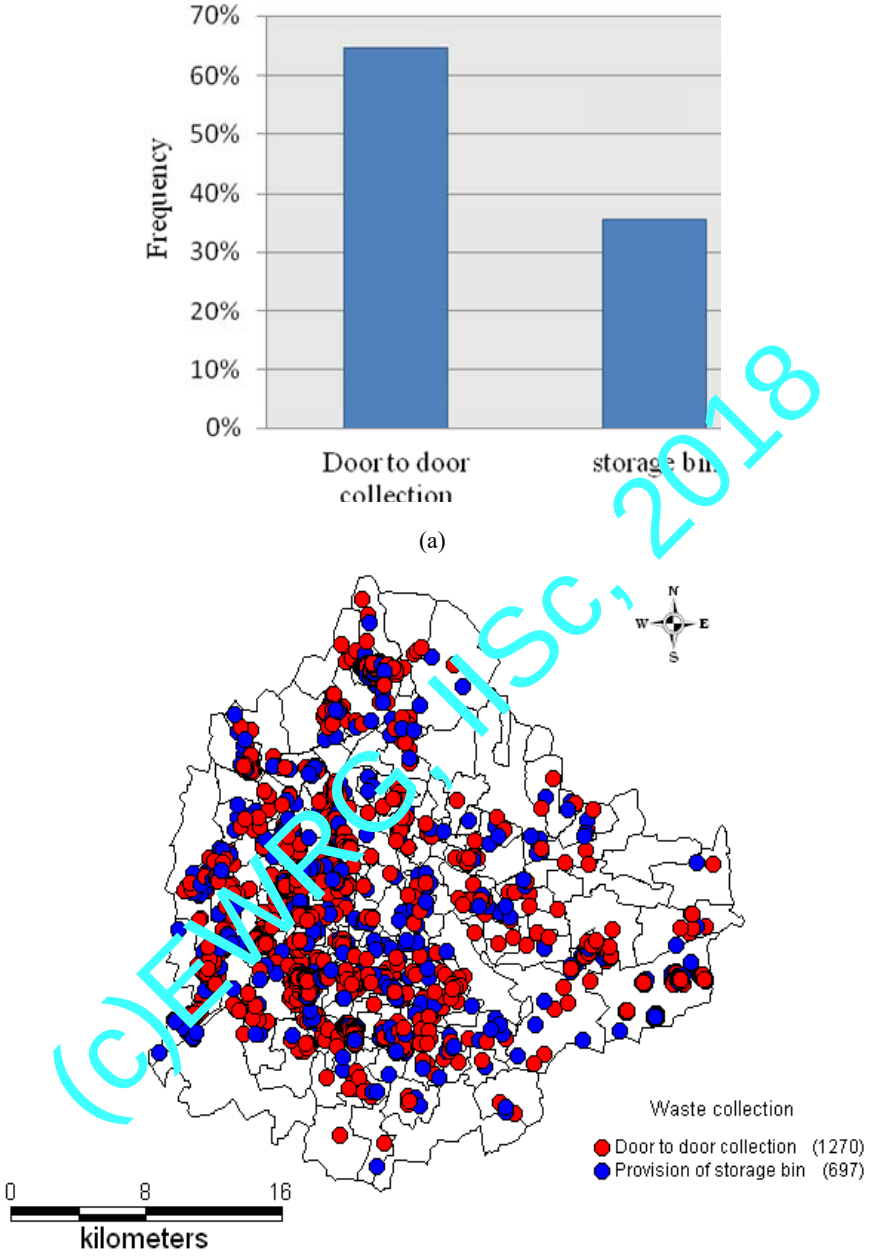
Table 6 Statistical analysis of waste generation (g/capita/day) across the zone

Zones	*Parameters*	*Mean*	*Minimum*	*Maximum*	*SD*	*Skewness*	*Std error*
East	Organic	78.84	4.67	187.50	33.02	0.55	2.03
	Inorganic	31.13	0.63	173.33	34.19	2.25	2.73
NE	Organic	78.70	12.50	150.00	31.60	0.27	6.20
	Inorganic	29.98	2.50	125.00	33.35	1.78	8.34
North	Organic	71.76	6.67	250.00	35.33	0.87	2.07
	Inorganic	24.82	1.00	186.67	29.07	2.63	2.09
NW	Organic	69.14	10.00	200.00	32.51	0.87	2.09
	Inorganic	24.71	0.83	200.00	29.88	2.76	2.40
SE	Organic	66.24	12.00	166.67	36.77	0.73	5.61
	Inorganic	29.70	2.00	166.67	39.85	2.28	7.67
South	Organic	74.22	12.00	250.00	37.39	0.88	2.20
	Inorganic	24.71	1.25	137.50	26.36	2.01	1.93
SW	Organic	74.38	11.11	175.00	34.22	0.48	2.17
	Inorganic	26.56	1.25	187.50	29.85	2.26	2.42
West	Organic	75.74	4.17	222.22	35.52	0.70	1.69
	Inorganic	24.37	1.00	208.33	32.66	2.28	1.88

5.2 SWM at household level in greater Bangalore

The collection, transportation and disposal of MSW are significant aspects of waste management. Waste collection [Figure 4(a)] is done either through door-to-door collection systems (64.57%) or through community bins (35.43%). Wards in Bangalore has both community bin and door to door collection system (ex., Bellandru, Varthur, Yelahanka Satellite Town, Vidyaranyapura and Arekere). Households are served with door-to-door collection system [Figure 4(b)] in majority of the wards (Sunkenahalli, Kormangala, Malleshwaram). In Bangalore city, the waste collection is done by the BBMP or outsourced agencies. Swachha Bangalore (or clean Bangalore) a novel initiative was launched in 2003 by the city municipality to manage the waste effectively through door to door collection, segregation at source, etc.

Figure 4 Waste collection (see online version for colours)



(a)

(b)

In majority of wards (64%) the waste is collected in the morning (6.00 am to 11.30 am) and only in 21 households [Figure 5(a)] from surveyed area the waste is collected in the evening mainly in the part of Yelahanka Satellite Town and Herohalli and in 0.36% households [Figure 5(b)], waste is collected in the afternoon.

Figure 5 Time of waste collection (see online version for colours)

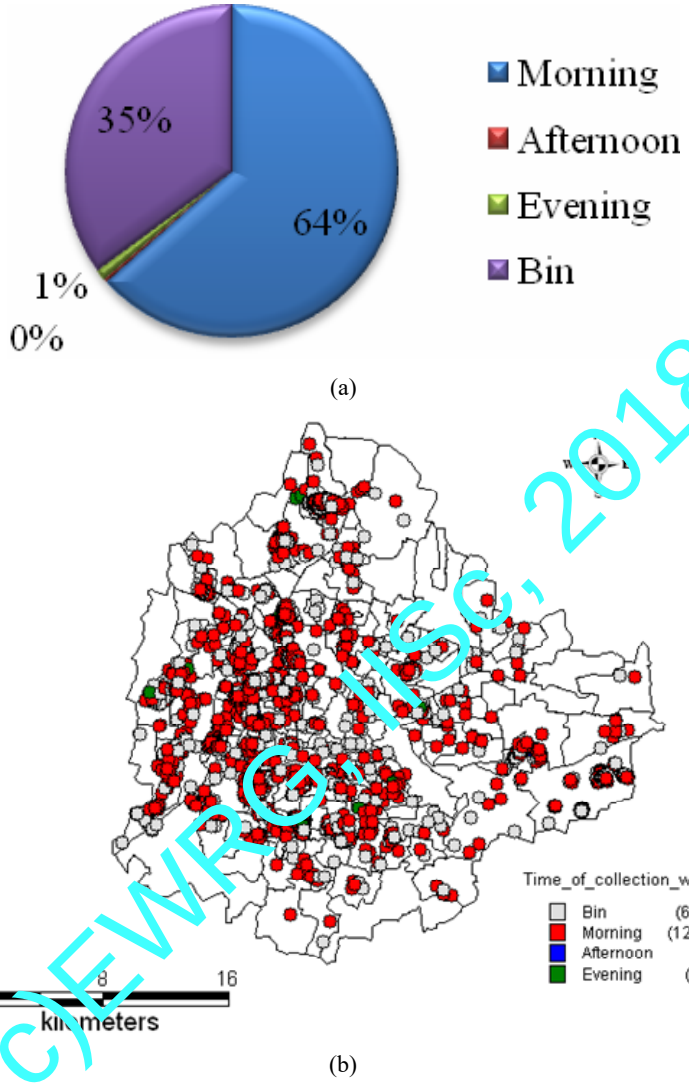
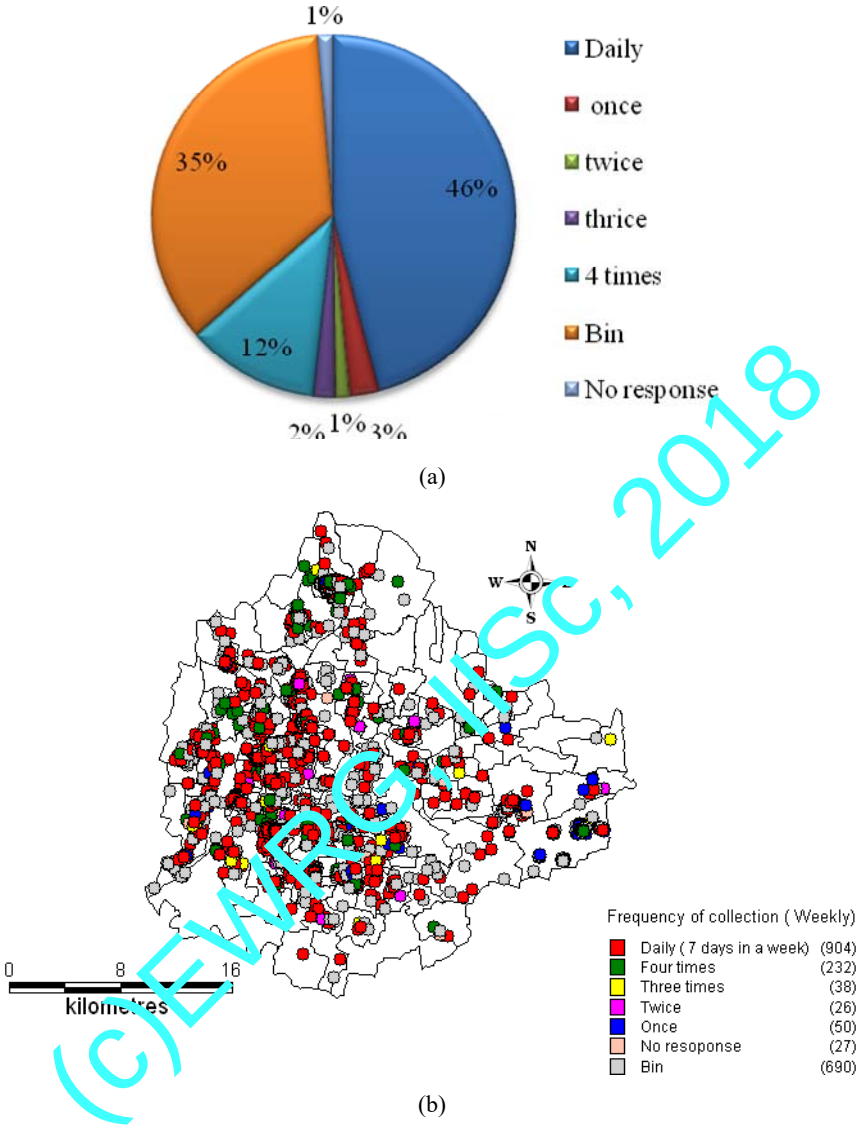


Table 7 Comparison of Household waste generation in different cities (as percentage)

City	*Organic*	*Paper*	*Plastics*	*Metal*	*Glass*	*Textile*	*Wood*	*Others*
Bangalore (India)	84	12	-	1	1	-	-	2
Bejing (China)	69.3	10.3	9.8	0.8	0.6	1.3	2.7	-
Cape Haitian (Republic of Haitian)	65.5	9.0	9.2	2.6	5.8	-	-	7.9
Chittagong (Bangalesh)	62	3	2	-	5	1	3	-

Source: Qu et al. (2009), Philippe and Culot (2009) and Sujauddin et al. (2008)

Figure 6 Frequency of collection (see online version for colours)

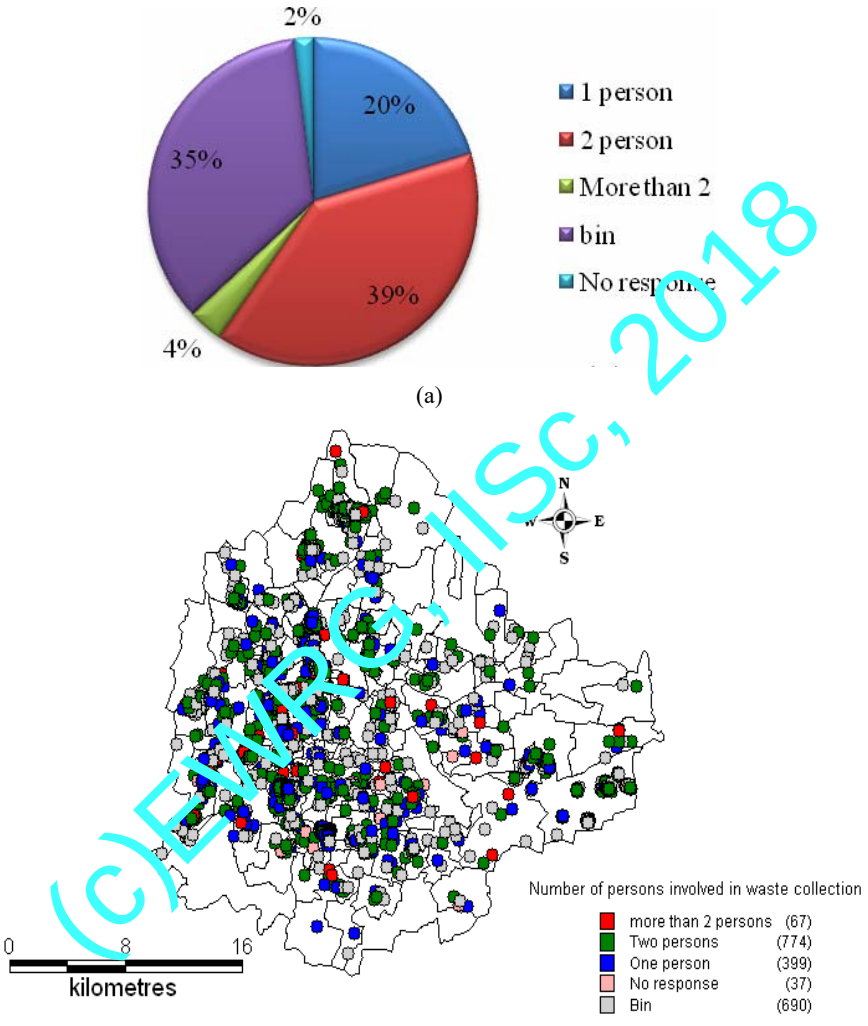


The frequency of collection of waste from door-to-door given in Figure 6a, which highlights of daily waste collection in 46% wards (ex., Sampangiram Nagar at centre of the city, Raja Rajeshwari, Malleshwaram, Rajajinagar, Jayanagar, Bellendur), while weekly four times in 12% wards (ex. Varthur, Hagadur, Kadugodi, Singasandra), thrice a week in 2% wards, twice a week in about 1% wards, once a week in 3% wards. Remaining 1% of the population did not respond to the question [Figure 6(b)].

Number of persons involved in door to door collection of waste was also surveyed and is represented in Figures 7(a) and 7(b) respectively. In most of the wards two persons were involved in collecting the waste (39%) followed by one person (20% of the total area). Figure 8(a) illustrates that 35% area have the facility of community bin and 37

households did not respond to the question [Figure 8(b)]. Municipalityis engaged in waste collection from households to final dumping sites in most (90%) parts of the city. In few areas, 8%private contractor and 2% NGO's (Swabhimana, Swachha Bangalore, Shuchi Mitras) are involved in waste collection.

Figure 7 Persons involved in door to door collection (see online version for colours)



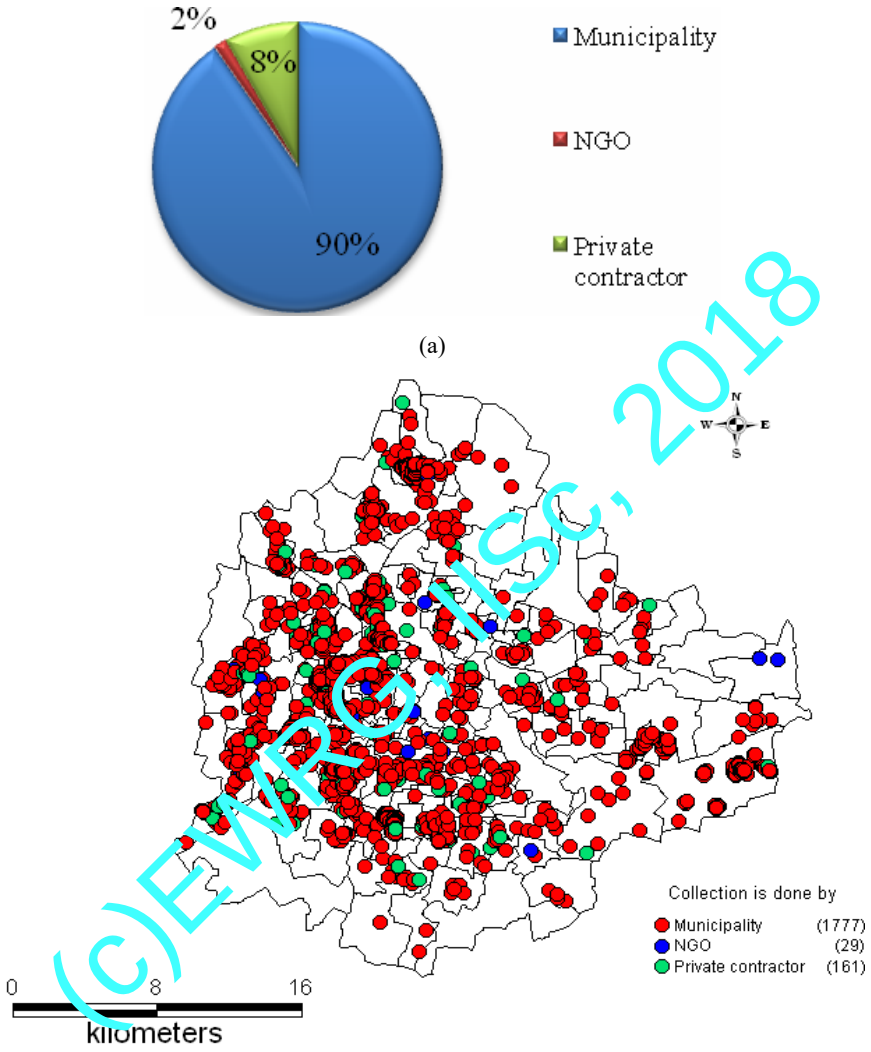
(a)

(b)

The analysis of distance of community bin from the households as represented in Figures 9(a) and 9(b), show that the dustbin is within 100 metre in 23% of the surveyed area, while in 11% area, bins is in the range of 100–500 metre away and ten household did not respond to the question. Remaining houses are served with the door to door collection system. Figure 10(a) and 10(b) reveals that bin size of 1 m^3 accounts 13.5% whereas in 7% area has less than 1 m^3 bin, and majority households (64%) have the facility of door to door collection system of waste. Depending on the local culture,

tradition and attitudes towards waste, the bins are allocated and there are two types of storage bins; stationary bin and hauled bin.

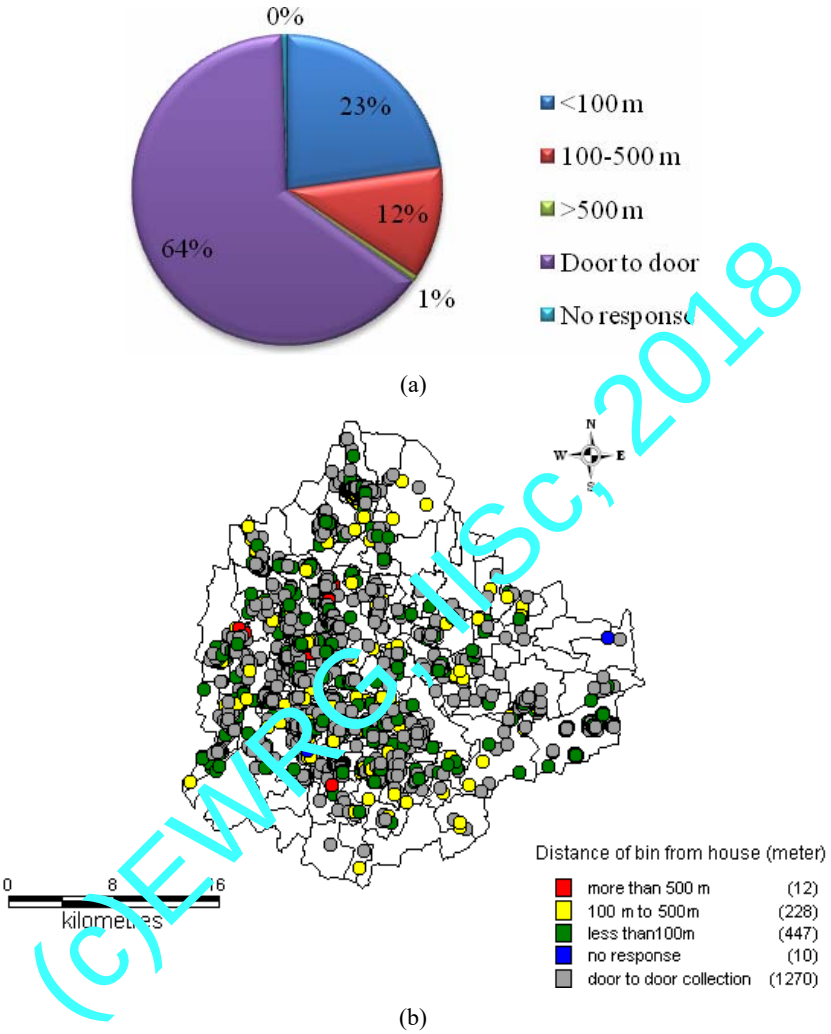
Figure 8 Collection of waste (see online version for colours)



Analyses of the source segregation given in Figures 11(a) and 11(b) respectively, highlight that about 78.34% households do not segregate the waste before dumping into dustbin because of lack of awareness and general attitude of public towards segregation of solid waste, while 21.66% segregate the waste into organic and inorganic waste or dry and wet waste in the south part of Bangalore (ex., Varthur, Dodda Nekundi, HBR layout, Basavanagudi, etc.). Street bin is cleared of litter by the municipality in the locality show that in majority of wards the bin is cleared weekly which accounts 45% while in other

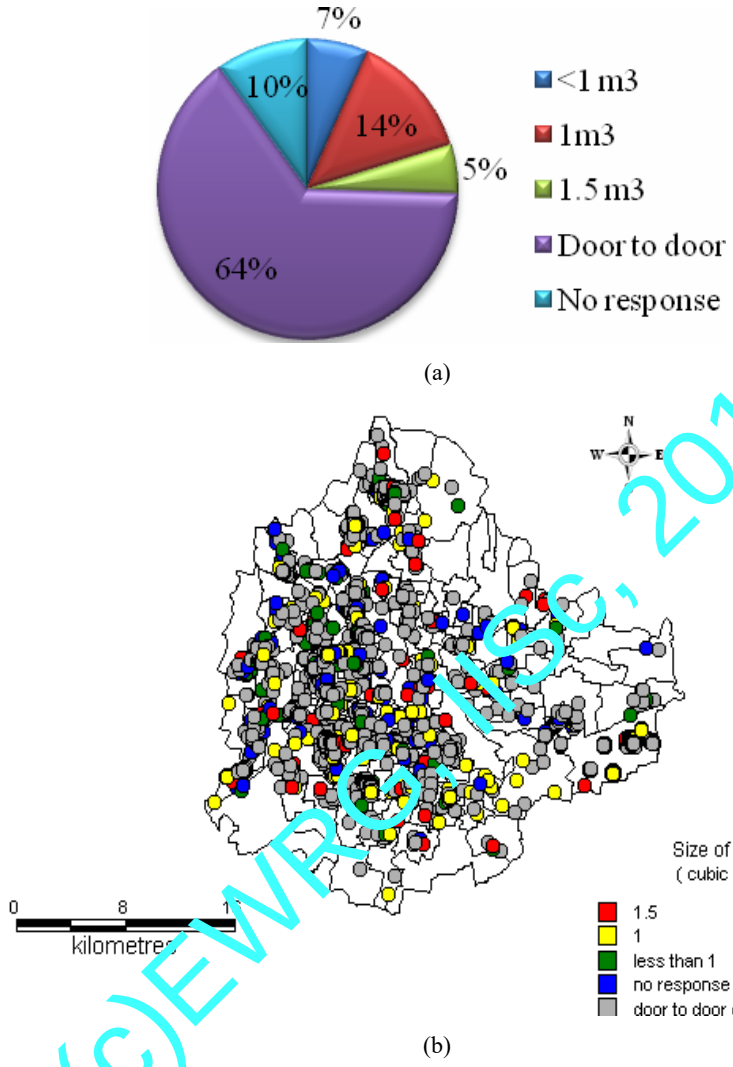
wards bin is cleared daily and 2/3 days once were 42% and 13% respectively [Figures 12(a) and 12(b)].

Figure 9 Distance of the bin from house (in metre) (see online version for colours)



Finally transportation of waste plays an important role in waste management of the city. The transportation of waste and distance of transportation of waste are illustrated in Figures 13(a), 13(b), 14(a) and 14(b) respectively. About 85% of households are not aware about the final destination of transported waste (final dumping site) and only 205 households were aware about the transportation of waste. Among 205 households, 9% stated that the waste is transported between the range of 10–100 km where as 4% stated less than 10 km and 1% stated that waste is transported greater than 100 km and 28 households did not respond to the question. Figures 15(a) and 15(b) reveal that of 71% of the region has no provision of landfill site, while landfill exists only in 28% area mainly in the north-east and west part of the outskirts in the Bangalore.

Figure 10 Size of the bin (see online version for colours)



5.3 Survey of socio-economic factors

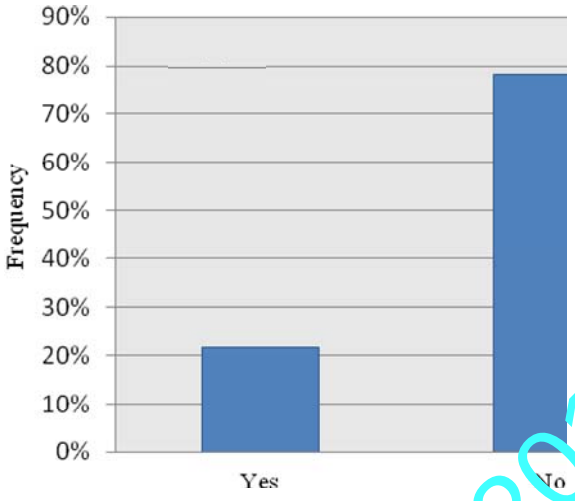
A number of socio-economic parameters such as household size, income, employment status and education status influence the quantum of solid waste generated. Table 8 shows the frequency, percentage and cumulative percentage of the socio-economic factors of households. It indicates the average household size is 4.5 ± 1.74 persons/hh. Majority of the households have four (45.86%) persons, followed by five persons

(19.2%), three persons (15%), six persons (13.9%), greater than six (5.4%), etc. The education and employment status mainly influence the food habits, materials consumed and waste generation. Graduates constitute 36.71% followed by high school educated (24.66%). The average monthly income INR 35,563.63 ± 77,851, which is similar to earlier studies (Sankoh et al., 2012; Getahun et al., 2012; Dennison et al., 1996).

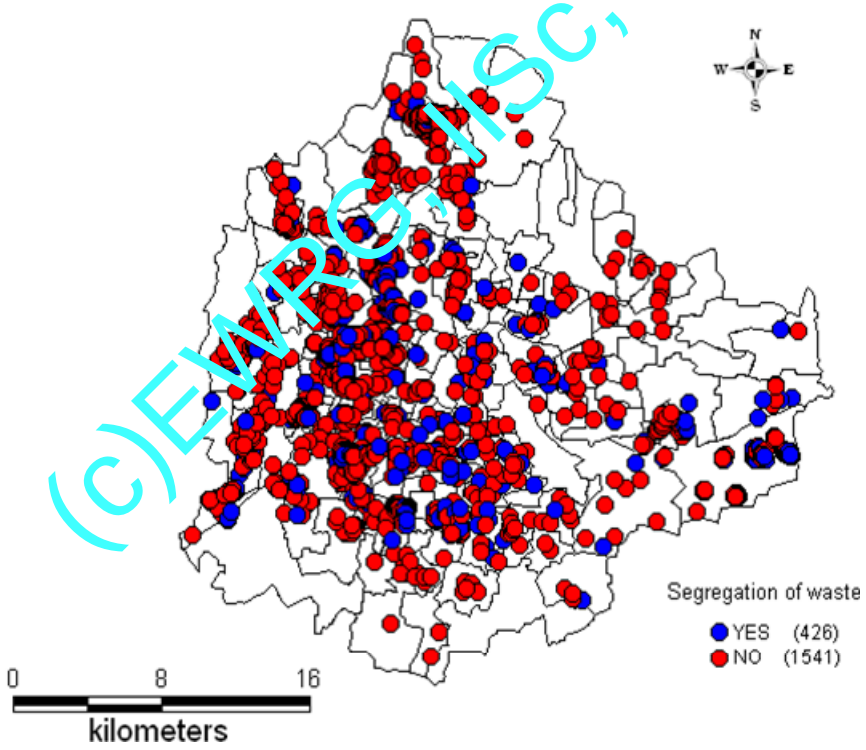
Table 8 Frequency, percentage and cumulative percentage of the socio-economic factors

Variables name		*Frequency*	*%*	*Cumulative %*
1	Family size			
	2	20	1.02	1.02
	3	286	14.54	15.56
	4	902	45.86	61.41
	5	378	19.22	80.63
	6	146	7.42	88.05
	More than 6	128	6.51	94.56
	No response	107	5.44	100.00
2	Education status			
	Middle school or lower	134	6.81	6.81
	High school	485	24.66	31.47
	Technical school	278	14.13	45.60
	Universities	722	36.71	82.31
	Masters	269	13.68	95.98
	PhD	79	4.02	100.00
3	Employment status			
	Government institution	460	23.39	23.39
	School/hospital/research or design institute	83	4.22	27.61
	Foreign corporation	113	5.74	33.35
	Local company	235	11.95	45.30
	State corporation	67	3.41	48.70
	Business institute	391	19.88	68.58
	Others	587	29.84	98.42
	No response	31	1.58	100.00
4	Monthly income			
	< 10,000	509	25.88	25.88
	0000–50,000	1192	60.60	86.48
	50,000–100,000	183	9.30	95.78
	>100,000	83	4.22	100.00

Figure 11 Segregation of waste (see online version for colours)

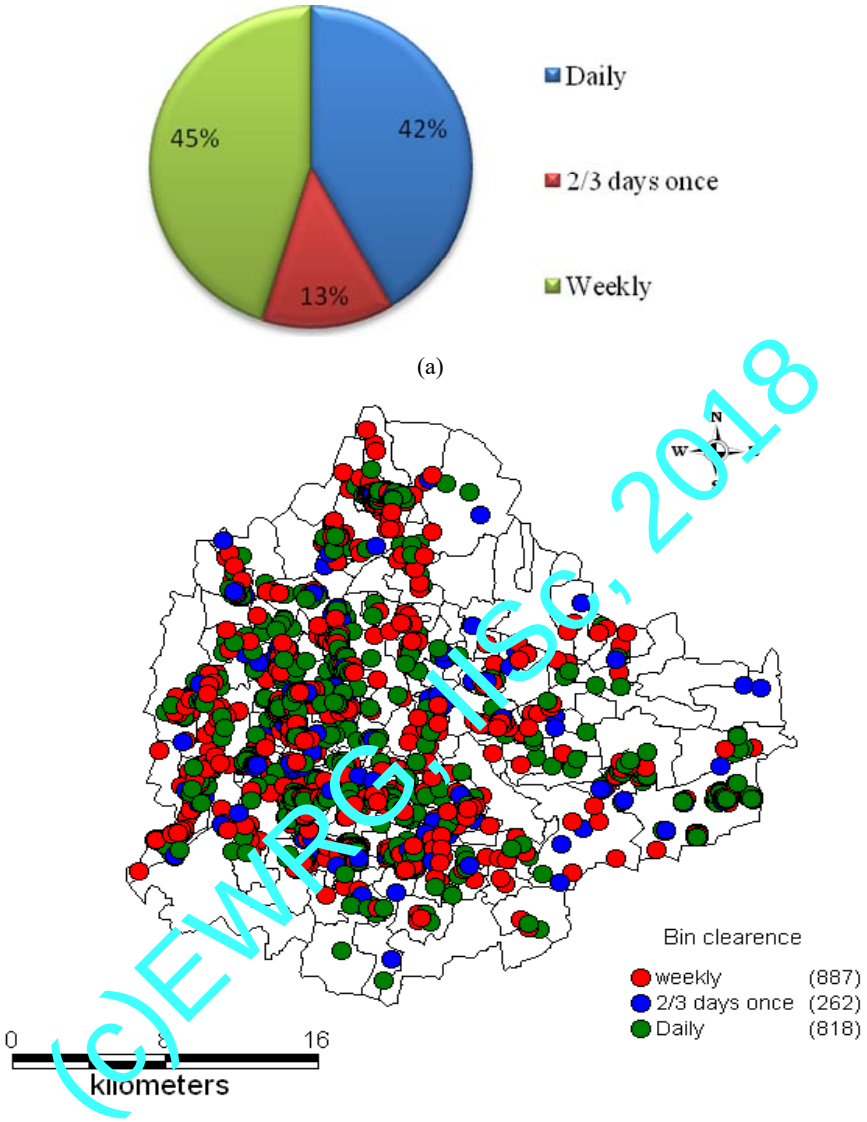


(a)



(b)

Figure 12 Bin clearance (see online version for colours)



5.4 Relationship between the quantity of HSW generated and socio-economic factors

Family size is an important factor in the household waste generation and Figure 16(a) reveals that the household size was positively related to the daily per capita waste generation. As the family size increases, the total waste generation of household increases and per capita waste generation decrease gradually similar to the earlier reports (Jones et al. 2009; Hockett and Lober, 1995) indicating smaller household size produced more per capita waste than the larger household size. Figure 16b indicate that family with an

income >100,000 produces more per capita waste compared to the other families. The relationship between family income and per capita waste quantity was found to be significant, i.e., as the family income increases the consumption pattern and purchase trend increases which in turn leads generation of more solid waste quantity, comparable to the earlier reports (Sujauddin et al., 2008; Dennison et al., 1996) highlighting that family income is positively related to the waste generation rate. The education levels of the family were not found to be significantly [Figure 16(c)] related with per capita waste generation. Families with the education level of masters produces more per capita waste compared to the families with higher levels of education (persons with PhD). In this study the employment status is not significantly relatedto the waste generation [Figure 16(d)]. The head of the family who are in the business produces more waste than the families who are working in the other sectors. The total waste generation from the household increases as the income increases is depicted in Figure 16(e). Table 9 lists the descriptive statistics on the physical composition of household waste with different socio-economic groups. This indicates that organic waste is the prominent component in the solid waste composition in all the socio-economic groups. It is also evident that as the income level increases the organic waste composition decreases with the increase in the proportion of paper, metal, glass and others. The organic waste generated from household varies from 80–82% in the surveyed area. Among them, the high income family group (annual income > 1,000,000 INR) produces the lowest (80.31%) organic waste and low income family group (< 100,000 INR) produces the highest organic waste (85.52%). The organic waste generation was found to be increasing from high income family group to low income family group. The opposite trend is observed for the paper, glass and others.

Table 9 Descriptive statistics of physical composition of household waste generated with different socio-economic groups (as a percentage)

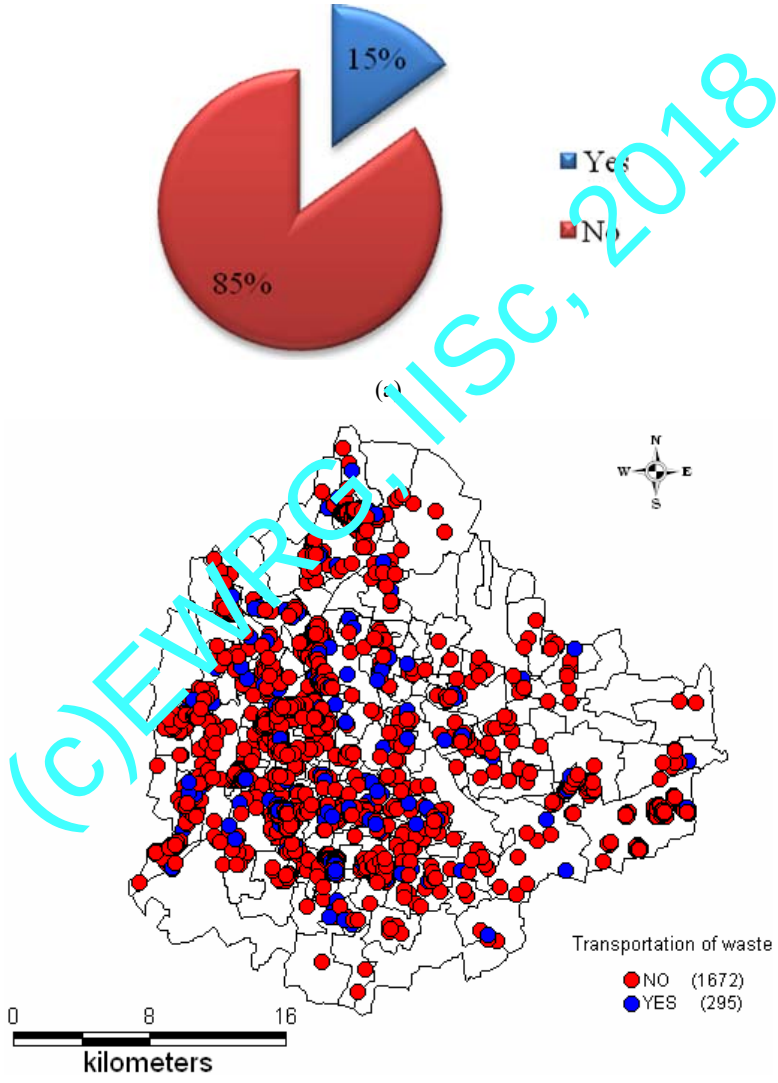
Annual income	*Organic*	*Paper*	*Metal*	*Glass*	*Others*
< 100,000	85.52	11.62	1.20	0.52	1.14
100,000–500,000	84.09	11.35	1.51	0.58	2.47
500,000–1,000,000	82.00	13.50	1.22	0.58	1.72
> 1,000,000	80.31	14.72	1.73	0.63	2.61

5.5 Carbon dioxide emissions from household waste

Mismanaged municipal solid waste is the significant contributor to the greenhouse gases such as methane and carbon dioxide in the atmosphere. CO_2 equivalent emission from organic waste generated at household is calculated by using the equation (3). According to this study, the total organic waste generated from surveyed houses was 231.01 tons/year and total emission is about 604.80 tons/year. Table 10 lists zone wise CO_2 equivalent emission (Gg/year) from solid waste generated in Bangalore. The Mean ward wise CO_2 emission varies from 2.59 (North) to 3.23 Gg/year (South West). The CO_2 equivalent emission from solid waste generated at household (kg/capita/day) is depicted in Table 11. It reveals that the average CO_2 equivalent emission is low in South East (0.17 kg/capita/day) and highest in East and North East zones (0.21 kg/capita/day). Figure 17 reveals the per capita CO_2 equivalent emission from households in the

surveyed area. 926 households emits 50–100 kg/person/year, 624 households emits less than 50 kg/person/year, 247 households emits 100–150 kg/person/year and only 46 households emits more than 150 kg/person /year. Quantification of GHG emissions from all the wards of Bangalore, reveal that the average ward-wise CO_2 equivalent emission is 2.93 ± 0.91 Gg/year. 47 wards emits in the range of 3 to 3.5Gg/year while 46 wards emits more than 3.5 Gg/year. Forty-five wards emit in the range of 2 to 2.5 Gg/year, 39 wards 2.5 to 3 Gg/year and 18 wards emits in the range of 1.5 to 2 Gg/year. Remaining seven wards emits less than 1.5 Gg/year.

Figure 13 Transportation of waste (see online version for colours)



(a)

(b)

Figure 14 Distance of the waste transportation (see online version for colours)

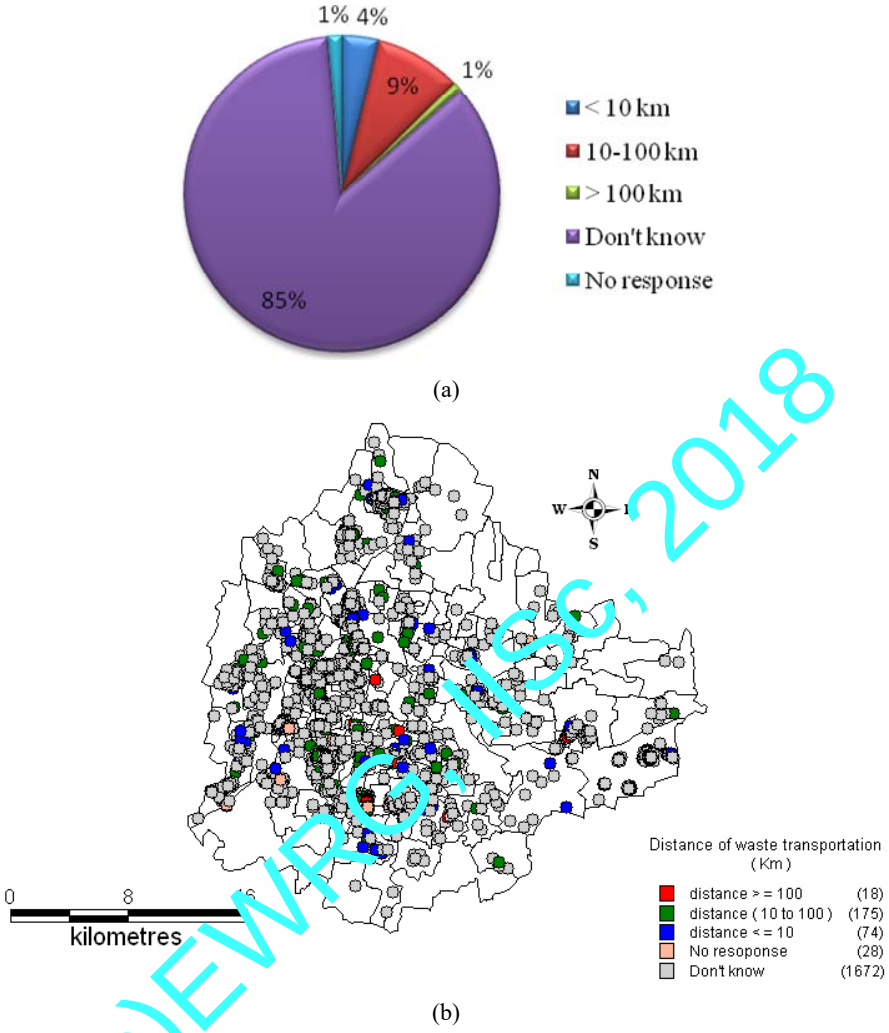


Table 10 CO_2 equivalent emission from solid waste in Bangalore (Gg/year) across the zone

Zone	*Mean*	*Min*	*Max*	*Sum*	*SD*
East	3.11	0.49	5.37	62.21	1.21
North East	2.89	1.66	4.70	57.87	0.80
North	2.59	0.60	5.58	54.41	1.01
North West	3.05	1.99	3.75	70.15	0.50
South East	2.72	0.59	6.25	32.62	1.47
South	2.62	1.01	4.69	83.93	0.80
South West	3.23	2.00	6.25	96.90	0.82
West	3.10	1.76	4.84	102.18	0.78

Figure 15 Landfill site in the region (see online version for colours)

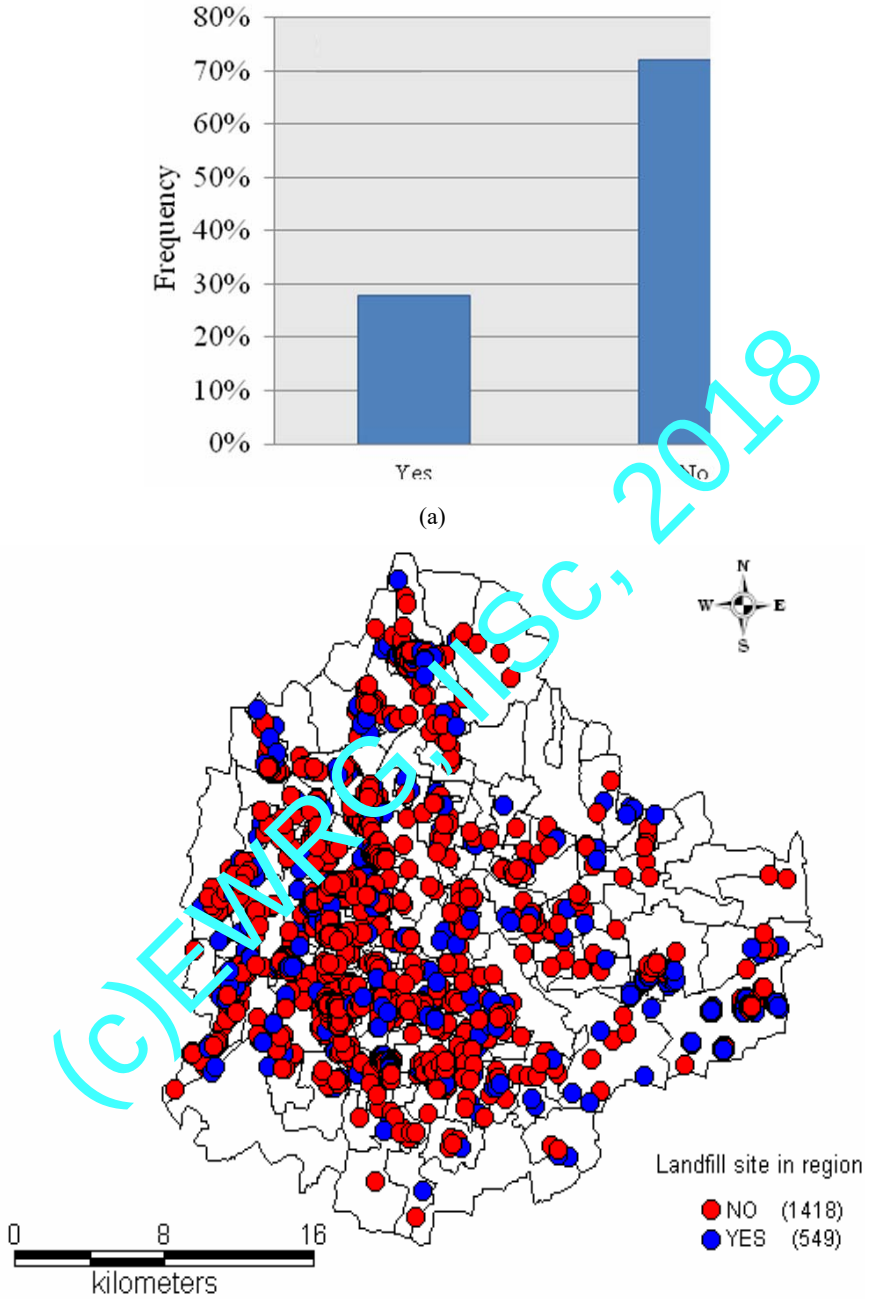


Figure 16 Relationship of per capita waste generation with socio-economic factors, (a) household size (b) 100,000, 4: >100,000 (c) educational level (d) occupation (e) annual income (see online version for colours)

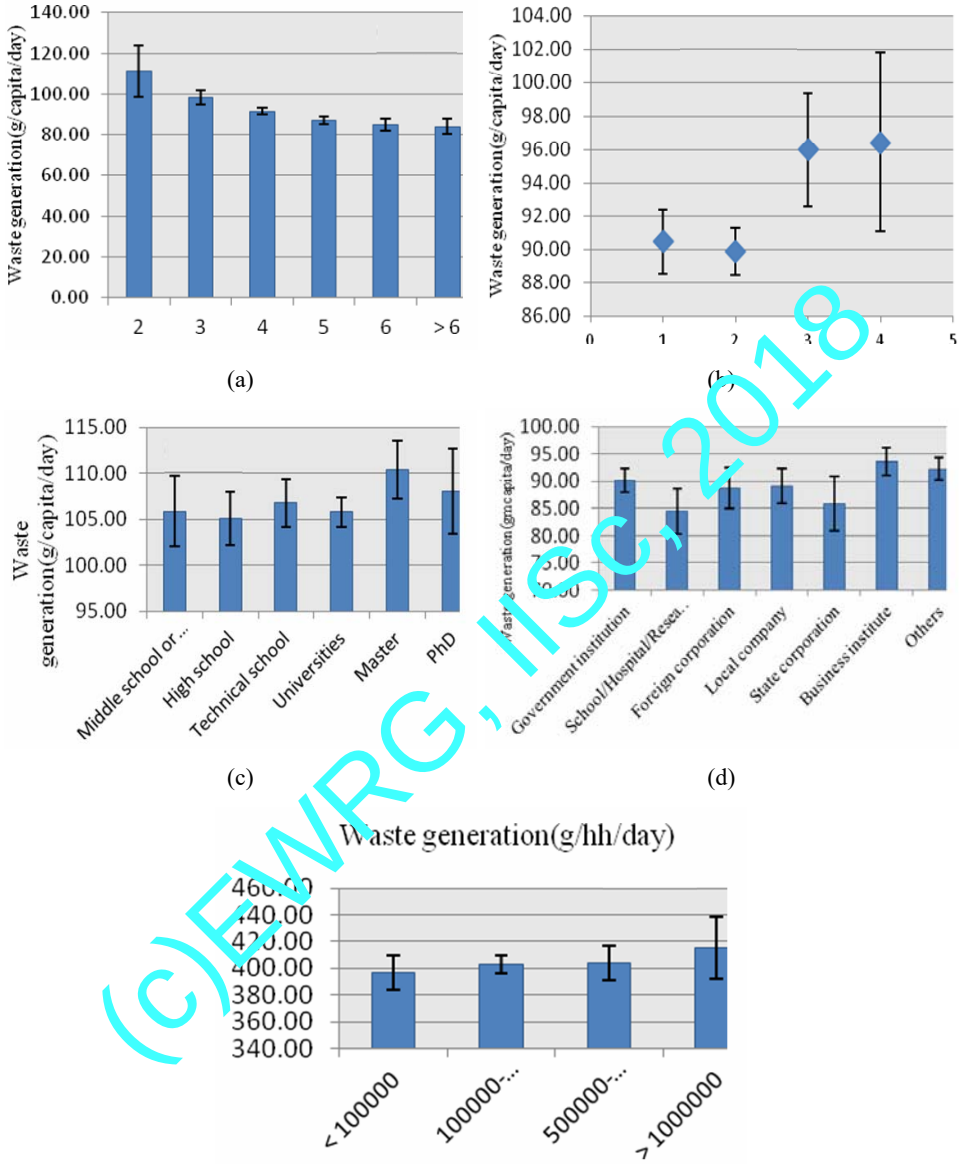


Figure 17 Per capita CO_2 equivalent emission from HSW generated (see online version for colours)

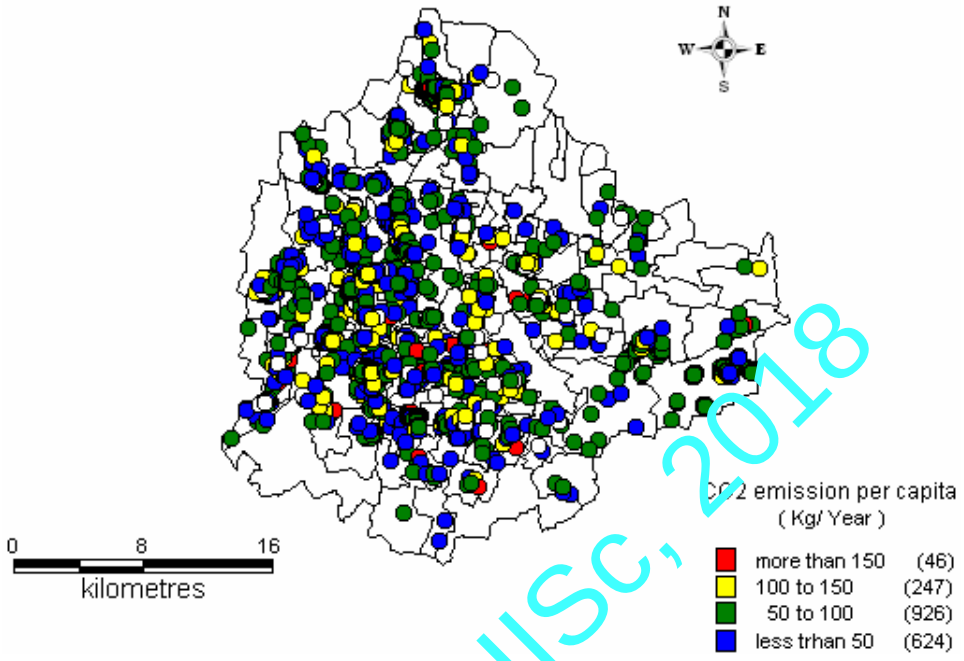


Table 11 CO_2 equivalent emission from solid waste generated at household (kg/capita/day) across zone

Zone	*Mean*	*Sum*	*Minimum*	*Maximum*	*SD*
East	0.21	54.49	0.01	0.49	0.09
North East	0.21	5.36	0.03	0.39	0.08
North	0.1[illegible]	54.67	0.02	0.65	0.09
North West	0.18	43.81	0.03	0.52	0.09
South East	0.1[illegible]	7.46	0.03	0.44	0.10
South	0.19	56.15	0.03	0.65	0.10
South West	0.19	48.30	0.03	0.46	0.09
West	0.20	87.25	0.01	0.58	0.09

5.6 Mitigation of GHG emissions

Scope for mitigation of GHG emission is through the recovery and conversion of organic component (which constitute 82%) to energy or compost. Policy interventions for the adoption of integrated solid waste management (ISWM) through the incorporation of the waste management hierarchy considering direct impacts (transportation, collection, treatment and disposal of waste) and indirect impacts (use of waste materials and energy

outside the waste management system) would reduce the carbon footprint due to mismanagement of waste (Ramachandra, 2011). ISWM framework optimises the existing systems and implements new waste management systems. In addition to climate concern, the recycling and energy recovery enriches the resource efficiency and reduce the environmental impacts from GHG emission. The strategy includes:

- Door to door collection of waste with incentive based mechanism to enhance segregation at source: This entails
  1. Deploying appropriate mobile collection vans (for each locality) with an option to store segregated and unsegregated wastes
  2. Incentive of Rs 1 per kg of segregated organic waste and payment directly to the respective household account through direct bank transfer
  3. Disincentive to unsegregated waste individuals who refuse to segregate needs to pay Rs 5 per kg of unsegregated waste. Revenue generation would encourage many households to switch over to segregation.
- Segregation of waste at source. The biodegradable organic waste bring a dominant component in MSW, treatment of organic fractions through appropriate technologies helps in the resource recovery while addressing its negative impact on the environment and potential economic benefits.
- A waste stream with a high biodegradable organic content can be processed to produce high-quality compost which avoids land filling and enables the provision of manure to enrich nutrients in the soil. The biodegradable fraction has the appropriate moisture content for composting.
- Promotion of recycling or reuse of segregated material reduces the quantity of waste and the burden on landfills, and provides raw materials for manufacturers.
- Improved storage containers for the storage of biodegradable / wet wastes.
- Setting up transfer stations taking in to account local situations to improve the efficiency of waste collection, especially in narrow roads and slums,. This will ensure the proper handling of wastes and the reduction of transportation costs.
- Primary collection of waste stored in various locations on a daily basis through active public participation
- Improved collection vehicle design to increase capacity and ergonomic efficiency.
- A helpline to tackle various issues such as road sweeping, open dump, open burning, garbage collection, etc.
- Garbage tax to be levied to the large and small generators for the disposal of wastes.
- Adequate training to all the levels of staff engaged in SWM to handle respective functional aspects (collection, generation, storage, segregation of waste, etc.).
- Adoption of technological solutions such as bio-gas recovery, composting, etc. for affecting improved recovery and disposal of waste.
- Collection trucks to have global positioning system (GPS) which would help in online tracking and also in reducing malpractices associated with waste management.

- Transparency in the administration though online availability of spatial information system, accessible to all including public. Adoption of geographic information system (GIS) with GPS would streamline collection of waste garbage and improves efficiency.
- Constitution of citizen forum in each corporation ward involving local people, NGO's and concerned authorities to ensure close monitoring and supervision of waste management practices regularly.
- Taking into account the bulk wastes to be handled every day, sanitary landfill sites have to be set up to dispose of the rejects after composting and landfilling.
- Regular monitoring of sanitary landfill sites involving local people in the team along with sanitary authorities.
- Administrative restructuring of the urban local bodies to discharge more efficiently specific responsibilities. This requires structural changes within the administration aimed at decentralising authority and responsibilities. This also includes periodic meetings among the staff and between the executives and elected wing of the corporation.
- Encouraging the involvement of local NGO's in working on various environmental awareness programmes and areas related to waste management including educating the public about the importance and necessity of better waste management.

6 Conclusions

GHG emissions in the municipal waste sector are quantified based on the sampling of 1967 households in Greater Bangalore chosen through multistage, stratified random sampling. The outcome of the analysis showed the daily solid waste generation from 1967 residential households in surveyed area of Greater Bangalore was about 772.2 kg and the per capita of 97.01 ± 45.52 g/day. The analysis revealed that the organic fraction (82%) constitutes a major portion of household wastes. The total organic waste is 632.92 ± 0.210 kg/day with the per capita organic waste generation of 74 ± 35 g/person/day. This emphasise the need for appropriate treatment option to minimise GHG emissions.

Most of the households (64%) in the study area have the facility of door to door collection of solid waste and about 78.34% of city population do not segregate the waste at source (household level). The decision makers should bring awareness among citizens and pourakarmikas (BMP staff) through capacity building workshops highlighting the importance of segregation at source level and promotion of recycling and reuse methods. This will reduce the quantity of waste and burden on landfills while ensuring the sustainability of natural resources. Further the study has revealed the relationship between waste generation and socio-economic factors. The family income and family size are positively related and the education status is negatively related with per capita waste generation at household level. The average carbon dioxide equivalent emission from household is 307.50 ± 205.51 kg/year and per capita emission is 66.33 ± 36.61kg/year. Further research is necessary to evaluate the seasonal variation in solid waste generation and composition as well as relationship between household waste

generation and socio-economic factors at household level during different time period. The implementation of functional elements (such as segregation at source, storage, treatment of organic fractions, etc.) would aid in reducing GHG emissions.

Acknowledgements

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Environmental audit of Municipal Solid Waste Management

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Abstract: The management of municipal solid waste has become an acute problem due to enhanced economic activities and rapid urbanisation. Increased attention has been given by the government in recent years to handle this problem in a safe and hygienic manner. In this regard, Municipal Solid Waste Management (MSWM) environmental audit has been carried out for Bangalore city through the collection of secondary data from government agencies, and interviews with stakeholders and field surveys. Field surveys were carried out in seven wards (representative samples of the city) to understand the practice and identify the lacunae. The MSWM audit that was carried out functional-element-wise in selected wards to understand the efficacy and shortfalls, if any, is discussed in this paper.

Keywords: solid waste; environmental auditing; functional elements; composting; landfill sites; municipal solid waste management; MSWM.

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1 Introduction

Solid waste generation is a continually growing problem at global, regional and local levels. Solid wastes are those organic and inorganic waste materials produced by various activities of the society, which have lost their value to the first user. Improper disposal of solid wastes pollutes all the vital components of the living environment (viz., air, land and water) at local and global levels. Urban society rejects and generates solid material regularly due to rapid increase in production and consumption. The problem is more acute in developing nations than in developed nations, as their economic growth as well as urbanisation is more rapid. This necessitates management of solid waste at generation, storage, collection, transfer and transport, processing, and disposal stages in an environmentally sound manner in accordance with the best principles of public health, economics, engineering, conservation, aesthetics and environmental considerations. Thus, solid waste management includes all administrative, financial, legal, planning, and engineering functions (Ramachandra, 2006; Ramachandra and Varghese, 2003).

The environmentally sound management of solid wastes issue had received the attention of international and national policy making bodies and citizens (Subramanian, 2005). At the international level, the awareness regarding waste began in 1992 with the Rio Conference, where efficient handling of waste was made one of the priorities of Agenda 21 (http://www.un.org/esa/sustdev/agenda21.htm). The Johannesburg World Summit on Sustainable Development in 2002 focused on initiatives to accelerate the shift to sustainable consumption and production, and the reduction of resource degradation, pollution, and waste (http://www.un.org/esa/sustdev/csd/aboutcsd.htm). Priority is being given to waste minimisation, recycle and reuse, followed by the safe disposal of waste to minimise pollution.

The government of India has taken many initiatives and implemented new technologies and methods by giving loans for setting up composting plants to encourage proper management of solid waste since the 1960s (MoEF, 2005). The MSWM problem was compounded with rapid urbanisation. Due to increased public awareness of MSWM, a public litigation was filed in the Supreme Court, which resulted in the Municipal Solid Wastes (Management and Handling) Rules, 2000. Government, for the first time, now has included private organisations in providing this public service (DPCC, 2002). New methods of storage, collection, transportation, processing and disposal are being explored and implemented. It is necessary to evaluate the current process at this stage to understand if the methods being implemented are suitable for the Indian scenario and to identify the lacunae in the adopted methods. This requires an auditing of all functional elements of MSWM, considering the environmental constraints. An environmental audit of MSWM in Bangalore city was undertaken apart from evaluating the Indian MSWM scenario to understand the shortcomings.

Environmental auditing first began with the principle of 'polluters pay', to prevent liabilities towards the government. The companies voluntarily carried out audits of their operations and processes to prove that their products are environment friendly, with the increasing awareness of the public about environmental protection. Waste audits are undertaken for a variety of reasons, which is to

- ensure regulatory compliance
- compare actual practices to best practice guidelines
- develop baseline generation data
- identify waste minimisation opportunities
- establish sustainable development indicators or bench marks (Ashwood et al., 1996).

In general, there are three different approaches for conducting a solid waste audit, namely

- the back end approach, which measures the material generated by the entire facility, i.e., no attempt is made to assess the manner in which the wastes and recyclables are generated within the facility
- the activities approach, which tracks the waste and recyclables as they are generated throughout the facility, by performing waste audits within each activity area, e.g., an office, warehouse, or cafeteria
- the input/output approach, which tracks the material input and output associated with each activity area (CCME, 1996; Dowie et al., 1998).

Environmental audit was introduced in India to minimise generation of wastes and pollution. In this regard, a gazette notification was issued by the Ministry of Environment and Forests on March 13th, 1992 and later amended on April 22nd, 1993. This applies to an industry, operation or process requiring consent to operate under Section 25 of the water (Prevention and Control of Pollution) Act, 1974 or under Section 21 of the Air (Prevention and Control of Pollution) Act, 1981 (14 of 1981), or both, or authorisation under the Environmental Protection Act, 1986 (29 of 1986) (Srivastava, 2003). The notification requires that an Environmental Statement for the financial year ending on 31st March be submitted to the concerned State Pollution Control Board, on or before 30th September of the same year.

The improvement of solid waste management is one of the greatest challenges faced by the Indian Government. The Government and the local municipal authorities have taken many initiatives towards the improvement of the current situation (The Expert Committee, 2000). The private sector has been included in the management of the MSW recently. To understand the level of success in the initiatives, it is necessary to carry out an audit. An audit will identify and bring out the lacunae and the loopholes in the current system with respect to the compliance with environmental regulations, occupational health, resource management, pollution prevention systems and occupational health and safety. This could be one of the best ways to increase awareness about the most suitable approaches to MSWM, the issues likely to be faced and the alternative measures that can be adopted, considering the local scenario.

Developed countries have provided technical assistance in SWM to developing countries focusing on SWM as a technical problem with the assumption that the solid waste problem can be solved with mechanisation (Lardinios and van de Klundert, 1997). The 'blind technology transfer' of machinery from developed countries to developing countries and its subsequent failure has brought attention to the need for appropriate technology (Beukering et al., 1999) to suit the conditions in developing countries (type of waste, composition, treatment, etc.). Composition of the waste provides a description of the constituents of the waste; this varies widely from place to place as is evident from Table 1. The most striking difference that can be seen is the difference in organic content which is much higher in the low income countries than the high income countries, while the paper and plastic content is much higher in high income countries than low income countries. This shows the difference in consumption pattern, cultural and educational differences. In higher income countries disposable material, magazines and packaged food are used in higher quantities; this results in the waste having higher calorific value, lower specific density and lower moisture content. In the case of lower income countries, the usage of fresh vegetables to packaged food is much higher and mostly materials that are reusable are used. This results in a waste composition that has high moisture content, high specific weight and low calorific value.

Table 1 Relative composition of household waste in low, medium and high-income countries

	Parameter	*Low-income countries*	*Medium-income countries*	*High-income countries*
Contents physical and chemical properties	Organic (putrecible), %	40–85	20–65	20–30
	Paper, %	1–10	15–30	15–40
	Plastics, %	1–5	2–6	2–10
	Metal, %	1–5	1–5	3–13
	Glass, %	1–10	1–10	4–10
	Rubber, leather, etc., %	1–5	1–5	2–10
	Other, %	15–60	15–50	2–10
	Moisture content, %	40–80	40–60	5–20
	Specific weight, kg/m^3	250–500	170–330	100–170
	Calorific value, kcal/kg	800–1100	1000–1300	1500–2700

Source: INTOSAI working group on environmental auditing (2002)

2 Municipal Solid Waste Management (MSWM) audit

Auditing has become an increasingly popular tool to assess the environmental policies, quality of implementation, compliance with national law and regulation, etc. Auditing has also been widely used in India, especially in industries. The most popular audits that are carried out in India are energy audits (TERI, 2002) followed by environmental management systems audits of which a waste minimisation audit is an integral part (Mannan, 2002). Audits on MSWM in India are however, very rare. In western countries however, audits on urban waste management have increasingly been carried out with respect to performance, compliance, risk, monitoring, existence of waste policy, quality of implementation, etc. Most of the countries have established an auditing institution to carry out the above given assessments.

The Estonian Government had carried out an audit to assess the necessary conditions for successful implementation of the waste policy. Reports and questionnaires were used for the audit and it was observed that the management had serious shortcomings, such as insufficient finance, in comparison to the goal, lack of organisation in the management no national waste management plan and poor monitoring (Linnas, 2001). The Audit Institution of Costa Rica had carried out an audit on SWM in two municipalities, with multiple focus such as pollution prevention system, management system and site audit. The audit was carried out by going through the reports, questionnaire interviews, and site surveys. The various aspects that were looked included compliance with national law and regulation, occupational health and safety, operational risk, pollution prevention and resource management. The audit identified that the ministries were not integrated, resulting in repetition of many working plans. The other findings were, insufficient public awareness programmes, lack of new methodologies and technologies, insufficient financial support and improper monitoring. The management and control of the dump was investigated with regard to national health legislation and technical regulations. Checklists and site surveys were used as tools for this audit. From the audit, it was observed that there was no urban cleanliness plan charted out by the municipal authority, serious violations of the legislations, no proper monitoring by the supervision agency and delayed closure of the dump (INTOSAI, 2002).

This paper presents an audit of the MSWM in Bangalore city. This would help to disseminate the innovative practices that have been adopted for managing municipal solid waste. The study explores the role of various stakeholders in MSWM, the current practices, the role of each entity, the shortcomings of the current practices and issues to be addressed to improve the condition. Auditing of MSWM involved the following objectives:

- to review the existing MSWM practices
- to audit the MSWM practices considering the case of Bangalore city.

3 Methods

The approach to the case study was mainly qualitative. Information was gathered using a variety of methods to gain a better understanding of the situation, issues, perspectives and priorities. Data collection methods included document/literature review, semi-structured interviews, checklists and observation. Different types of audits were carried out to achieve various objectives:

- *Compliance audit.* To check if the current waste management process is being carried out as per the legislation.
- *Operational risk audit in combination with pollution prevention audit*. To check the frequency with which an environmental damage occurs and what the consequence of it is. The measures that have been taken against these possible environmental damages were verified.
- *Resource management audit*. To check the optimal utilisation of water, energy and material resources.
- *Occupational risk audit*. To verify the measures of occupational safety.

4 A case study- environmental audit of MSWM in Bangalore city

The city of Bangalore (12.97°N and 77.56°E), the state capital of Karnataka is located on the southern part of the Deccan Plateau at the border of two other South Indian states, Tamil Nadu and Andhra Pradesh. At an elevation of 900 m, it is known for its mild, salubrious climate. Since the 1980s, Bangalore has enjoyed the reputation of being one of the fastest growing cities in Asia (Dittrich, 2004). The Bangalore metropolitan area covers an area of 223 sq km, and is the fifth largest city in India. However, with a burgeoning population and the increasing necessities of the Information Technology (IT) sector, the local authorities are not able to provide the necessary services like solid waste management, water supply, road maintenance, etc., to a satisfactory level. The authorities however have taken initiatives and measures to achieve compliance with regulations and reduce complaints from citizens, especially in the MSWM sector. The case study would help to identify techniques suitable for the present scenario, the lacunae or the loopholes in the adopted methods and the possible alternatives.

The Bangalore City Corporation (BCC), which has 100 wards within its municipal jurisdiction, has a population of 4,292,223 accounting for 75.68% of the total population of Bangalore Urban Agglomeration of which 2,240,956 are males and 2,051,267 are females. The decadal growth rate of population for the decade 1991–2001 for Bangalore City is as high as 61.36%. This high growth rate can be attributed not only to the extension of the municipal limits of Bangalore City but also to the ever-increasing population.

The amount of waste generated in Bangalore city varies from 1700 MT/day to 2300 MT/day and the composition of waste is given in Table 2. The Bangalore Metropolitan Area is, on the whole, divided into 30 ranges and 100 Revenue wards under the jurisdiction of Bangalore Mahanagara Palike (BMP). BMP is responsible for the SWM policy, setting up targets and objectives. Revenue wards are further divided into 294 health wards for proper management of the sanitation functions. Out of these 294 health wards 112 are managed by BMP, while 182 wards have been assigned to private agencies on contract basis.

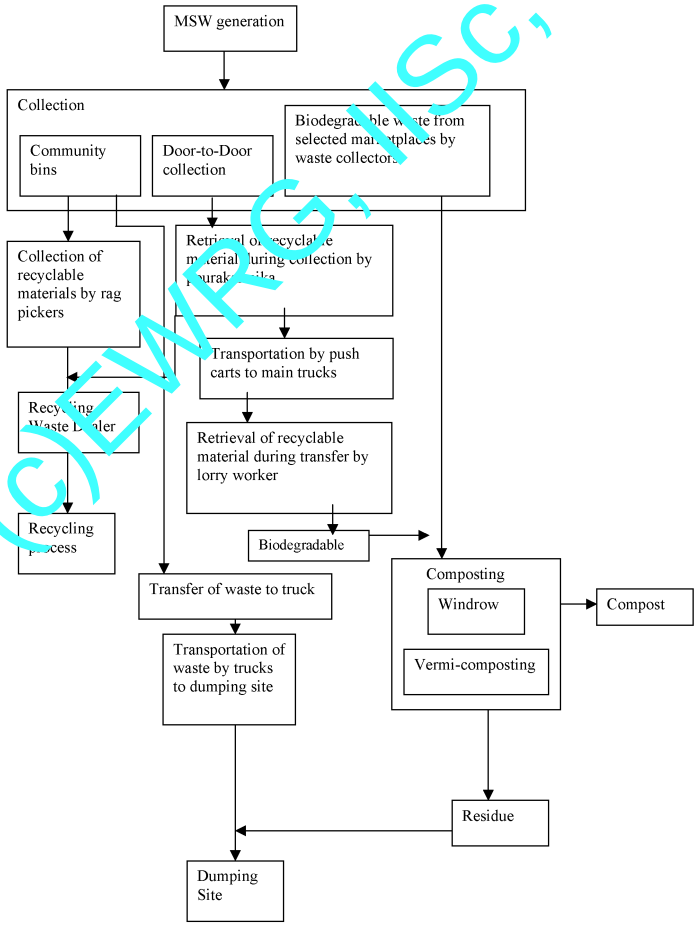
Table 2 Physical characteristics of Bangalore MSW

Organic waste (%)	60
Dust (%)	5
Paper (%)	12
Plastic (%)	14
Glass (%)	4
Metal (%)	1
Bio Medical Waste (%)	1
Card Board (%)	1
Rubber (%)	1
Miscellaneous (%)	1

Source: BMP

A list of necessities was listed in a checklist with regard to the specific target and the presence and absence of each was marked for MSWM auditing. Site survey was done in seven representative sample wards (Shivajinagar, Malleswaram, Koramangala, Indian Institute of Science campus (IISc), Hindustan Machine Tools colony (HMT), Airport Road and Chikpet). A checklist was prepared prior to the visit to check the presence or absence of techniques used, safety measures adopted, compliance with regulatory measures, and the pollution prevention system adopted. Interviews with health Inspectors, workers and lorry drivers were done at the ward level. Discussions with range health officers, zonal health officers, the chief health officer and the special commissioner helped in understanding the structure and management of the system, which helped to understand the objectives, strategies, success, failure of strategies and the issues faced while implementing strategies. The site surveys and ward level interviews helped to verify the process and to identify the lacunae in each functional element. Site visits to the Karnataka Compost Development Authority, Terra Firma Biotechnologies, Betahalli dump yard, K.R. Puram dump yard and the quarry site in Bomanhalli were done during the study to understand waste processing and disposal. The current MSWM is explained in detail in Figure 1.

Figure 1 Current MSWM practice in Bangalore city



4.1 Collection

The most common method of collection in Bangalore city is door-to-door collection, followed by community bin collection. In 2003, the door-to-door collection method was implemented in 60 health wards. As per the BMP, all wards in the city are supposed to have door-to-door collection and all the community bins have been removed. However, during the site survey, it was observed that many of the wards still have community bins that are in a very dilapidated state. A large quantity of organic waste is generated from 12 commercial vegetable markets. This waste is collected using separate trucks every morning and evening.

The waste collected in pushcarts from lanes is transferred to a truck at a meeting point called a synchronisation point. The truck arrives at the designated point at a specified time and place. The waste is transported to the disposal site by means of a large capacity tipper truck, and in a few wards by a small capacity tipper truck or dumper placers. The truck is covered with a mesh and a polythene sheet to prevent scattering. Currently, Bangalore city has no transfer stations for intermediate storage of waste and intermediate segregation of waste.

4.2 Processing of wastes

The Karnataka Compost Development Corporation (KCDC) was one of the 11 composting units set up in 1975, based on the technology suggested by WHO (2002). Within a year, 10 of these units had to be closed, because the technology suggested by WHO was unable to successfully handle unsegregated Indian waste for composting. Also the usage of crushing and grinding machines caused problems while selling the compost because the quality was poor due to the existence of glass splinters and other non-biodegradable material. In the 1970s KCDC processed 50–60 tons of mixed waste per day. By 2002 the capacity was expanded to 150 tons/day. Currently the units process 250 tons/day of mixed waste plus 50 tons/day of market waste, which is collected using vehicles owned by KCDC.

4.3 Disposal

City waste is disposed off at Betahalli (Mavallipuram) dump yard situated 18 km north west of Bangalore city. The waste is brought in by the municipal and contract lorries. This waste is dumped in the yard in the form of a heap. There are three JCB's (Front End Loaders) in the dump yard for waste levelling. The waste is sprayed with Effective Microorganisms (EM) solution, covered with a 10 cm layer of debris and sprayed with water after levelling. The solution used for spraying is prepared by mixing 4 litres of EM solution with 8 kg of molasses or jaggery and 150 litres of water. After mixing it is allowed to stand for 7–8 days, after which the pH reduces to 3.4. The EM stock solution consists of actinomycetes, photosynthetic bacteria, and yeast, Lactic acid bacteria (*Lactobacillus sp.*, *Streptococcus sp.*, *Streptomyces sp., Rhodopseudomonas sp.*, *Saccharomyces sp.*, *Propionibacterium sp.*), which speed up the degradation process and reduce the volume, the flies and the odour. The observations made on the site are:

- a large number of rag pickers collect recyclable waste from the landfill and pay a small amount to have access to the waste
- there is a recycling dealer in the dump yard who buys the recyclable material from the rag pickers and there is one dealer on the way to the dump yard who buys the recyclable waste from the lorry driver
- the levelling of MSW after dumping is not carried out efficiently due to fewer number of front-end loaders
- the foul odour was strong and could be inhaled at long distances
- large number of flies, birds and stray dogs
- there is emission of methane gas from the dump yard, due to which the waste can be easily set on fire
- there is always a queue of at least 5–10 Lorries waiting to unload; this is due to the lack of number of front-end loaders to level the MSW
- this dump yard has no fencing, weigh bridge or no proper approach roads.

The stakeholders and their responsibilities.

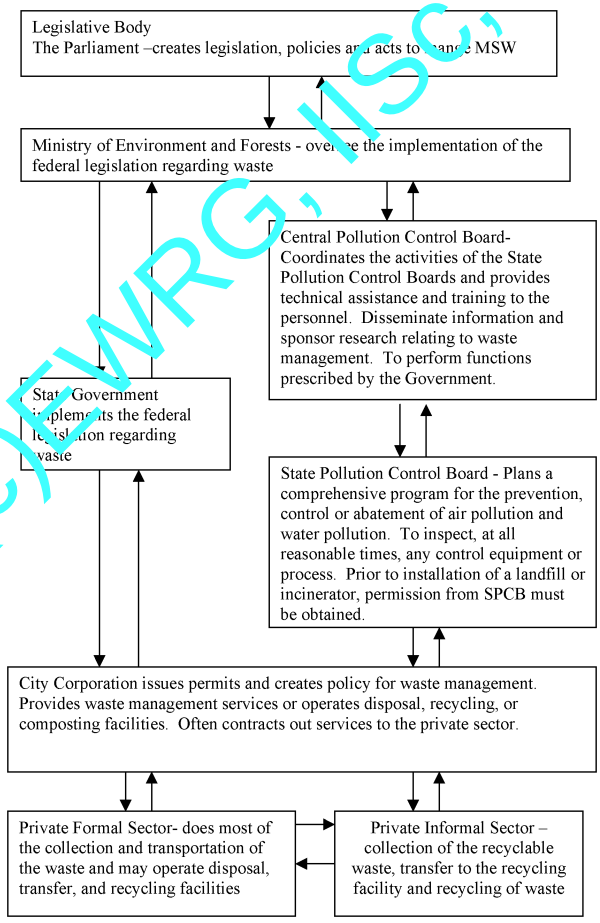
The MSWM system and the relationship among the stakeholders are depicted in Figure 2. Various stakeholders are

- Ministry of Environment and Forests is responsible for all of the environmental policies at the national level, including the management of waste. The Ministry has an overview of all the activities of the MSWM sector and makes sure that it is performed well.
- Central Pollution Control Board keeps a check on all the activities that have potential to pollute the environment, which includes the monitoring of the MSWM in the country. It has divisions in each state that report to CPCB on the environmentally hazardous activities in the state, the actions taken to check them and the improvements made by the industries and public towards a cleaner environment (CPCB, 1998).
- Karnataka Pollution Control Board keeps a check on all the activities that have the potential to pollute the environment, which includes the monitoring of the MSWM in the state. It reviews the Environmental Impact Assessment carried out by the agencies prior to the construction of a landfill site, installation of an incinerator or any other processing plant. It carries out public participation meetings to make the public aware of the proposed project and its benefits. Public participation is especially important so that once the project is started there should not be any agitation against the project.
- Bangalore Mahanagara Palike is responsible for management policy, setting up the targets and objectives. They are responsible for managing the solid waste in the city and are answerable to the Karnataka State Pollution Control Board. They also have the authority to privatise the solid waste management sector.

- *Organisational Structure of the Health Department*. The hierarchy of the Health Department in charge of SWM is a pyramidal structure headed by the Chief Health Officer. For effective administration, the city has been divided into three zones namely east, west and south. A Zonal Health Officer administers each zone. There are two Deputy Health Officers to assist him. Each zone consists of ten ranges headed by a Medical Officer of Health. Each Medical Officer of Health is assisted by Senior, Junior Health Inspectors and Sanitary Daffedars. The field worker who is employed in the sanitation work is known as Pourakarmika.
- *NGO*. Swabhimana, Waste wise, Swachha Bangalore, Shuchi Mitras, etc., are some Non Governmental Organisations (NGOs) that support the MSWM. Their functions are stated below:
    - they carry out public grievance meetings to identify the problem spots and convey these complaints to the authorities
    - they collaborate with authorities to carry out door-to-door collection of segregated waste
    - they identify public volunteers to monitor the SWM in their respective areas
    - few NGOs have also set up decentralised composting plants in residential areas and for this they also carry out door-to-door collection and educate the public to segregate the waste prior to disposal
    - they carry out public meetings in schools, colleges, public places etc., to educate the public about segregation of waste, non-littering, etc.
- *Private formal sector*. Currently, out of the 294 health wards in Bangalore city, 182 wards have been given out on a private contract. This includes the functions of collection of waste, transfer of waste to trucks, transport of waste to the specified dump yard. The dump yards that are currently being used are all owned by private entities. They have the responsibility of disposing of the waste by alternative layering of waste and soil, spraying it with EM solution and water. Processing of wastes is done by:
    - Karnataka Compost Development Corporation (KCDC), which is a government-aided organisation. This carries out the function of composting (windrow and vermicomposting)
    - Terra Firma Biotechnologies, which is a private organisation that carries out vermicomposting
    - Ramky Consultants, which is a private consultancy proposing to set up a sanitary landfill site in Bangalore
    - Srinivas Gayathri Resource Recovery, which is a private consultancy proposing to set up a waste to energy plant and a sanitary landfill site in Bangalore.

- *Private informal sector*. The informal sector in the city is very large and plays a very vital role in the MSWM. It comprises the rag pickers who retrieve recyclable waste from the community bins and landfills, the people who buy recyclable waste from households usually called as 'batli wallas', the middlemen who buy waste from the rag pickers and 'batli wallas' and sell it to either bigger dealers or to recycling factories. Municipal workers like the pourakarmika collect waste from the households and retrieve the recyclable waste; even the lorry workers retrieve the recyclable waste before transferring the waste into the lorry. The waste retrieved by them is sold to the informal sector.
- *Donor agencies*. Development corporation of Norway (DCN), Deutsch Gesellschaft fur Technische Zusammenarbeit (GTZ) and World Health Organization (WHO) are a few of the international organisations that have sponsored projects in Bangalore. WHO has sponsored large scale composting plants all over India and DCN has sponsored decentralised plants all over Bangalore.
- Service users comprise the entire public in the city, including the tourists visiting the city.

Figure 2 Municipal Solid Waste Management (MSWM) system in India



5 Results and discussion

The techniques and the shortcomings of the techniques adopted have been identified in all sampled wards and Table 3 lists the Malleswaram ward. Door-to-door collection is adopted in Malleswaram area, which has resulted in efficient collection of waste and reduction of littering, foul odour and unaesthetic appearance of bins. However, in commercial areas, due to the absence of community bins, sudden waste, generated at odd hours, is disposed in the street. A few waste heaps can be found on the roadsides in commercial areas. All the trucks that are used for transportation of waste have meshes that prevent littering of waste, but 40% of the trucks have partial polythene cover and 20% have no polythene cover and this results in scattering of waste and foul odour during transport. The recycling process is carried out by the informal sector that has resulted in high efficiency of recovery of recyclable material. There is no other process carried out, leading to the entire waste being disposed. There is a large quantity of organic waste that is produced in this ward, including organic waste generated in a market. The waste is disposed off in the Betahalli dump yard, causing foul odour, scattering, leachate formation, and air pollution from burning and methane emissions from decomposing organic matter.

Table 3 MSWM in Malleswaram (Ward 7) (Malleswaram Population- 37760, Area- 1.69263 sq km)

Function	*Shortcoming*	*Suggestion*
Storage		
The waste is stored in households and in shops until it is collected by the door to door collector	–	–
Collection		
Door-to-Door method – Adopted in the whole ward, for residential and commercial areas	Seventy percent of drums are not painted as per the regulations of green for biodegradable, white for recyclable and black for mixed	Painting of drums at regular intervals to make it more convenient to workers
	Segregation not carried out by worker nor householder, though separate bins are provided	Workers accept only segregated waste from households
The recyclable waste is retrieved by the worker and sells it separately to the informal sector	PET bottles and thin plastic bags are not retrieved. The soiled recyclable material cannot be retrieved	
	Waste heaps found near commercial areas	Placement of large community bins in commercial areas (in commercial area there is a possibility of sudden generation of a large quantity of waste that cannot be stored in the shop till the next day)
		Small litter bins should be provided for the pedestrians in commercial areas and bus stands

Table 3 MSWM in Malleswaram (Ward 7) (Malleswaram Population- 37760, Area- 1.69263 sq km) (continued)

Function	*Shortcoming*	*Suggestion*
Sweeping	The dirt is pushed into the drains which blocks the drains	The workers educated on the affects of blocked drains and regular inspection of drains
	Workers do not use the gloves and footwear that are provided for protection	Mandatory usage of the protection gear provided
Transfer and transport		
The waste collected in pushcarts from narrow lanes and meet at a synchronisation point at a specified time. The waste is transferred from the pushcart to the truck	The waste even if segregated by the workers and stored in separate drums, the waste gets mixed during transfer from pushcarts to lorry. This is because there is no facility in the lorry for separate storage of waste	A small capacity truck and a large capacity truck can be assigned for the collection of dry and wet waste respectively. A better option is to have a partition in a single truck for the collection of segregated waste
The lorry worker retrieves recyclable material during transfer of waste from push cart to lorry	PET bottles and thin plastic bags are not retrieved. The soiled recyclable material cannot be retrieved	Only segregated waste should be accepted to be filled into the lorry
BMP truck – 3 large capacity tipper	Mesh covering – 5 trucks, No Polythene covering – 1, Partial Polythene covering – 2 trucks, Complete polythene covering – 2 trucks	Trucks completely covered with polythene to prevent scattering of waste and foul odour
Contract truck –1 large capacity tipper	There is leakage of wet waste from truck during transportation	Provision of proper enclosure
Trip truck – 1 large capacity tipper	Foul odour emitted from the waste during transportation	Regular inspections
	The waste is not segregated at an intermediate level and is directly transported to the disposal site	Transfer stations to be provided where waste can be further segregated and higher efficiency for transportation can be achieved by increasing the number of trips made by each truck
	Long distance from ward to dump site, hence only one trip a day is made by each truck	
	Manual transfer of waste	Mechanical loading collection vehicles or proper equipment for transfer of waste
Process	No processing carried out prior to disposal	Recycling of the recyclable material retrieved from waste
		Composting
		High quantity of yard waste generated in the ward and also high quantity of organic waste generated from the market and households

Table 3 MSWM in Malleswaram (Ward 7) (Malleswaram Population- 37760, Area- 1.69263 sq km) (continued)

Function	*Shortcoming*	*Suggestion*
Disposal		
Dump yard in Betahalli	Foul odour, flies and bird menace	Usage of higher quantity of EM solution
	Stray dog nuisance	
	Waste burnt emitting toxic fumes and causing air pollution	Waste burning should be prohibited and strict action should be taken if still continued
	Waste is dumped in heaps causing scattering	Usage of front end loaders for levelling and use soil cover
	Soil contamination	
	The lorry workers and drivers are exposed to diseases	Provision of masks and safety gear
Rag pickers retrieve the recyclable material from the landfill	High exposure to diseases	Provision of masks and safety gear
		Closure of dumpsite and replacement with sanitary landfill

The ward-wise auditing of functional components of MSWM is given in Table 4. In the sampled wards of Bangalore, the waste is stored in open or closed community bins. Out of the community bins present, the average percentage of bins covered is 49%. The collection of the waste is carried out by the community bin method and the door-to-door method. It is essential to have community bins along with the door-to-door collection in commercial areas to avoid littering. The percentage of area covered by community bin in commercial areas is 17.5%. The door-to-door collection method has been implemented in all areas of the city as it is a suitable method for collection from residential areas and also suitable for collection of segregated waste. In Bangalore door-to-door collection has been implemented in 94% of the residential areas. However, only 3% of the waste is segregated at source. There are currently no transfer stations in Bangalore and all the waste is directly transported to the disposal site. This is very expensive and the efficiency of the trucks is not utilised to the maximum. As per the regulations, all trucks should have mesh and polythene covering. However, only 96% of the trucks have mesh covering and 41.43% of the trucks have polythene covering. The quantity of waste processed is very small. The informal sector in the city manages the recycling sector, 18% of the total waste generated is recycled by this sector. The other process method adopted in the city is composting. 3.14% of the waste is reduced through composting. The final quantity of waste sent to the dump yard and quarry (open dump) is 60.71% and 21.14%, respectively. The compliance audit through checklist was attempted and results listed in Table 5 indicate that the regulations being followed by the authorities and private companies responsible for the MSWM. Functional unit wise compliance of regulations are as given below:

- *Storage*. From the audit it was observed that the placement of bins has not been done keeping in mind the population density and the quantity of waste generated. There is a lack of community bins in a few of the commercial areas. Due to the high generation of waste in commercial areas, the waste is not always stored on site, but is disposed on the roadsides, causing unaesthetic appearances. Well-designed community bins have to be placed in commercial areas, depending on the quantity of waste generated. The maintenance of the present bins is poor and has resulted in rusted bins having sharp edges. This can prove to be dangerous to the collection staff and also to the users. The staff must be provided with well fitting gloves for safety. Community bins should be provided with a partition for separate collection of waste and proper colouring and labelling on the bins. To improve the separation of waste at source and throughout the MSWM process, adequate staffing, supervision, procedures, training, posters, verbal reminders, reporting, meetings and equipments are required.

- *Collection*. Adopting the door-to-door collection method has proved to have many advantages. The complaints from residents due to unaesthetic bins near their houses have stopped, the number of stray dogs and stray cattle has reduced and the no bin system has also improved the waste handling by people or residents. This method is also better suited for collection of segregated waste. However, the door-to-door collection method has its own considerations. In commercial areas, due to the higher quantity of waste generation, the shopkeepers find it difficult to store the waste on site and hence this waste ends up on the street. Though separate drums have been provided for collection of segregated waste, neither the household nor the pourakarmika carry out segregation. This is due to the poor awareness and the general attitude of public and pourakarmikas. The number of awareness programmes and training programmes carried out by the authorities need to be increased and should be at a regular frequency. It has to be kept in mind that such practices are not easy to instil and will take many months, or even years, to implement. Here again, adequate staffing, supervision, procedures, training, posters, verbal reminders, reporting, meetings and equipment are required to make it possible. The participation of NGOs in such programmes can prove to be very helpful to the authorities in making this a success. During door-to-door collection the pourakarmika manually segregates the waste. It is very important that this is carried out with proper protection. The staff should be provided with gloves, footwear, apron, masks and goggles for safety, as they are constantly exposed to waste every day.

- *Transfer and transport*. The innovative idea of synchronisation that has been adopted by the municipality to transfer waste from pushcarts to trucks has proved to be successful. This has reduced the spillage, no space is occupied for intermediate storage and collection happens on time as the workers and trucks have to meet at a specified time and location for the transfer. The transfer of small drums is also much easier and safer than the transfer of waste from large community bins. The trucks that are currently used do not have provision for separate collection of waste. This results in the mixing of waste even if the waste is collected separately. Trucks can either be provided with partition or two trucks can be provided – one truck for the collection of organic and mixed waste and another truck for collection

of recyclable waste. The truck for recyclable waste can have a frequency of once in three days as the quantity of recyclable waste generated is less when compared to organic waste. Transfer of waste is carried out manually so it is very important to have proper safety gear like gloves, apron, masks and goggles during transfer. The vehicles used for the transportation of waste should be in a good condition. Most of the trucks have a mesh covering and about 50–60% also have polythene covering. However, there is no proper enclosure provided to prevent the wet waste from leaking on to the road. It is very essential that all trucks have mesh and polythene covering with a proper enclosure to prevent scattering of waste, foul odour and leakage while travelling on crowded roads.

- *Treatment process*. The only treatment option that is provided for Bangalore city is composting. This is carried out only for 400 MT/day while the total amount of waste generated is about 2300 MT/day. There have been proposals for setting up three integrated waste management sites that have composting and sanitary landfills. This action needs to be hastened to prevent the excessive damage being caused by open dumping of large quantities of waste every day. Other treatment options also should be considered like decentralised anaerobic digesters near markets. This will not only produce biogas but also reduce the transportation cost of waste to landfill sites. Waste to energy plants like production of refuse derived fuels and incineration plants can be set up to use waste from commercial areas, once the source segregation process is set in place.

- *Disposal*. In the current MSWM system, the function that has been totally ignored is that of final disposal of MSW. The current method of disposal adopted, as explained earlier, is extremely hazardous to the environment and can cause irreversible damage to the surrounding areas. Unauthorised open dumping of waste is also carried out near crowded slum areas. This is extremely hazardous to the people living around that area. The identification and closure of such dumps should be given the topmost priority. The setting up of the proposed sanitary landfill sites with integrated composting plants should be hastened.

Some important factors that need to be considered for the overall improvement of the waste management system are:

- *Data management*. To improve data management there should be commitment to improving reliability of the data on waste from the staff and authorities. Greater confidence in data will help in monitoring the efficiency of the collection, transportation, process and disposal options. Geoinformatics would help in monitoring the unauthorised activities, by monitoring the number of trucks and trips made by trucks to the specified disposal site.

- *Training and education*. Environmental education is a way of increasing understanding of problems, cooperation among stakeholders, environmental entrepreneurship and environmental performance. The training should be a regular feature of MSWM, with hands on training on sorting and collection. After training there should be follow up of the practices.

- *Health and safety programmes*. It has been a common observation that in Bangalore, maintenance staffs do not use the protection gear that is provided to them. Regular health and safety programmes are required to educate the staff on the ill effects of manual handling of waste, walking bare foot in dump yards and continuous exposure to waste. Regular health check ups should be carried out to monitor the health of the workers.

- *Involvement of the community*. Community involvement in waste management monitoring programmes like that of Suchi Mitra should be encouraged and more people should be involved in such activities. This increases the environmental awareness of the participants and other people. This is one of the fastest and most effective ways to make the public understand the importance of activities like sorting.

- *Integration of waste pickers*. NGOs should organise waste pickers and, instead of the waste pickers retrieving waste at the dump yard which is extremely hazardous to their health, safer methods of retrieving waste from the source by the waste pickers should be developed. Additionally, the waste pickers should be paid to retrieve waste from process plants and dump yards, instead of them paying to access the waste. Ways of improving the working conditions of the waste pickers and providing safety gear for them should be developed.

- *Planning*. The waste management that is carried out currently comprises more low cost measures in order to comply with regulation and avoid public agitation and complaints. There is no environmental management planning that is taken into consideration. Improper planning before setting up the sanitary landfill sites has led to increased public agitation and legal complications that have delayed the projects for a very long period. Although an informal approach to problem solving may have worked reasonably well while the programme was relatively small, a more systematic and proactive approach to management is required when the complexity of the programme increases. This would help to ensure that requirements are handled in a consistent and professional way and problems are addressed promptly and effectively. This would also ensure that the staff has clear objectives and goals while carrying out their activities.

- *Monitoring*. Monitoring during collection, transfer, process and disposal needs to become an integral part of the waste management system. The municipal authority not only has to monitor their own staff's activities but also the activities carried out by the private organisations. The State pollution control board has to carry out regular inspections of the dump yards and stop open dumping as it causes serious air and water pollution problems.

- *Public participation*. Currently the main hindrance to the implementation of the sanitary landfill sites is due to lack of information dissemination to the public. It is very essential that before any project is implemented, a public participation meeting be held to make the public aware of the technology used in sanitary landfill and the impacts.

Table 4 Ward wise Auditing of functional components of MSWM

Function	*Technique*		*Shivajinagar*	*Malleswaram*	*Koramangala*	*IISc*	*HMT*	*Airport road*	*Chickpet*	*Average %age*
Storage	Community bin	Percentage of covered bins	30	–	–	33	–	–	34	49.00*
Collection	Community bin	Percentage of area covered in commercial areas	40	0	0	–	–	–	30	17.5**
	Door to door	Percentage of area covered in residential areas	100	100	100	60	100	100	100	94.29
		Percentage of waste segregated	0	0	20	5	0	0	0	3.57
Transfer		Transfer station	A	A	A	A	A	A	A	A
Transport	Truck	Truck with mesh (%)	100	100	100	75	100	100	100	96.43
		Truck with mesh and polythene cover (%)	75	40	75	0	0	0	100	41.43
Process	Percentage of waste recycled	Informal	18	18	18	18	18	18	18	18.00
		Formal								
	Percentage of waste composted				22					3.14
	Percentage of waste for anaerobic digestion									
	Percentage of waste incinerated									
Disposal	Sanitary landfill									
	Dump yard		85	85		85	85		85	60.71
	Quarry				63			85		21.14

A: Absent.

*Only the areas having bins are taken into consideration.

**Only the commercial areas have been taken into consideration i.e., Shivajinagar, Malleswaram, Koramangala and Chikpet.

Table 5 Compliance audit of MSWM

Checklist for compliance	*Sample wards*						
Function Regulation	*Shivajinagar 79*	*Malleswaram 7*	*Koramangala 67*	*IISc 5*	*HMT 1*	*Airport Road 73*	*Chickpet 28*
Storage							
No littering on the streets?	X	X	X	√	√	X	X
No littering around bins?	X	na	na	X	X	√	X
Are the bins covered?	X	na	na	X	X	√	X
Are the bins cleared every 24 hrs?	√	na	na	√	√	√	√
The storage facility is designed taking into account the quantity of waste generated in a given area and the population density	X	na	na	√	√	X	X
Aesthetically acceptable	X	na	na	√	X	X	X
Bins have easy to operate design	X	na	na	√	X	X	X
Bins for biodegradable waste are painted green, for recyclable waste they are painted white and for other waste they are painted black	X	√	√	X	√	√	√
No manual handling of waste	X	X	X	X	X	X	X
Manual handling with proper precaution and safety	√	√	√	√	√	√	√
Segregation							
Organisation of awareness programmes to ensure community participation in waste segregation	√	√	√	X	X	X	√
Arranging meetings at quarterly intervals	X	X	X	X	X	X	X
Arranging meetings at monthly intervals	X	X	X	X	X	X	X
Arranging meetings once in every six months	√	√	√	X	X	X	√
Collection							
Door-to-door collection/ community bin/ block collection	√	√	√	√	√	√	√
Segregation done at source	X	X	X	X	X	X	X
Collection from slums and squatter area	X	√	√	√	√	√	X
Collection from hotels/ restaurants/ office complexes	V	V	V	V	V	V	V
Separate collection of waste from slaughter houses/ meat and fish markets/ fruit and vegetable markets	√	√	√	√	√	√	√
No mixing of biomedical wastes and industrial wastes with MSW	√	√	√	X	√	√	√
Usage of hand driven container carts for the collection and transfer of waste to trucks or community bins	√	√	√	X	√	√	√
Horticulture, dairies and construction and demolition waste is collected separately	√	√	√	√	√	√	√

Table 5 Compliance audit of MSWM (continued)

Checklist for compliance	*Sample wards*						
Function Regulation	*Shivajinagar 79*	*Malleswaram 7*	*Koramangala 67*	*IISc 5*	*HMT 1*	*Airport Road 73*	*Chickpet 28*
Collection							
No burning of waste (garbage, dry leaves)	√	√	√	√	√	√	√
No stray animals allowed to move around waste storage facilities	X	X	X	X	X	X	X
No stray animals allowed to move around other places in city or town	X	X	X	X	X	X	X
Notification of the waste collection schedule and the likely method to be adopted for public benefit by Municipal authority	X	X	X	X	X	X	X
Has the public been educated about the law stating that it is the responsibility of the waste generator to avoid littering and ensure delivery of wastes in accordance with the collection and segregation system notified by the Municipal authority	X	X	X	X	X	X	X
Transportation							
Waste transportation vehicles are covered	√	√	√	X	√	√	√
Waste during transportation not visible to public	X	X	X	X	X	X	X
Waste not scattered during transportation	X	X	X	X	X	X	X
Waste collected daily and before overflow of bin	√	√	√	√	√	√	√
Multiple handling of waste avoided	√	√	√	√	√	√	√

Process	*Regulations*	*KCDC*	*Terra firma*
Composting	Agreement between the private agency and the municipal authority for supply of solid waste	√	√
	Waste storage area should be covered, else it should have an impermeable base with facility for collection of leachate and surface water run-off into lined drains leading to a leachate treatment and disposal facility	√	√
	Precautions shall be taken to minimise nuisance of odour, flies, rodents, bird menace and fire hazard	√	√
	During breakdown of plant the waste intake is stopped and is diverted into a landfill	√	√
	Segregation prior to process and constant removal of rejects	X	X
	Constant removal of rejects post processing	√	√
	Recyclables routed through appropriate vendors	√	√
	Non-recyclables sent to well designed landfill sites	√	√

Table 5 Compliance audit of MSWM (continued)

Process	*Regulations*	*KCDC*	*Terra firma*
	For windrow composting provided with impermeable base	√	na
	Made of concrete or compacted clay, 50 cm thick, having permeability coefficient less than 10^{-7} cm/sec	√	na
	The base shall be provided with 1–2% slope and circled by lined drains for the collection of leachate or surface run-off	√	na
	Ambient air quality monitoring is regularly carried out	√	X
	Compost quality as per standards	√	[illegible]
	Treated leachate complies to standards	na	[illegible]
Disposal	*Regulation*	*Kodungaiyur*	*Mavallipura*
Site selection (*proposed sites*)			
	The landfill site shall be large enough to last for 20–25 years	√	√
	The landfill site is away from habitation clusters	√	√
	The landfill site is away from forest areas	√	√
	The landfill site is away from water bodies	√	√
	The landfill site is away from monuments	√	√
	The landfill site is away from National Parks	√	√
	The landfill site is away from Wetlands	√	√
	The landfill site is away from places of important cultural, historical or religious interest	√	√
	The landfill site is at least 20 km away from airport including airbase	√	X
	If not necessary approval should be obtained	na	X
	Waste processing facility shall be planned as an integral part of the landfill site	√	√
	A buffer zone of no-development is maintained around landfill site and incorporated in the Town Planning Department's land use plans	X	X

6 Conclusion

The audit has brought out the key issues that need immediate attention and minor lacunae that pose major hindrances in the further process of the system. In the storage function, only 49% of the present bins are covered. In collection, 17.5% of the commercial areas have community bins and 94% of the residential areas have adopted the door-to-door method. With these methods of collection, only 3% of waste segregation has been achieved. There are no transfer stations present and out of the trucks present, only 41.43% have polythene covering. Recycling is carried out mainly by the informal sector

achieving a high level of efficiency. 3.14% of waste reduction is achieved through composting and 60.71% of the waste is disposed in dump yards and 21.14% is disposed in open quarry sites.

Waste disposal needs immediate attention and strict monitoring. The setting up of sanitary landfill sites has to speed-up and this needs to be given top priority. The number of treatment process plants has to be increased to manage total quantity of waste generated. Many new techniques have been implemented for storage, collection, transfer and transportation. These techniques have brought about many positive changes and have increased the efficiency of the MSWM system. However, segregation of waste at each step is not being carried out. The segregation of waste during storage, collection and transportation has to be set in place for the efficient running of the process plants. Proper training and education needs to be provided to the workers and public awareness programmes should be conducted regularly. The occupational and health and safety measures taken by the authorities are not sufficient. Health and safety programmes have to be conducted regularly to check the health condition of the workers in the various areas of MSWM and they should be educated on the health hazards related to their work and the importance of wearing the safety gear.

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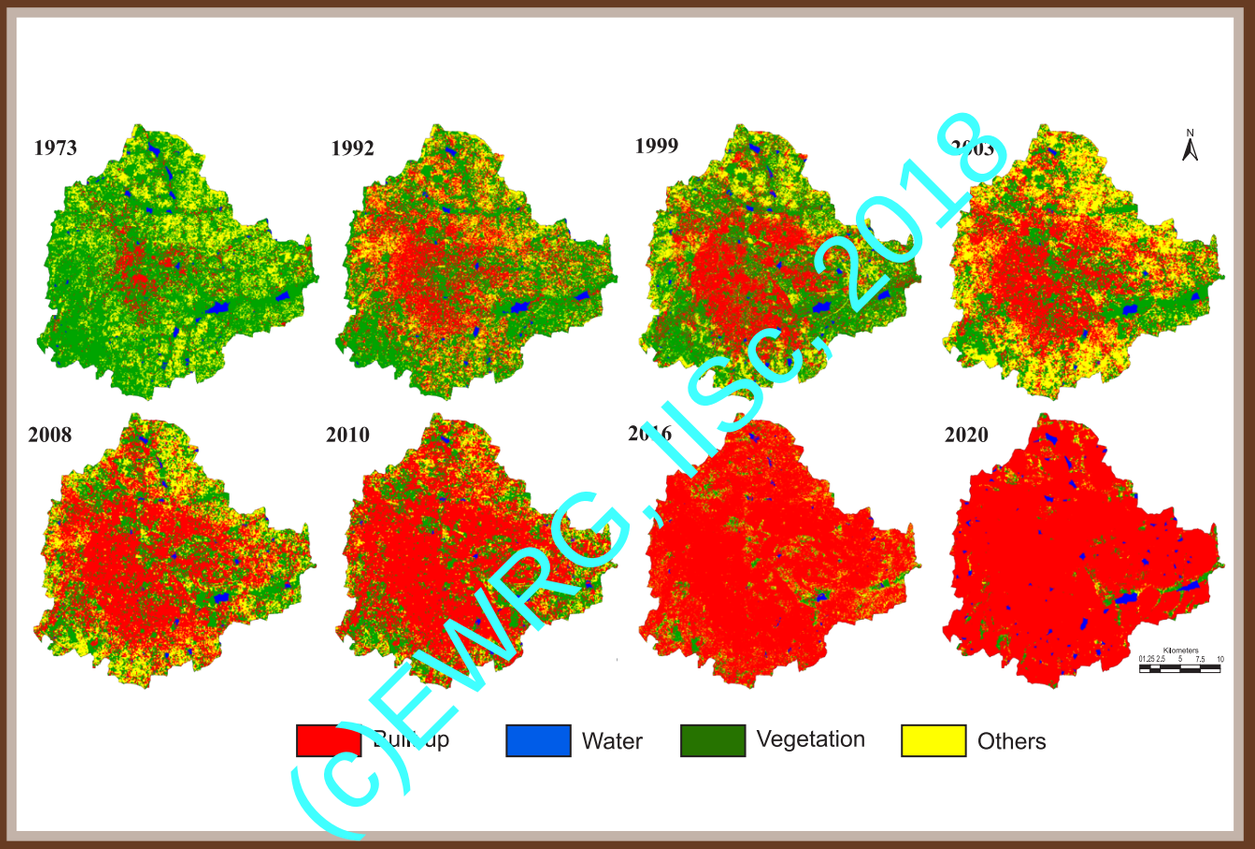

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GUEST EDITORIAL

Bengaluru's reality: towards unlivable status with unplanned urban trajectory

The origin of cities can be traced back to the river valley civilizations of Mesopotamia, Egypt, Indus Valley and China. Initially these settlements were largely dependent upon agriculture; however, with the growth in population the city size increased and economic activity transformed to trading (Ramachandra, T. V. *et al.*, *TEMA J. Land Use, Mobility Environ.*, 2014, **7**(1), 83–100). The process of urbanization gained impetus with the Industrial Revolution 200 years ago and accelerated in the 1990s with globalization and consequent relaxation in market economy (Ramachandra, T. V. *et al.*, *Int. J. Appl. Earth Obs. Geoinf.*, 2012, **18**, 329–343).

Urbanization refers to the growth of towns and cities due to large proportion of the population living in urban areas and its suburbs at the expense of rural areas (*op. cit*). In most of the countries, the total population living in urban regions has extensively accelerated since the Second World War. Rapid urbanization is evident from the increase in global urban population from 13% (220 million) in 1900 to 49% (3.2 billion) in 2005, and is expected to increase to 60% (4.9 billion) by 2030 (*op. cit*). Current global population is 7.4 billion and urban population has been increasing three times faster than the rural population, mainly due to migration in most parts of the world. People migrate to urban areas with the hope of better living, considering relatively better infrastructural facilities (education, recreation, health centres, banking, transport and communication), and higher per capita income. Unplanned urbanization leads to the large-scale land-use changes affecting the sustenance of local natural resources. Rapid unplanned urbanization in most cities in India has led to serious problems in urban areas due to higher pollution (Ramachandra, T. V. *et al.*, *Renew. Sustain. Energy Rev.*, 2015, **44**, 473–495) (air, water, land, noise), inequitable distribution of natural resources, traffic congestion, spread of slums, unemployment, increased reliance on fossil fuels, and uncontrolled outgrowth or sprawl in the periphery. Understanding spatial patterns of urban growth and visualization is imperative for sustainable management of natural resources and to mitigate changes in climate. This would help the city planners to mitigate the problems associated with the increased urban area and population, and ultimately build sustainable cities.

Bengaluru is experiencing unprecedented rapid urbanization and sprawl in recent times due to unrealistic concentrated developmental activities with impetus on industrialization for the economic development of the region. This has led to large scale land-cover changes with serious environmental degradation, posing serious challenges to the decision makers in the city planning and management process, such as climate change, enhanced emissions of greenhouse gases (GHGs), lack of appropriate infrastructure, traffic congestion, and lack of basic amenities (electricity, water and sanitation) in many localities. Apart from these, major implications of urbanization are the following.

Urbanization and loss of natural resources (wetlands and green spaces): Urbanization during 1973–2016 (1005% concretization or increase of paved surface) has had a telling influence on the natural resources, such as decline in green spaces (88% decline in vegetation), wetlands (79% decline), higher air pollutants and sharp decline in groundwater table. Figure (see Cover Page of this issue) depicts the unrealistic urban growth during the last four decades. Quantification of the number of trees in the region using remote sensing data with field census reveals that there are only 1.5 million trees to support Bengaluru's population of 9.5 million, indicating one tree for every seven persons in the city (Ramachandra, T. V. *et al.*, *ENVIS Technical Report 75*, IISc, 2014, p. 75). This is insufficient even to sequester respiratory carbon (ranges from 540 to 900 g per person per day). Geovisualization of likely land uses in 2020 through multicriteria decision-making techniques (Fuzzy-AHP) reveals a calamitous picture of 93% of Bengaluru's landscape being filled with paved surfaces (urban cover), and drastic reduction in open spaces and green cover. This would make the region GHG-rich, water-scarce, non-resilient and unlivable, depriving the city-dwellers of clean air, water and environment.

Field studies during 2015–16 of 105 lakes revealed that 98% of the lakes have been encroached for illegal buildings (high-rise apartments, commercial buildings, slums, etc.) and 90% of the lakes are sewage-fed. Also, lake catchments are being used as dumping yards for either municipal solid waste or building debris. Indiscriminate disposal of solid and liquid waste (rich in organic nutri-

ent) has enriched nitrate levels in the surrounding groundwater resources, threatening the health of residents (such as kidney failure, cancer, etc.). Washing, household activities, vegetable cultivation and even fishing was observed in few contaminated lakes. Unauthorized construction in valley zones, lakebeds and storm water drains highlight the apathy of decision-makers, while mirroring weak and fragmented governance. This is correlated with the increase in unauthorized constructions violating town planning norms (city development plan), which has severely affected open spaces and water bodies in particular.

Large-scale fish mortality in recent months further highlights the level of contamination and irresponsible management of water bodies. Sustained inflow of untreated sewage has increased the organic content beyond the threshold of remediation capability of the respective water bodies. Increasing temperatures (34–35°C) with the onset of summer, enhanced the biological activities (evident from higher ammonia and biochemical oxygen demand) that lowered dissolved oxygen levels leading to fish death due to asphyxiation.

Floods: Conversion of wetlands to residential and commercial layouts has compounded the problem by removing the interconnectivities in an undulating terrain. Encroachment of natural drains, alteration of topography involving the construction of high-rise buildings, removal of vegetation cover, and reclamation of wetlands are the prime reasons for frequent flooding even during normal rainfall post 2000.

Decline in groundwater table: The water table has declined to 300 m from 28 m, and 400–500 m in intensely urbanized area such as Whitefield, over a period of 20 years.

Heat island: Surface and atmospheric temperatures have increased due to the loss of natural cover (trees and water bodies) with an increase in artificial materials having high heat conductivities. Temperature has increased by ~2–2.5°C during the past three decades. Highlights the implications of explosive urban growth on local climate, necessitating appropriate mitigation strategies.

Increased carbon footprint: Drastic increase in electricity consumption has been observed in certain corporation wards due to adoption of inappropriate building architecture in tropical climate. Per capita electricity consumption in the zones dominated by high-rise building with glass facades ranges from 14,000 to 17,000 units (kWh) per year compared to zones with eco-friendly buildings (1300–1500 units/person/yr)[3].

Emissions from the transport sector is about 43.83% (in Greater Bengaluru) on account of large-scale usage of private vehicles, and mobility related to job accounts for 60% of total emissions due to lack of appropriate public transport system and haphazard growth with unplanned urbanization. Majority commute longer distances with private vehicles, thus contributing to emissions. Apart from these, mismanagement of solid and liquid waste has aggravated the situation with emission of GHGs (methane, CO_2, etc.)

Unplanned cities thus not only contribute to global climate change by emitting the majority of anthropogenic GHGs but are also particularly vulnerable to the effects of climate change and extreme weather. This emphasizes the need to improve urban sustainability through innovations while addressing technical, ecological, economic, behavioural and political challenges to create cities that are low-carbon, resilient and livable.

The 'Smart Cities Mission' launched by the Government of India recently (June 2015) envisages developing physical, institutional and social infrastructure in select cities with central assistance targeted at improving the quality of life as well as economic visibility of the respective urban centres (http://smartcities.gov.in/ (last accessed on 20 May 2016)). Four strategic components are: (i) green field development through smart townships by adopting holistic land management; (ii) pan-city development through adoption of smart applications like transport, reuse and recycle of wastewater, smart metering, recovering energy from solid waste, etc. (iii) retrofitting to make existing areas more efficient and livable by reducing GHG footprint, improving power and treated water supply, improving communication and infrastructure connectivity and security, and (iv) re-development of existing built-up area, creation of new layouts through mixed land use, adoption of appropriate floor area index considering the level of existing, and scope for improvement of infrastructure and basic amenities, which helps in keeping the city's growth within the region's carrying capacity, and also urban infrastructure becomes inclusive. This entails efficient decision-making through (i) integrated land-use planning according to the city's requirements; (ii) enhancement of the functional capacity through user-friendly and economic public transport support; (iii) development of mass rapid-transport systems, and (iv) effective use of ICTs as enabling technologies. These measures have to be implemented quickly as most cities are in a civic and financial disarray because of senseless unplanned rapid urbanization.

Environmentally sound urban centres with essential basic amenities and advanced infrastructure (such as sensors, electronic devices and networks) would stimulate sustainable economic growth and improvements in citizen services. The effective and coordinated governance supports social and urban growth through improved economy and active participation of citizens. Indian cities, while exhibiting technological innovations and connectedness, should also focus on increased living comfort through adequate infrastructure, green spaces and essential basic amenities to every citizen.

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Mismanagement of solid waste - global warming and changes in climate

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As the "Clean India" initiative picks up, the one big hurdle in the way is that of effective waste management. Ill managed waste not only makes cities untidy, it also adds to global warming and pollution.

Bangalore generates around 3000-4000 tonnes of solid waste every day. The growing population of the city has increased the pressure on the required waste management system. Residences, hotels, restaurants, commercial premises, slums and parks contribute to the generated waste. The household waste contributes about 55% of the total waste while hotels and eateries generate 20%. It is essential to understand how the composition and quantities of waste affects our environment.

Dr T.V. Ramachandra and his 'Energy and Wetlands Research Group' at the Centre for Ecological Sciences (CES) study solid waste management and its environmental impact. They studied composition of waste according to various factors. According to their research, 72% out of all the waste generated in the city is organic or biodegradable. Organic waste includes vegetable and fruit peels, food waste and garden waste. It is a rich resource of nutrients and can be treated to make compost. The inorganic waste consists of material like plastic, paper, glass, metal etc. These materials can be recycled to make other products if obtained separately.

The amount and type of waste produced have changed in the last few decades. Currently, a Bangalore citizen generates around 580 gram of waste per day on an average. This is a significant increase from 160 gram in the last few decades. Low income group use unprocessed vegetables and products with minimal packaging while the high income group use more packaged foods and produce more food waste. Similar variation is observed between urban and rural areas. People in rural areas use less packaged food products and generate lesser waste.

When waste is not disposed properly it creates problems. The major issue we face today is that the waste is not segregated properly. The ways to dispose various materials are different. So when the waste is not separated properly, it cannot be disposed properly. Some of the waste is also dumped on roadsides and open plots or is burned in open air causing health hazards and incomplete decomposition.

There is a significant increase in the amount of plastic waste due to the use of more packaged food in the recent years. "The plastic waste is a worrying phenomenon. The use and unsystematic disposal of plastic waste is choking storm water drains leading to floods in the city areas, entering the food chain through animals or directly affecting human health due to contact with cancer causing materials", says Dr. T. V. Ramachandra.

From the total waste generated in Bangalore, roughly 21% is made up of materials like paper, plastic, glass and metal that can be recycled. The recycling of materials that have an economic value is done by rag pickers and individual vendors. However there is a need to develop a system to collect the sorted waste regularly.

In this regard, for an effective segregation at sources suggestions were to implement incentive based segregated waste collection system. This involves (i) mobile vans with the provision to collect segregated waste and unsegregated waste, (ii) Bangalore lane friendly mobile vans with GPS facility, (iii) incentive mechanism - residents who segregate to be given an incentive of Rs 1-2 per kg of organic waste, which is

accounted electronically and transferred to the respective household owner's bank account (with Aadhaar, etc.), (iv) those who give unsegregated waste need to pay Rs 5 per kg. These suggestions implemented effectively, would generate revenue to the BBMP, if the present trend of unsegregated waste continues.

When biodegradable waste is composted effectively there is a very little amount of GHG's (greenhouse gases) emissions . For effective decomposition, sufficient oxygen is required to convert waste into compost. However when biodegradable waste is mixed with other non biodegradable materials, less oxygen is available for decomposition. As a result, high quantity of methane is released instead of limited quantities of carbon dioxide. Methane, a potent greenhouse gas, is one of the causes of global warming. Unscientific dumping of organic waste in dumping sites also results in huge quantities of methane released in open air.

Dr. T.V. Ramachandra and his research group have estimated the carbon dioxide and methane gas emitted from the waste sector by theoretical as well as experimental methods. Total methane emission from Bangalore solid waste using the experimental methods is about 32 kg/day, whereas carbon dioxide is 404 kg/day.

The researchers suggest segregation of waste at source as the most important way to better waste management. Households, restaurants, commercial premises should separate waste into categories like plastic, paper, food waste etc. This will ensure that biodegradable waste is efficiently treated and plastic and paper can be recycled. Burning of waste in open air should be stopped as it releases harmful gases in the air. The organic fraction of the waste contributes majorly to the release of Green house gases in the air, mainly methane. However if the organic waste is treated in biogass plants and if the methane gas is captured, it can be used a good source of fuel.

Some residential colonies that have started operating composting units to process the biodegradable waste produced by the residents. The city needs more such local initiatives to cope up with the problem of growing waste.

About the author

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About the paper

It was published in November 2014 in the book 'Assessment of Carbon Footprint in Different Industrial Sectors, Volume 1

https://www.researchgate.net/publication/275017534_Carbon_Footprint_of_the_Solid_Waste_Sector_in_Greater_Bangalore_India

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पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय

अधिसूचना

नई दिल्ली, 8 अप्रैल, 2016

का.आ. 1357(अ).—ठोस अपशिष्ट प्रबंधन नियम, 2015 का प्ररुप भारत सरकार के पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय की अधिसूचना सं. सा.का.नि.451 (अ) तारीख 3 जून, 2015 को भारत के राजपत्र भाग II, खंड-3, उप खंड (i) में उसी तारीख को प्रकाशित किए गए थे, जिसमें उनसे प्रभावित होने वाले संभावित व्यक्तियों से नगरीय ठोस अपशिष्ट (प्रबंधन और हथालन) नियम 2000 को अधिक्रांत करते हुए उक्त अधिसूचना के द्वारा ठोस अपशिष्ट प्रबंधन नियम, 2015 के प्रकाशन की तारीख से साठ दिनों की अवधि की समाप्ति से पूर्व आक्षेप और सुझाव आमंत्रित किए थे।

उक्त राजपत्र की प्रतियां जनता को तारीख 3 जून, 2015 को उपलब्ध कराई गईं थीं;

निर्धारित अवधि के भीतर उक्त प्रारूप नियमों पर प्राप्त आपत्तियों तथा टिप्पणियों पर केन्द्र सरकार द्वारा सम्यक रूप से विचार किया गया था;

पर्यावरण (संरक्षण) अधिनियम, 1986 (1986 का 29) की धारा 3, 6 और 25 द्वारा प्रदत्त शक्तियों का प्रयोग करते हुए और नगरीय ठोस अपशिष्ट (प्रबंधन और हथालन) नियम, 2000, उन बातों के सिवाय अधिक्रांत करते हुए जिन्हें ऐसे अधिक्रमणों से पहले किया गया है या किए जाने का लोप किया गया है, केन्द्रीय सरकार ठोस अपशिष्टों का प्रबंधन करने के लिए निम्नलिखित नियम बनाती है अर्थात् :

1. संक्षिप्त नाम और प्रारंभ.–

(1) इन नियमों का संक्षिप्त नाम ठोस अपशिष्ट प्रबंधन नियम, 2016 है।

(2) ये राजपत्र में इनके प्रकाशन की तारीख से प्रवृत्त होंगे ।

2. लागू होना- ये नियम प्रत्येक शहरी स्थानीय निकाय, शहरी क्षेत्रों के विस्तार, भारत के महारजिस्ट्रार और जनगणना आयुक्त द्वारा यथा घोषित जनगणना नगरों, अधिसूचित क्षेत्रों, अधिसूचित औद्योगिक नगरी, भारतीय रेल के अधीन क्षेत्रों, विमानपत्तनों, वायुयान बेस, बंदरगाह और हारबर, रक्षा स्थापनाओं, विशेष आर्थिक जोन, राज्य और केन्द्रीय सरकारों के संगठनों, समय-समय पर क्रमश: राज्य सरकार द्वारा यथा अधिसूचित तीर्थ, धार्मिक तथा ऐतिहासिक महत्व के स्थानों और जिसमें औद्योगिक अपशिष्ट, परिसंकटमय अपशिष्ट, परिसंकटमय रसायन, जैव चिकित्सा अपशिट, ई-अपशिष्ट, सीस-अम्ल बैटरियां और रेडियो सक्रिय अपशिष्ट पर्यावरण (संरक्षण) अधिनियम, 1986 के अधीन अलग से बनाए गए नियमों के अधीन आते हैं, के सिवाय प्रत्येक घरेलू, सांस्थानिक, वाणिज्यिक और किसी भी अन्य गैर-आवासीय ठोस अपशिष्ट जनित्रों पर लागू होंगे:-

3. परिभाषाएं- (1) इन नियमों में, जब तक कि संदर्भ से अन्यथा अपेक्षित न हो,- (1) **"वातजीवी कम्पोस्टीकरण"** से ऑक्सीजन की विद्यमानता में जैविक पदार्थ का सूक्ष्म जैवकीय विघटन अंतर्वलित कोई नियंत्रित प्रक्रिया अभिप्रेत है;

2. **''अवायुजीवी उपचारण''** से ऑक्सीजन के अभाव में जैविक पदार्थ का सूक्ष्म जैवकीय विघटन अंतर्वलित कोई नियंत्रित प्रक्रिया अभिप्रेत है;

3. **"प्राधिकार"** से यथास्थिति, राज्य प्रदूषण नियंत्रण बोर्ड या प्रदूषण नियंत्रण समिति द्वारा किसी प्रसुविधा के प्रचालक या शहरी स्थानीय प्राधिकरण या ठोस अपशिष्ट के प्रसंस्करण और निपटान के उत्तरदायी किसी अन्य अभिकरण को दी गई अनुज्ञा अभिप्रेत है;

4. **''जैविक रूप से अपघटित अपशिष्ट''** से कोई ऐसी कार्बनिक सामग्री अभिप्रेत है जिसे सूक्ष्म जीव द्वारा सरलतर टिकाऊ सम्मिश्रण में निम्नीकृत किया जा सकता है;

5. **''जैविक मिथेनीकरण''** से ऐसी प्रक्रिया अभिप्रेत है जिसमें मिथेन से भरपूर जैव गैस का उत्पादन करने के लिए सूक्ष्मजीवी क्रिया द्वारा कार्बनिक पदार्थ का इंजाइमी अपघटन को अपरिहार्य बनाता है;

6. **"ब्रांडस्वामी"** से कोई व्यक्ति या कंपनी अभिप्रेत है जो किसी रजिस्ट्रीकृत ब्रांड लेवल के अधीन कोई वाणिज्यिक विक्रय करता है;

7. **''मध्यवर्ती परिक्षेत्र''** से ऐसा विकास रहित परिक्षेत्र अभिप्रेत है जिसमें 5 टीपीडी से अधिक की संस्थापित क्षमता वाली ठोस अपशिष्ट प्रसंस्करण तथा निपटान सुविधा के चारों ओर अनुरक्षित किया जाएगा। इसे ठोस अपशिष्ट के प्रसंस्करण तथा निपटान संबंधी सुविधा के लिए आवंटित कुल क्षेत्र के भीतर अनुरक्षित किया जाएगा;

8. **'भारी मात्रा में अपशिष्ट उत्पादक"** से अभिप्रेत है और इसके अंतर्गत औसतन 100 कि.ग्रा. प्रतिदिन की दर से अधिक अपशिष्ट उत्पादित करते हैं तथा इनसे केन्द्रीय सरकार के विभागों अथवा उपक्रमों, राज्य सरकार के विभागों या उपक्रमों, स्थानीय निकायों, सार्वजनिक या प्राइवेट सेक्टर की कंपनियों, अस्पतालों, नर्सिंग होम, स्कूलों, कॉलेजों, विश्वविद्यालयों, अन्य शैक्षिक संस्थाओं, छात्रावासों, होटलों, वाणिज्यिक स्थापनाओं, बाजारों, पूजा स्थलों, स्टेडियमों और खेल परिसरों द्वारा अधिकृत भवन भी है;

9. **"उप-विधि"** से स्थानीय निकाय, जनगणना शहर और अधिसूचित क्षेत्र टाउनशिप द्वारा, अपने अधिकारिता वाले क्षेत्र में इन नियमों को प्रभावी ढ़ंग से कार्यान्वित करने को सुविधाजनक बनाने के लिए, अधिसूचित नियामक ढांचा अभिप्रेत है;

10. **"जनगणना नगर"** से भारत के महारजिस्ट्रार और जनगणना आयुक्त द्वारा यथा परिभाषित शहरी क्षेत्र अभिप्रेत है;

11. **"ज्वलनशील अपशिष्ट"** से प्लास्टिक, काष्ठ लुगदी आदि जैसी क्लोरोनीकृत सामग्री को छोड़कर गैर-जैवअवक्रमणीय, गैर-पुनर्चक्रणीय, गैर-पुन:उपभोज्य, गैर-परिसंकटमय ठोस अपशिष्ट अभिप्रेत है जिनका 1500 किलो कैलोरी प्रति कि.ग्रा. से न्यूनतम कैलोरिफिक मान हो;

12. **''कम्पोस्टीकरण''** से जैविक पदार्थ का सूक्ष्मजीवी अपघटन अंतर्वलित की एक ऐसी नियंत्रित प्रक्रिया अभिप्रेत है;

13. **''ठेकेदार''** से ऐसा व्यक्ति या फर्म अभिप्रेत है जो कोई सेवा करने के लिए या सेवा प्रदाता प्राधिकारी के लिए कार्य करने के लिए सामग्री या श्रम प्रदान करने की संविदा करता है या करती है;

14. **''सह प्रसंस्करण''** से प्राकृतिक खनिज संसाधनों और औद्योगिक प्रक्रियाओं में जीवाश्म ईंधनों को प्रतिस्थापित करने या उन्हें अनुपूरित, दोनों को करने के लिए कच्ची सामग्री के रूप में या ऊर्जा के स्रोत के रूप में 1500 किलो कैलोरी से अधिक कैलोरिफिक मूल्य वाले गैर-जैव अवक्रमणीय और गैर-पुनर्चक्रणीय ठोस अपशिष्ट का उपयोग अभिप्रेत है;

15. **"विकेंद्रित प्रसंस्करण"** से जैव अवक्रमणीय अपशिष्ट के प्रसंस्करण को अधिकतम करने के लिए बिखरी हुई सुविधाओं की स्थापना और उत्पादन के स्रोत से निकटतम पुनर्चक्रण योग्य सामग्रियों की प्रतिप्राप्ति करना अभिप्रेत है ताकि प्रसंस्करण या निपटान के लिए अपशिष्ट का न्यूनतम परिवहन करना पड़े;

16. **''निपटान''** से भूजल, सतही जल, परिवेशी वायु के संदूषण तथा पशुओं या पक्षियों के आकर्षण को रोकने के लिए अनुसूची 1 में यथा विनिर्दिष्ट भूमि पर प्रसंस्करण के उपरांत अवशिष्ट ठोस अपशिष्ट और निष्क्रिय गली का कूड़ा, करकट और सतही नाले की गाद का अंतिम तथा सुरक्षित निपटान अभिप्रेत है;

17. **''घरेलू परिसंकटमय अपशिष्ट''** से घरेलू स्तर पर उत्पन्न संक्रामक अपशिष्टों जैसे फेंके हुए पेंट के ड्रम, कीटनाशी के डिब्बे, सीएफएल बल्ब, ट्यूब लाइटें, अवधि समाप्त औषधियां, टूटे हुई पारा वाले थर्मामीटर, प्रयुक्त बैटरियां, प्रयुक्त सूइयां, तथा सिरिंज और संदूषित पट्टियां आदि अभिप्रेत हैं;

18. **"द्वार-द्वार संग्रहण"** से घरों, दुकानों, वाणिज्यिक प्रतिष्ठानों, कार्यालयों, संस्थागत या किसी अन्य गैर आवासीय परिसरों से द्वार तक जाकर ठोस अपशिष्ट का संग्रहण करना और जिसके अंतर्गत किसी आवासीय सोसायटी, बहुमंजिले भवन या अपार्टमेंट, बड़े आवासीय, वाणिज्यिक या संस्थागत कॉम्प्लैक्स या परिसरों में भूतल पर प्रवेश द्वार या किसी अभिहित स्थल से ठोस अपशिष्ट का संग्रहण करना भी अभिप्रेत है;

19. **''शुष्क अपशिष्ट''** से जैव-निम्नीकरण अपशिष्ट और निष्क्रिय गली का कूड़ा-करकट से भिन्न अपशिष्ट अभिप्रेत है और जिसके अंतर्गत पुनर्चक्रणीय अपशिष्ट, गैर पुनर्चक्रणीय अपशिष्ट, दाह्य अपशिष्ट और स्वास्थ्यकर नैपकिन और डायपर आदि अपशिष्ट भी है;

20. **''क्षेपण स्थल''** से जिसका स्वास्थ्यकर भूमिभरण के लिए सिद्धांतों को पालन किए बिना ठोस अपशिष्ट के निपटान के लिए शहरी स्थानीय निकाय द्वारा उपयोग की गई कोई भूमि अभिप्रेत है;

21. **"विस्तारित उत्पादक दायित्व"** से पैकेजिंग उत्पादों के जीवन काल के अंत तक पर्यावरण की दृष्टि से अनुकूल प्रबंधन के लिए, पैकेजिंग उत्पादों जैसे प्लास्टिक, टिन, कांच और कॉरूगेटेड बक्सों इत्यादि के किसी उत्पादक के उत्तरदायित्व अभिप्रेत है;

22. **''सुविधा''** से ऐसा कोई स्थापन अभिप्रेत है जिसमें ठोस अपशिष्ट प्रबंध प्रक्रियाएं अर्थात् पृथक्करण पुन:प्राप्ति, भंडारण, संग्रहण, पुनर्चक्रण, प्रसंस्करण, उपचार या सुरक्षित निपटान किया जाता है;

23. **"जुर्माना"** से इन नियमों तथा/अथवा उप-विधियों के निदेशों के अनुपालन के लिए उपविधियों के अधीन अपशिष्ट जनित्रों या अपशिष्ट प्रसंस्करण के प्रचालकों और निपटान सुविधाओं पर लगाए गए जुर्माना अभिप्रेत है;

24. **''प्ररूप''** से इन नियमों से उपाबद्ध प्ररूप अभिप्रेत है;

25. **''प्रहस्तन''** के अंतर्गत ठोस अपशिष्टों की छंटाई, पृथक्करण, सामग्री की पुन:प्राप्ति, संग्रहण, गौण भंडारण, काटना, गट्ठा बनाना, दलन, लदाई, उतराई, परिवहन, प्रसंस्करण तथा निपटान से संबंधित सभी क्रियाकलाप भी हैं;

26. **''निष्क्रिय''** से ऐसा अपशिष्ट अभिप्रेत है जो जैव अपघटनीय, पुन:चक्रणीय या दाह्य नहीं है, गली की सफाई तथा सतही नालियों से निकाली गई धूल तथा गाद भी हैं;

27. **"भस्मीकरण"** से उच्च तापमान पर अपशिष्ट सामग्रियों को तापीय रूप से निम्नीकृत करने के लिए ठोस अपशिष्ट का जलाना या दहन अंतर्वलित इंजीनियरीकृत प्रक्रिया अभिप्रेत है;

28. **"अनौपचारिक अपशिष्ट संग्राहक"** के अंतर्गत व्यष्टि, संगम ऐसे या अपशिष्ट व्यापारी सम्मिलित है जो पुनर्चक्रणीय सामग्रियों की छंटाई, विक्रय और खरीद से अंतर्वलित है;

29. **"निक्षालितक"** से ऐसा द्रव अभिप्रेत है जो ठोस अपशिष्ट के माध्यम से या अन्य माध्यम से रिसता है जिसमें उसमें घुली हुई या निलंबित सामग्री का सत्व है;

30. **"स्थानीय निकाय"** से अभिप्रेत इन नियमों के प्रयोजन के लिए और जिसके अंतर्गत म्युनिसपल कॉरपोरेशन, नगर निगम, म्युनिसपल कौंसिल, नगरपालिका, नगरपालिका परिषद, म्युनिसपल बोर्ड, नगर पंचायत, और टाउन पंचायत, जनगणना नगर, अधिसूचित क्षेत्र और भारत के विभिन्न राज्यों और संघ राज्य क्षेत्रों में औद्योगिक नगरी चाहे उसका कोई भी नाम से पुकारा जाए, भी है;

31. **"सामग्री पुनर्प्राप्ति सुविधा (एमआरएफ)"** से ऐसी सुविधा अभिप्रेत है जहां गैर कंपोस्टीय ठोस अपशिष्ट को स्थानीय निकाय या नियम 2 में वर्णित कोई अन्य अस्तित्व या इसमें से किसी के द्वारा प्राधिकृत कोई व्यक्ति या अभिकरण जो अपशिष्ट को प्रसंस्करण या निपटान के लिए उसे परिदान या देने के पूर्व इस प्रयोजन के लिए स्थानीय निकाय या नियम 2 में वर्णित अस्तित्व द्वारा नियोजित अपशिष्ट चुनने वाले, अनौपचारिक पुनर्चक्रणकर्ता या कोई अन्य नियोजित कार्यबल को प्राधिकृत अनौपचारिक सेक्टर द्वारा अपशिष्ट के विभिन्न संघटकों से पृथक्करण, छंटाई या पुनर्चक्रण योग्य की पुनर्प्राप्ति की प्रसुविधा है;

32. **"अजैविक निम्नीकरण योग्य अपशिष्ट"** से कोई ऐसा अपशिष्ट अभिप्रेत है जिसका सूक्ष्म जीव द्वारा सरलतर स्थायी यौगिक में निम्नीकरण नहीं किया जा सकता है;

33. **"सुविधा का प्रचालक"** से ऐसा व्यक्ति या अस्तित्व अभिप्रेत है जो ऐसे ठोस अपशिष्ट के प्रहस्तन के लिए सुविधा का स्वामी है या प्रचालित करता है जिसके अंतर्गत स्थानीय निकाय और स्थानीय निकाय द्वारा नियुक्त कोई अन्य अस्तित्व या अभिकरण भी है;

34. **"प्राथमिक संग्रहण"** से पृथक्कृत ठोस अपशिष्ट को उसके उत्पादन के स्रोत जिसके अंतर्गत घर, दुकानें, कार्यालय और कोई अन्य गैर आवासीय परिसर भी हैं से या किसी संग्रहण बिंदु या शहरी स्थानीय निकाय द्वारा विर्निदिष्ट किसी अन्य अवस्थान से संगृहीत करना, उठाना या हटाना अभिप्रेत है;

35. **"प्रसंस्करण"** से कोई वैज्ञानिक प्रक्रिया जिसके द्वारा ठोस अपशिष्ट को पुन: उपयोग, पुन: चक्रित या नए उत्पादों में परिवर्तित करने के प्रयोजन के लिए हथालित करना अभिप्रेत है;

36. **"पुनर्चक्रण"** से पृथक्कृत ठोस अपशिष्ट को अजैव निम्नीकृत नए पदार्थ या उत्पाद या नए उत्पादों का उत्पादन करने के लिए कच्ची सामग्री के रूप में परिवर्तित करने की प्रक्रिया अभिप्रेत है, जिसमें मूल उत्पादों को समरूप किया जा सकेगा या नहीं किया जा सकेगा;

37. **"पुनर्विकास"** से जहां विद्यमान भवन और अन्य अवसंरचनाएं जीर्णशीर्ण हो गई हैं वहां उसी स्थल पर पुरानी आवासीय या वाणिज्यिक भवनों का पुनर्निर्माण अभिप्रेत है;

38. **"कचरा व्युत्पन्न ईंधन (आरडीएफ)"** से ठोस अपशिष्ट, जैसे प्लास्टिक, काष्ठ, लुगदी या कार्बनिक अपशिष्ट, क्लोरीनीकृत पदार्थों से भिन्न ठोस अपशिष्ट को सुखाकर कतरन, निर्जलीकरण और संहनन द्वारा गुटिका या रोएं के कप में उत्पादित बाह्य अपशिष्ट प्रभाजी से व्युत्पन ईंधन अभिप्रेत है;

39. **"अवशिष्ट ठोस अपशिष्ट"** से और उसके अंतर्गत ऐसी ठोस अपशिष्ट प्रसंस्करण सुविधाओं, जो पुनर्चक्रण या अतिरिक्त प्रसंस्करण के लिए उपयुक्त नहीं है, से प्राप्त अपशिष्ट और अस्वीकृत भी अभिप्रेत है;

40. **"स्वास्थ्यकर भूमिभरण"** से अवशिष्ट ठोस अपशिष्ट के अंतिम और सुरक्षित निपटान और भूजल, सतही जल या क्षणभंगुर वायु धूल, हवा से उड़ा हुआ कूड़ाकरकट, दुर्गंध, अग्नि परिसंकट, पशुओं का खतरा, पक्षियों का खतरा, नाशकजीव, कृंतकनाशी, ग्रीनहाउस गैस उत्सर्जन, सतत जैव प्रदूषणकारी तत्व प्रावण्य अस्थिरता तथा अपरदन के प्रदूषण के प्रति संरक्षात्मक उपायों सहित प्रकल्पित सुविधा में भूमि पर निष्क्रिय अपशिष्ट अभिप्रेत है;

41. **"स्वास्थ्यकर अपशिष्ट"** से प्रयोग किए गए डायपर, स्वास्थ्यकार तौलिए या नैपकिन, टैम्पोन, कन्डोम, इनकंटीनेंस शीट और कोई अन्य समरूप अपशिष्ट से मिलकर बना अपशिष्ट अभिप्रेत है;

42. **"अनुसूची"** से इन नियमों से उपाबद्ध अनुसूची अभिप्रेत है;

43. **"गौण भंडारण"** से प्रसंस्करण या निपटान सुविधा को अपशिष्ट के आगे परिवहन के लिए गौण भंडारण डिपो या एमआरएफ या आधानों पर संग्रहण के पश्चात ठोस अपशिष्ट का अस्थायी संदूषक अभिप्रेत है;

44. **"पृथककरण"** से ठोस अपशिष्ट के विभिन्न संघटकों अर्थात जैविक निम्नीकरण अपशिष्ट जिसके अंतर्गत कृषि और दुग्धपालन अपशिष्ट अजैविक निम्नीकरण अपशिष्ट जिसके अंतर्गत पुन:चक्रणयोग्य अपशिष्ट, गैर पुन:चक्रणयोग्य दाह्य योग्य अपशिष्ट, स्वास्थ्यकर अपशिष्ट और गैर चक्रण योग्य कूड़ाकरकट अपशिष्ट, घरेलू परिसंकटमय अपशिष्ट तथा संनिर्माण और विध्वंस अपशिष्ट भी है, की छंटाई और पृथक भंडारण अभिप्रेत है;

45. **"सेवा प्रदाता"** से जल, मलवहन, विद्युत, टेलीफोन, सड़क, जल निकास आदि अभिप्रेत हैं;

46. **"ठोस अपशिष्ट"** से ठोस या अर्द्धठोस घरेलू अपशिष्ट अभिप्रेत है और इसके अंतर्गत स्थानीय प्राधिकरण और नियम 2 में वर्णित अन्य अस्तित्व के अधीन क्षेत्र में उत्पन्न स्वास्थ्यकर अपशिष्ट, वाणिज्यिक अपशिष्ट, सांस्थानिक अपशिष्ट, खानपान और बाजार अपशिष्ट तथा अन्य गैर–आवासीय अपशिष्ट, गली की सफाई, सतह नालियों से हटाई गई या एकत्रित गाद, उद्यान कृषि अपशिष्ट, कृषि और डेयरी अपशिष्ट, औद्योगिक अपशिष्ट को छोड़कर उपचारित जैव चिकित्सक अपशिष्ट और ई-अपशिष्ट, बैटरी अपशिष्ट, रेडियो सक्रिय अपशिष्ट भी अभिप्रेत है;

47. **"छंटाई करना"** से मिश्रित अपशिष्ट से पुन:चक्रणयोग्य विभिन्न संघटकों और प्रवर्गों जैसे कागज, प्लास्टिक, गत्ता, धातु, कांच आदि को समुचित पुन:चक्रण सुविधा में पृथक करना अभिप्रेत है;

48. **"स्थिरीकरण"** से जैव निम्नीकरण अपशिष्ट को जैवीय अपघटन को स्थायी अवस्था में परिवर्तित करना अभिप्रेत है जहां वह निक्षालन या अरूचिकर सुगंध उत्पन्न नहीं करता है और कृषि भूमि, भू-कटाव नियंत्रण तथा भूमि उपचार के लिए उपयुक्त है;

49. **"मार्गविक्रेता"** से किसी गली, लेन, पार्श्व पथ, पैदल पथ, खडंजा, सार्वजनिक उद्यान या किसी अन्य सावर्जनिक स्थान या प्राइवेट क्षेत्र, अस्थायी रूप से निर्मित संरचना या स्थान से स्थान घूमकर साधारण जनता को दैनिक उपयोग के वस्तु, माल, सौदा, खाद्य मद या वाणिज्यिक वस्तु के विक्रय करने या उन्हें एक स्थान से दूसरे स्थान तक स्थानांतरित करने में लगे व्यक्ति अभिप्रेत हैं जिसके अंतर्गत फेरीवाला, पैकार, आबादकर तथा ऐसी सभी अन्य समानार्थी पद जो स्थानीय या विनिर्दिष्ट क्षेत्र में हो सकते हैं, भी है और "मार्ग विक्रय" शब्दों को उनके व्याकरणिक रूप भेदों और सजातीय पदों का अर्थ तदनुकूल किया जाएगा;

50. **"बख्शीश फीस"** से स्थानीय प्राधिकरण या राज्य सरकार द्वारा प्राधिकृत कोई राज्य अभिकरण द्वारा कोई फीस या समर्थन मूल्य अभिप्रेत है जो ठोस अपशिष्ट प्रसंस्करण सुविधा के ग्राही या प्रचालक या भूमिभरण पर ठोस अपशिष्ट के निपटान के लिए अवधारित संदात्त है;

51. **"अंतरण स्थल"** से संग्रह क्षेत्रों से ठोस अपशिष्ट प्राप्त करने को सृजित सुविधा और अपशिष्ट प्रसंस्करण और, या निपटान सुविधा को आच्छादित यानों या आधानों में बड़ी मात्रा में परिवहन अभिप्रेत है;

52. **"परिवहन"** से ठोस अपशिष्ट चाहे वह या तो उपचारित आंशिक उपचारित या अनुपचारित को एक स्थान से दूसरे स्थान पर किसी पर्यावरणीय रूप से युक्ति युक्त रीति में विशिष्ट रूप से अभिहित और आच्छादित परिवहन प्रणाली जैसे दुर्गध, कूड़ा कचरा और घृणित दशा को रोकने के लिए प्रवहन अभिप्रेत है;

53. **"उपचार"** से किसी अपशिष्ट के भौतिक, रसायनिक या जैविक लक्षणों या संघटन में रूपांतरण की अभिहित पद्धति, तकनीक या प्रक्रिया अभिप्रेत है जिससे उसके आयतन और क्षितिकारक क्षमता को कम करता है;

54. **"उपयोक्ता फीस"** से ठोस अपशिष्ट संग्रहण, परिवहन प्रसंस्करण और निपटान सेवाओं को उपलब्ध कराने की कुल या आंशिक लागत को प्राप्त करने में अपशिष्ट जनित पर स्थानीय निकाय और नियम 2 में वर्णित किसी अस्तित्व द्वारा अधिरोपित फीस अभिप्रेत है;

55. **"कृमि कम्पोस्ट बनाना"** से केचुओं का प्रयोग करते हुए कम्पोस्ट में सपंरिवर्तित करने की जैव निम्नीकरण प्रक्रिया अभिप्रेत है;

56. **"अपशिष्ट जनित्र"** से और इसके अंतर्गत सम्मिलित से, रेल तथा रक्षा स्थापनाओं सहित प्रत्येक व्यक्ति या व्यक्तियों का समूह या प्रत्येक आवासीय परिसर तथा गैर आवासीय स्थापनाएं भी है, जो ठोस अपशिष्ट उत्पन्न करते हैं, अभिप्रेत है;

57. **''अपशिष्ट की क्रमबद्धता''** से ऐसा प्राथमिकता क्रम अभिप्रेत है जिसके अनुसार ठोस अपशिष्ट का प्रबंधन निवारण, कटौती, पुन:उपयोग, पुनर्चक्रण, पुन: प्राप्ति और निपटान पर बल देकर किया जाना चाहिए जिसमें निवारण को सर्वाधिक प्राथमिकता और भू-भरण में निपटान को न्यूनतम वरीयता का विकल्प होगा;

58. **"अपशिष्ट चुनने वाला"** से ऐसा व्यक्ति या व्यक्तियों का समूह अभिप्रेत है जो अपशिष्ट उत्पादन के स्रोत से पुनः उपयोजनीय तथा पुनर्चक्रण योग्य ठोस अपशिष्ट के संग्रहण और साथ ही पुनर्चक्रकों को उनकी आजीविका अर्जित करने के लिए सीधे या उनके मध्यवर्तियों के माध्यम से विक्रय के लिए गलियों, डिब्बों, प्रसंस्करण तथा अपशिष्ट निपटान सुविधाओं से अपशिष्ट को उठाने में औपचारिक रूप से लगे हुए है;

(2) इसमें प्रयुक्त जिन शब्दों और पदों का अर्थ परिभाषित नहीं किया गया है, परंतु जो पर्यावरण (सरंक्षण) अधिनयम 1986, जल (प्रदूषण निवारण और नियंत्रण) अधिनियम, 1974 जल (प्रदूषण निवारण और नियंत्रण) उपकर अधिनियम 1977 तथा वायु (प्रदूषण निवारण और नियंत्रण) अधिनयम, 1981 में परिभाषित है, के अर्थ होंगे जो संबंधित अधिनियमों में हैं।

4. अपशिष्ट उत्पन्नकर्ताओं के कर्तव्य. प्रत्येक अपशिष्ट उत्पन्नकर्ता,-

(क) उनके द्वारा उत्पन्न किए गए अपशिष्ट को पृथक्कृत और तीन पृथक शाखाओं अर्थात जैव निम्नीकरणयोग्य, गैर निम्नजीकरणयोग्य और घरेलू परिसंकटमय अपशिष्ट के तीन अलग-अलग डिब्बों में भंडारित करेगा और समय-समय पर स्थानीय प्राधिकरणों द्वारा निदेश या अधिसूचना के अनुसार पृथक किए गए अपशिष्टों को प्राधिकृत अपशिष्ट चुनने वालों या अपशिष्ट संग्रहकर्ताओं को सौंपेगा;

(ख) प्रयोग किए गए स्वास्थ्यकर अपशिष्ट जैसे डायपरों और स्वास्थ्यकर पैडों आदि इन उत्पादों के निर्माताओं या ब्रांड स्वामियों द्वारा उपलब्ध कराई गई थैली में या स्थानीय प्राधिकारियों द्वारा यथा निर्देशित उपयुक्त लपेटन सामग्री में शुष्क अपशिष्ट या अजैविक निम्नीकरण अपशिष्ट के लिए बनाए गए डिब्बे में उसे डालेगा;

(ग) संनिर्माण और विध्वंस अपशिष्ट को पृथक रूप से अपने ही परिसर में भंडारित करेगा, जब कभी वह उत्पन्न होता हो, और उसे संनिर्माण और विध्वंस अपशिष्ट नियम, 2016 के अनुसार निपटान करेगा; और

(घ) अपने परिसर से उत्पन्न कृषि उद्यान अपशिष्ट और उद्यान अपशिष्ट को अपने ही परिसर में पृथक रूप से भंडारित करेगा और समय समय पर स्थानीय निकाय द्वारा निदेशानुसार इसका निपटान करेगा;

(2) कोई अपशिष्ट जनित्र उसके द्वारा उत्पन्न अपशिष्ट को गली, खुले सार्वजनिक स्थानों, नाली या जलाशयों में न फेंकेगा, न जलाएगा और न गाड़ेगा;

(3) सभी अपशिष्ट उत्पन्नकर्ता ऐसी उपयोक्ता फीस का संदाय करेंगे जो ठोस अपशिष्ट प्रबंधन के लिए स्थानीय निकायों की उपविधियों में विनिर्दिष्ट किया जाए;

(4) कोई व्यक्ति अग्रिम रूप से कम से कम तीन कार्य दिवस पूर्व स्थानीय निकाय को सूचित किए बिना किसी गैर अनुज्ञप्ति वाले स्थान पर एक सौ व्यक्तियों से अधिक का ऐसा कोई आयोजन या समारोह आयोजित नहीं करेगा । ऐसा व्यक्ति या ऐसे आयोजन का आयोजक स्रोत पर अपशिष्ट के पृथककरण की व्यवस्था करेगा और पृथक्कृत अपशिष्ट को स्थानीय निकाय द्वारा अभिहित अपशिष्ट चुनने वाले को या अपशिष्ट संग्रहण अभिकरण को सौंपेगा;

(5) प्रत्येक मार्ग विक्रेता अपने कार्यकलाप के दौरान उत्पन्न अपशिष्ट जैसेकि खाद्य अपशिष्ट प्रयोज्य (डिस्पोजेबल) प्लेटों, कपों, डिब्बों, रैपरों, नारियल के छिलको, शेष बचे भोजन, सब्जियों, फलों आदि के लिए उपयुक्त पात्र रखेगा और ऐसे अपशिष्ट को स्थानीय प्राधिकरण द्वारा यथा अधिसूचित अपशिष्ट भंडारण डिपो या पात्र या वाहन में डालेगा;

(6) इन नियमों के अधिसूचित होने की तारीख से एक वर्ष से अंदर सभी आवास कल्याण और बाजार संघ स्थानीय प्राधिकरण की भागीदारी में इन नियमों में यथा विहित जनित्रों द्वारा अपशिष्ट को स्रोत पर पृथक करने, पृथक किए गए अपशिष्ट को अलग-अलग पात्रों में संग्रहण करने में सहायता और पुनर्चक्रणीय सामग्री को प्राधिकृत अपशिष्ट उठाने वालों अथवा प्राधिकृत पुनर्चक्रकों को सौंपना सुनिश्चित करेंगे। जैव-अवक्रमणीय अपशिष्ट का जहां तक संभव होगा परिसर के अंदर संसाधित, उपचारित और कंपोस्ट करके अथवा बायोमिथानेशन के जरिए निपटान किया जाएगा। शेष अपशिष्ट स्थानीय प्राधिकरण द्वारा यथा निर्देशित अपशिष्ट संग्रहकर्ताओं या अभिकरण को दिया जाएगा;

(7) इन नियमों के अधिसूचित होने की तारीख से एक वर्ष के अंदर 5,000 वर्ग मीटर से अधिक क्षेत्रफल वाले सभी गेट लगे समुदाय और संस्थान स्थानीय प्राधिकरण की भागीदारी में इन नियमों में यथा विहित जनित्रों द्वारा अपशिष्ट को स्रोत पर ही पृथक करना, पृथक किए गए अपशिष्ट को अलग-अलग पात्रों में संग्रहण करने में सहायता करना तथा पुनर्चक्रकों को सौंपना सुनिश्चित करेंगे। जैव अवक्रमणीय अपशिष्ट का जहां तक संभव होगा परिसर के अंदर संसाधित, उपचारित और कंपोस्ट करके अथवा बायोमिथानेशन के जरिए निपटान किया जाएगा। शेष अपशिष्ट स्थानीय प्राधिकरण द्वारा यथा निर्देशित अपशिष्ट संग्रहकर्ताओं या अभिकरण को सौंप दिया जाएगा;

(8) इन नियमों के अधिसूचित होने की तारीख से एक वर्ष के अंदर सभी होटल और रेस्टोरेंट स्थानीय प्राधिकरण की भागीदारी में इन नियमों में यथा विहित जनित्रों द्वारा अपशिष्ट को स्रोत पर पृथक करना, पृथक किए गए अपशिष्ट को अलग-अलग पात्रों में संग्रह करने में सहायता करना तथा पुनर्चक्रणीय सामग्री को प्राधिकृत अपशिष्ट उठाने वालों अथवा प्राधिकृत

पुनर्चक्रकों को सौंपना सुनिश्चित करेंगे। जैव-अवक्रमणीय अपशिष्ट का जहां तक संभव होगा परिसर के अंदर संसाधित उपचारित और कंपोस्ट करके अथवा बायोमिथानेशन के जरिए निपटान किया जाएगा। शेष अपशिष्ट स्थानीय प्राधिकरणद्वारा यथा निर्देशित अपशिष्ट संग्रहकर्ताओं या अभिकरण को दिया जाएगा।

5. पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय के कर्तव्य.- (1) पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय देश में इन नियमों के अनुपालन की मॉनीटरी के लिए उत्तरदायी होगा। यह सचिव, पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय की अध्यक्षता के अधीन केन्द्रीय मॉनीटरी समिति का गठन करेगा, जिसमें निम्नलिखित अधिकारी शामिल होंगे जो संयुक्त सचिव या सलाहकार की पंक्ति से निम्न के नहीं होंगे अर्थात् :

(1) शहरी विकास मंत्रालय

(2) ग्रामीण विकास मंत्रालय

(3) रसायन एवं उर्वरक मंत्रालय

(4) कृषि मंत्रालय

(5) केंद्रीय प्रदूषण नियंत्रण बोर्ड

(6) तीन राज्य प्रदूषण नियंत्रण बोर्ड/प्रदूषण नियंत्रण समिति, चक्राणुक्रम द्वारा

(7) तीन राज्य सरकारों के शहरी विकास विभाग, चक्राणुक्रम द्वारा

(8) दो राज्य सरकारों के ग्रामीण विकास विभाग, चक्राणुक्रम द्वारा

(9) तीन शहरी स्थानीय निकाय, चक्राणुक्रम द्वारा

(10) दो जनगणना (सेंसस) शहर, चक्राणुक्रम द्वारा

(11) एफआईसीसीआई, सीआईआई

(12) दो विषय विशेषज्ञ

2. इस केन्द्रीय मानीटरी समिति की बैठक इन नियमों के अनुपालन का मॉनीटर करने और पुनर्विलोकन करने के लिए एक वर्ष में कम से कम एक बार होगी। पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय दो विशेषज्ञों को, यदि आवश्यक हो, सहयोजित कर सकेगा। समिति का प्रत्येक तीन वर्ष में नवीकरण किया जाएगा।

6. शहरी विकास मंत्रालय के कर्त्तव्य.- (1) शहरी विकास मंत्रालय राज्य सरकारों तथा संघ राज्य क्षेत्र के प्रशासनों के साथ निम्नलिखित के लिए समन्वय करेगा, -

(क) ठोस अपशिष्ट प्रबंधन व्यवहारों को सुधारने के लिए राज्यों तथा स्थानीय निकायों द्वारा किए गए उपायों तथा मंत्रालय और बाह्य अभिकरणों द्वारा वित्त पोषित ठोस अपशिष्ट प्रबंधन परियोजनाओं के निष्पादन का वर्ष में कम से कम एक बार आवधिक पुनर्विलोकन करेगा तथा सुधारात्मक उपाय करने पर सलाह देगा;

(ख) इन नियमों की अधिसूचना की तारीख से छह मास के भीतर पणधारियों के साथ परामर्श से ठोस अपशिष्ट प्रबंधन पर राष्ट्रीय नीति तथा रणनीति तैयार करना, जिसके अंतर्गत अपशिष्ट से ऊर्जा की नीति भी है;

(ग) राष्ट्रीय ठोस अपशिष्ट प्रबंधन नीति और राष्ट्रीय शहरी स्वच्छता नीति पर आधारित ठोस प्रबंध के संबंध में राज्य नीति और रणनीति को तैयार करने में राज्यों तथा संघ राज्य क्षेत्रों का मार्गदर्शन करना और उन्हें सुकर बनाना;

(घ) ठोस अपशिष्ट प्रबंध सेक्टर में अनुसंधान और विकास को प्रोत्साहन देना तथा राज्यों और स्थानीय निकायों के लिए सूचना का प्रसार करना;

(ड.) स्थानीय निकायों और अन्य पणधारियों को प्रशिक्षण देना और उनका क्षमता निर्माण करना; और

(च) समय सीमाओं और मानकों को सुकर बनाने के लिए ठोस अपशिष्ट प्रबंधन पर राज्यों, संघ राज्य क्षेत्रों और स्थानीय निकायों को तकनीकी मार्गदर्शी सिद्धांत तथा परियोजना वित्त प्रदान करना;

7. उर्वरक विभाग, रसायन और उर्वरक मंत्रालय के कर्त्तव्य.- (1) उर्वरक विभाग समुचित क्रियाविधि के माध्यम से, -

(क) नगर कम्पोस्ट के बाजार विकास में सहायता उपलब्ध कराएगा; और

(ख) कंपनियों को विपणन के लिए इस सीमा तक उपलब्ध कराना कि उर्वरक कंपनियों द्वारा 3 से 4 थैले: 6 से 7 थैले के अनुपात में रासायनिक उर्वरकों के साथ कम्पोस्ट के सह विपणन का संर्वधन सुनिश्चित हो।

8. कृषि मंत्रालय, भारत सरकार के कर्तव्य :- कृषि मंत्रालय समुचित तंत्र के माध्यम से.-

(क) कंपोस्ट के विनिर्माण एवं बिक्री के लिए उर्वरक नियंत्रण आदेश को लचीलापन प्रदान करेगा;

(ख) कृषि भूमि पर कंपोस्ट के उपयोग को बढ़ावा देगा;

(ग) स्थानीय प्राधिकारियों या उनकी प्राधिकृत एजेंसियों द्वारा उत्पादित कंपोस्ट की गुणता जांच के लिए प्रयोगशालाएं स्थापित करेगा;

(घ) कंपोस्ट की गुणता बनाए रखने और कृषि भूमि पर कंपोस्ट का उपयोग करते समय कंपोस्ट की तुलना में रासायनिक उर्वरकों के उपयोग के अनुपात के लिए समुचित मार्गदर्शक सिद्धांत जारी करेगा।

9. विद्युत मंत्रालय के कर्तव्य.- विद्युत मंत्रालय समुचित तंत्र के माध्यम से :- (क) ठोस अपशिष्ट पर आधारित अपशिष्ट से ऊर्जा पैदा करने वाले संयंत्रों से उत्पादित विद्युत के लिए टैरिफ या प्रभार निर्धारित करेगा;

(ख) ऐसे अपशिष्ट से उत्पन्न विद्युत की खरीद को वितरण कंपनियों द्वारा ऊर्जा संयंत्रों के लिए अनिवार्य बनाएगा।

10. नवीन और नवीकरणीय ऊर्जा स्रोत मंत्रालय के कर्तव्य.- नवीन और नवीकरणीय ऊर्जा स्रोत मंत्रालय समुचित तंत्र के माध्यम से :-

(क) अपशिष्ट से ऊर्जा पैदा करने वाले संयंत्रों के लिए अवसंरचना सृजन को सुविधाजनक बनाएगा; और

(ख) ऐसे अपशिष्ट से ऊर्जा पैदा करने वाले संयंत्रों के लिए समुचित सब्सिडी या प्रोत्साहन प्रदान करेगा।

11. राज्यों और संघ राज्य क्षेत्रों में शहरी विकास के प्रभारी सचिव के कर्तव्य.-

(1) राज्य या संघ राज्य क्षेत्र में सचिव, राज्य शहरी विकास विभाग म्युनिसिपल प्रशासन के आयुक्त या निदेशक या स्थानीय निकायों के निदेशक के माध्यम से निम्नलिखित सुनिश्चित करेगा :

(क) इन नियमों से सुसंगत अपशिष्ट प्रबंधन के क्षेत्र में अपशिष्ट चुनने वालों के प्रतिनिधियों, स्वयं सहायता समूह और समान समूहों सहित पणधारियों के परामर्श से राज्य या संघ राज्य क्षेत्र के लिए राज्य नीति और ठोस अपशिष्ट प्रबंधन रणनीति तैयार करना जो इन नियमों की अधिसूचना की तारीख से एक वर्ष की अवधि के भीतर शहरी विकास मंत्रालय को राष्ट्रीय ठोस अपशिष्ट प्रबंधन नीति और राष्ट्रीय शहरी स्वच्छता नीति से समरूप होगी;

(ख) ठोस अपशिष्ट प्रबंधन के संबंध में राज्य नीति और रणनीति तैयार करते समय भूमिभरण में जाने वाले अपशिष्ट का न्यूनीकरण को सुनिश्चित करने तथा राज्य नीति और ठोस अपशिष्ट प्रबंध रणनीति में मानव स्वास्थ्य और पर्यावरण पर ठोस अपशिष्ट के प्रभाव को न्यूनीकृत करने के लिए ठोस अपशिष्ट के विभिन्न संघटकों के अपशिष्ट में कमी, पुन:उपयोग, पुनर्चक्रण, वसूली और अनुकूलतम उपयोग पर बल देगा;

(ग) राज्य नीतियों और रणनीतियों में कूड़ा चुनने वालों एवं अपशिष्ट संग्रहकर्ताओं और पुनर्चक्रण उद्योग के अनौपचारिक सेक्टर द्वारा अपशिष्ट को कम करने में निभाई गई महत्वपूर्ण भूमिका को स्वीकार किया जाना और अपशिष्ट प्रबंधन प्रणाली में अपशिष्ट चुनने वालों या अनौपचारिक अपशिष्ट संग्रहकर्ताओं के एकीकरण के बारे में विस्तृत मार्गदर्शक सिद्धांत उपलब्ध कराना;

(घ) सभी स्थानीय प्राधिकरणों द्वारा इन नियमों के उपबंधों के क्रियान्वयन को सुनिश्चित करना;

(ड.) राज्य के शहरी योजना विभाग को यह सुनिश्चित करने के लिए निदेश देना कि उन शहरों को छोड़कर जो साझा अपशिष्ट प्रसंस्करण सुविधा या शहरों के एक समूह के लिए क्षेत्रीय स्वच्छता भूमिभरण के सदस्य है, राज्य या संघ राज्य क्षेत्र में प्रत्येक शहर की मास्टर प्लान में ठोस अपशिष्ट प्रसंस्करण और निपटान सुविधाएं स्थापित करने के लिए प्रावधान है;

(च) ठोस अपशिष्ट के लिए प्रसंस्करण और निपटान सुविधाएं स्थापित करने के लिए एक वर्ष के अंदर स्थानीय निकायों के वास्ते उपयुक्त भूमि की पहचान और आवंटन सुनिश्चित करना और उन्हें महानगर एवं जिला योजना समितियों या नगर एवं ग्राम योजना विभाग के माध्यम से राज्य/शहरों की मास्टर योजना (भूमि उपयोग की योजना) में शामिल करना;

(छ) राज्य और स्थानीय निकायों के शहरी योजना विभाग को यह सुनिश्चित करने के लिए निदेश देना कि 200 से अधिक आवास वाले या 5,000 वर्ग मीटर से अधिक क्षेत्रफल के प्लॉट वाली ग्रुप हाउसिंग या वाणिज्यिक, सांस्थानिक या अन्य गैर-आवासीय परिसर के लिए विकास योजना में ठोस अपशिष्ट के पृथक्करण, भंडारण, विकेंद्रित प्रसंस्करण के लिए एक अलग स्थल चिन्हित किया जाता है;

(ज) विशेष आर्थिक जोन, औद्योगिक संपदा, औद्योगिक पार्क के विकासकों को निदेश देना कि प्लॉट के कुल क्षेत्रफल का कम से कम 5 प्रतिशत प्लॉट या शैड वसूली या पुनर्चक्रण सुविधा के लिए आरक्षित करें;

(झ) लागत भागीदारी आधार पर क्षेत्रीय सुविधा से 50 कि. मी. (या अधिक) की दूरी के अन्तर्गत आने वाले शहरों और नगरों के समूह के साझा क्षेत्रीय स्वास्थ्यकर भूमिभरण की स्थापना को सुकर बनाना और ऐसे स्वास्थ्यकर भूमिकरणों के वृत्तिक प्रबंधन को सुनिश्चित करना;

(ञ) ठोस अपशिष्ट के प्रबंधन में शहरी स्थानीय निकायों के क्षमता निर्माण तथा स्रोत पर अपशिष्ट के पृथक्करण एवं परिवहन या प्रसंसकरण की व्यवस्था करना;

(ट) राज्य प्रदूषण नियंत्रण बोर्ड के साथ परामर्श करके 5 टन प्रतिदिन से अधिक के ठोस अपशिष्ट प्रसंस्करण और निपटान सुविधाओं के लिए बफर जोन अधिसूचित करना; और

(ठ) अपशिष्ट चुनने वालों और अपशिष्ट के व्यापारियों के पंजीकरण के संबंध में एक योजना शुरू करना ।

12. जिला मजिस्ट्रेट या जिला कलक्टर या उपायुक्त के कर्त्तव्य.- यथा स्थिति, जिला मजिस्ट्रेट या जिला कलक्टर या उपायुक्त,

(क) इन नियमों की अधिसूचना की तारीख से एक वर्ष के भीतर राज्य शहरी विकास विभाग के प्रभारी सचिव के निकट समन्वय से अपने जिले में स्थानीय निकायों को ठोस अपशिष्ट प्रसंस्करण तथा निपटान सुविधाओं की स्थापना करने के लिए नियम 11 के खंड (च) के अनुसार उपयुक्त भूमि की पहचान तथा आबंटन को सुकर बनाएगा;

(ख) अपशिष्ट के पृथक्करण, प्रसंस्करण, उपचार और निपटान पर एक तिमाही में कम से कम तीन मास में एक बार स्थानीय निकायों के अनुपालन का पुनर्विलोकन करेगा और निदेशक या नगरपालिका प्रशासन के आयुक्त या स्थानीय निकायों के निदेशक और राज्य शहरी विकास के प्रभारी सचिव के साथ परामर्श करके उपचारात्मक उपाय करेगा ।

13. राज्य और संघ राज्य क्षेत्र में ग्राम पंचायत या ग्रामीण विकास विभाग के प्रभारी सचिव के कर्तव्य.- (1) उन क्षेत्रों के लिए जो इन नियमों के अधीन आते हैं और उनके अधिकार क्षेत्र में हैं, राज्य और संघ राज्य क्षेत्र में ग्राम पंचायत या शहरी विकास विभाग के प्रभारी सचिव के कर्तव्य वहीं होंगे जो राज्य या संघ राज्य क्षेत्र में शहरी विकास के प्रभारी सचिव के हैं ।

14. केन्द्रीय प्रदूषण नियंत्रण बोर्ड के कर्त्तव्य.- केन्द्रीय प्रदूषण नियंत्रण बोर्ड –

(क) इन नियमों के कार्यान्वयन के लिए राज्य प्रदूषण नियंत्रण बोर्डों और प्रदूषण नियंत्रण समितियों के साथ समन्वय करेगा और स्थानीय निकायों द्वारा विहित मानकों का पालन करेगा;

(ख) सभी ठोस अपशिष्ट प्रसंस्करण और निपटान सुविधाओं की बाबत भूजल, परिवेशी वायु, ध्वनि प्रदूषण, निक्षालन के लिए मानक निश्चित करेगा;

(ग) ठोस अपशिष्ट प्रसंस्करण सुविधाओं या उपचार प्रौद्योगिकियों के लिए विहित पर्यावरणीय मानकों और सन्नियमों का पुनर्विलोकन करना और जब कभी भी अपेक्षित हो, उनको अद्यतन करना;

(घ) ठोस अपशिष्ट प्रसंस्करण सुविधाओं या उपचार प्रौद्योगिकियों के लिए विहित पर्यावरणीय मानकों के कार्यान्वयन को वर्ष में कम से कम एक बार राज्य प्रदूषण नियंत्रण बोर्डों/प्रदूषण नियंत्रण समितियों के माध्यम से पुनर्विलोकन और उनके द्वारा मॉनीटर किए गए आंकड़ों का संकलन करना;

(ड.) ठोस अपशिष्ट के प्रसंस्करण, पुनर्चक्रण और उपचार के लिए किसी नई प्रौद्योगिकी के प्रयोग पर राज्य प्रदूषण नियंत्रण बोर्डों या प्रदूषण नियंत्रण समितियों के प्रस्तावों का पुनर्विलोकन करना और छ: माह के अंदर उनके लिए निष्पादन मानक, उत्सर्जन मानदंड विहित करना;

(च) स्थानीय निकायों द्वारा इन नियमों के कार्यान्वयन को राज्य प्रदूषण नियंत्रण बोर्डों या प्रदूषण नियंत्रण समितियों के माध्यम से मॉनीटर करना;

(छ) राज्य प्रदूषण नियंत्रण बोर्डों और समितियों से प्राप्त रिपोर्टों के आधार पर इन नियमों के कार्यान्वयन पर वार्षिक रिपोर्ट तैयार करना और उसे पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय को प्रस्तुत करना तथा यह रिपोर्ट लोक अधिकार क्षेत्र में भी रखी जाएंगी;

(ज) प्रतिदिन 5 टन से अधिक ठोस अपशिष्ट का प्रबंधन करने वाली सुविधाओं के विभिन्न आकारों के लिए अपशिष्ट प्रसंस्करण और निपटान सुविधाओं की बाहरी सीमाओं से किसी आवासीय, वाणिज्यिक या किसी अन्य संनिर्माण संबंधी क्रियाकलाप को प्रतिबंधित करने वाले बफर जोन को बनाए रखने के लिए मार्गदर्शक सिद्धांतों को प्रकाशित करना;

(झ) इन नियमों के प्रावधानों का अनुपालन करने के लिए ठोस अपशिष्ट के शहरी स्थानीय निकायों के समर्थ बनाने के लिए प्रसंस्करण और निपटान के पर्यावरणीय पहलुओं पर समय-समय पर मार्गदर्शक सिद्धांत प्रकाशित करना; और

(ञ) अपशिष्ट के अंतरराज्यीय संचलन पर राज्यों या संघ राज्य क्षेत्रों को मार्गदर्शन प्रदान करना ।

15. स्थानीय निकायों, और जनगणना नगरों की ग्राम पंचायतों तथा शहरी समूहों के कर्तव्य और उत्तरदायित्व.- (1) स्थानीय निकाय और पंचायतें :-

(क) राज्य नीति और रणनीति की अधिसूचना की तारीख से छह मास के भीतर ठोस अपशिष्ट प्रबंधन पर राज्य नीति और रणनीति के अनुसार ठोस अपशिष्ट प्रबंध योजना तैयार करना और उसकी एक प्रति राज्य सरकार या संघ राज्य प्रशासन द्वारा राज्य सरकार या संघ राज्य प्रशासन द्वारा प्राधिकृत अभिकरण से उसे अनुमोदित कराना;

(ख) मलिन बस्तियों तथा अनौपचारिक बसावटों, वाणिज्यिक, संस्थागत और अन्य गैर आवासीय परिसरों सहित सभी घरों से पृथक्कृत ठोस अपशिष्ट का द्वार-द्वार के संग्रहण की व्यवस्था करना। बहु मंजिलों भवनों, बड़े वाणिजियक परिसरों, मॉलों, आवासीय परिसरों इत्यादि से अपशिष्ट का संग्रहण प्रवेश द्वार या किसी अन्य अभिहित स्थान किया जा सकता है;

(ग) कूड़ा चुनने वालों/अनौपचारिक अपशिष्ट संग्रहकर्ताओं के संगठनों को मान्यता प्रदान करने की प्रणाली स्थापित करना और द्वार-द्वार जाकर अपशिष्ट संग्रह करने सहित ठोस अपशिष्ट के प्रबंधन में इनकी भागीदारी को सुकर बनाने के लिए इन प्राधिकृत चुनने वालों और अपशिष्ट संग्रहणकर्ताओं के एकीकरण के लिए एक प्रणाली स्थापित करना;

(घ) स्वयं सहायता समूह बनाने को सुकर बनाना, पहचान पत्र उपलब्ध कराना और तदुपरांत घर-घर जाकर अपशिष्ट संग्रह करने सहित ठोस अपशिष्ट प्रबंधन में एकीकरण को प्रोत्साहन देना;

(ड.) इन नियमों की अधिसूचना की तारीख से एक वर्ष के भीतर इन नियमों के उपबंधों को समाविष्ट करते हुए उपविधियां बनाना और समय पर कार्यान्वयन सुनिश्चित करना;

(च) उपयोक्ता फीस, जो समुचित समझी जाए, समय-समय पर विहित करना और स्वयं या प्राधिकृत अभिकरण के माध्यम से ठोस अपशिष्ट उत्पन्नकर्ताओं से फीस का संग्रह करना;

(छ) अपशिष्ट उत्पन्नकर्ताओं को निदेश देना कि कूड़ा करकट न फैलाएं अथवा कागज, पानी की बोतलें, पेय पदार्थों के केनों, टेट्रा पैक्स, फलों के छिलके, रैपर आदि या सड़क खुले सार्वजनिक स्थान, नालों अपशिष्ट निकायों पर न जलाए या कुंड में न फैंके या उनका निपटान न करें तथा इन नियमों के अधीन विहित किए गए अनुसार स्रोत अपशिष्ट को अलग-अलग करें और पृथक किए गए अपशिष्ट को स्थानीय निकाय द्वारा प्राधिकृत अपशिष्ट चुनने वालों या प्राधिकृत अपशिष्ट संग्रहकर्ता को सौंप दें;

(ज) पुनर्चक्रणीय सामग्रियों छंटाई करने के लिए पर्याप्त स्थान के साथ सामग्री वसूली सुविधाएं या गौण भंडारण सुविधाएं स्थापित करना ताकि अनौपचारिक या प्राधिकृत अपशिष्ट चुनने वाले और अपशिष्ट संग्रह करने वाले अपशिष्ट में से पुनर्चक्रणीय सामग्रियों को अलग कर सकें या उत्पादन के स्रोत से या सामग्री वसूली सुविधाओं से कागज, प्लास्टिक, धातु, शीशा, कपड़ा आदि जैसे पृथक किए गए पुनर्चक्रणीय अपशिष्ट को संग्रह करने के लिए अपशिष्ट चुनने वालों और पुनर्चक्रकों को सुलभ मार्ग उपलब्ध कराना; जैव निम्नीकरण अपशिष्ट के भंडारण के लिए डिब्बे हरे रंग से मुद्रित होंगे, जो पुनर्चक्रण के अपशिष्ट के भंडारण के लिए सफेद रंग से मुद्रित होंगे और अन्य अपशिष्ट के भंडारण के लिए काले रंग से मुद्रित होंगे;

(झ) घरेलू परिसंकटमय अपशिष्ट के लिए अपशिष्ट निक्षेपण केंद्रों की स्थापना करना और अपशिष्ट उत्पन्नकर्ताओं को निदेश देना कि घरेलू परिसंकटमय अपशिष्टों निक्षेपण परिसंकटमय अपशिष्ट निपटान सुविधा में उसके सुरक्षित निपटान के लिए इस केंद्र में करें। ऐसी सुविधा की स्थापना किसी शहर या नगर में इस ढंग से की जाएगी कि एक केंद्र की स्थापना बीस किलोमीटर क्षेत्रफल या उसके भाग के लिए हो जाए और इन केंद्रों में घरेलू परिसंकटमय अपशिष्ट प्राप्त करने के समय अधिसूचित होगा;

(ञ) परिसंकटमय अपशिष्ट निपटान सुविधा तक घरेलू परिसंकटमय अपशिष्ट का सुरक्षित भंडारण और परिवहन सुनिश्चित करना या जो राज्य प्रदूषण नियंत्रण बोर्ड/प्रदूषण नियंत्रण समिति द्वारा निर्देश किया जाए;

(ट) गली के सफाई कर्मचारियों को निदेश देना कि गली की सफाई से संग्रहीत पेड़ के पत्तों को न जलाएं तथा उन्हें अलग से भंडारण करे और स्थानीय निकाय द्वारा प्राधिकृत अपशिष्ट संग्रहकर्ता या अभिकरण को सौंपे;

(ठ) अपशिष्ट चुनने वालों और अपशिष्ट संग्रहकर्ताओं को ठोस अपशिष्ट प्रबंधन का प्रशिक्षण देना;

(ड) दिन-प्रतिदिन आधार पर बाजारों से सब्जियों, फलों, फूलों, मांस, कुक्कुट पालन और मछली बाजार से अपशिष्ट संग्रह करना और स्वास्थ्यकर स्थिति सुनिश्चित करने के लिए बाजारों में उचित स्थानों पर या बाजारों के आस-पास विकेन्द्रीकृत कंपोस्ट प्लांट या जैव मिथेनीकरण प्लांट की स्थापना को प्रोत्साहन देना;

(ढ) जनसंख्या के घनत्व, वाणिज्यिक क्रियाकलाप और स्थानीय स्थिति पर निर्भर करते हुए दैनिक या वैकल्पिक दिवसों या सप्ताह में दो बार सड़कों, मार्गों, गलियों और उप-गलियों की सफाई के अपशिष्ट को पृथक रूप से संग्रह करना;

(ण) सड़क की सफाई के कूड़े और सतही नालियों से निकाली गई गाद को जिन मामलों में इन अपशिष्टों का सीधा संग्रह करने के लिए परिवहन वाहन सुविधाजनक व्यवहार्य नहीं है, अस्थाई रूप से भंडारण करने के लिए आच्छादित गौण भंडारण सुविधा स्थापित करना। इस प्रकार संग्रह किए गए अपशिष्ट का संग्रह और निपटान स्थानीय निकाय द्वारा यथा निर्धारित नियमित अंतराल पर किया जाएगा;

(त) बागवानी, उद्यानों और बगीचों के अपशिष्ट को पृथक रूप से संग्रह करना और जहां तक संभव हो उसका प्रसंस्करण पार्कों और बगीचों में करना;

(थ) पृथक किए गए जैव निम्नीकरणीय अपशिष्ट का परिवहन प्रसंस्करण सुविधाओं जैसे कंपोस्ट प्लांट, जैव मिथेनिकरण संयंत्र या ऐसी कोई सुविधा तक करना। ऐसे अपशिष्ट के स्थल पर प्रसंस्करण को अधिमान्यता दी जानी चाहिए;

(द) क्रमवर्ती प्रसंस्करण सुविधा या सामग्री पुन:प्राप्ति सुविधाओं या द्वितीयक भंडारण सुविधा को गैर जैव निम्नीकरणीय अपशिष्ट को परिवहन करना;

(ध) निर्माण और विध्वंस अपशिष्ट का परिवहन समय-समय पर यथासंशोधित निर्माण और विध्वंस अपशिष्ट प्रबंधन नियम, 2016 के उपबंधों के अनुसार करना;

(न) समुदाय सुविधा के आस-पास दुर्गंध के नियंत्रण और स्वास्थ्य रक्षक स्थितियों के अनुरक्षण के अध्यधीन समुदाय स्तर पर घरेलू कंपोस्टिंग, बायोगैस उत्पादन, अपशिष्ट के विकेंद्रित प्रसंस्करण में समुदायों को अंतर्वलित करना;

(प) दो वर्षों के भीतर रासायनिक खाद के उपयोग को चरणबद्ध रूप से समाप्त करना और स्थानीय निकायों द्वारा अनुरक्षित सभी उद्यानों, बगीचों में कंपोस्ट का प्रयोग करना और जहां कहीं संभव हो इसके अधिकारिता के अधीन अन्य स्थानों पर भी ऐसा करना अनौपचारिक अपशिष्ट पुनर्चक्रण क्षेत्र द्वारा की जाने वाली पुनर्चक्रण पहलों को प्रोत्साहन उपलब्ध कराए जा सकते हैं;

(फ) उपयुक्त प्रौद्योगिकी जिसके अंतर्गत निम्नलिखित प्रौद्योगिकियां भी हैं, को अंगीकृत करते हुए और समय-समय पर शहरी विकास मंत्रालय द्वारा समय-समय पर जारी मार्गदर्शी सिद्धांतों और केन्द्रीय प्रदूषण नियंत्रण बोर्ड द्वारा जारी दिशानिर्देशों का पालन करते हुए ठोस अपशिष्ट के विभिन्न अवयवों के उचित उपयोग के लिए स्वयं या निजी क्षेत्र के सहभागी या किसी अभिकरण के माध्यम से ठोस अपशिष्ट प्रसंस्करण सुविधाओं और संबंधित अवसंरचना के संनिर्माण, प्रचालन और अनुरक्षण को सुकर बनाना: परिवहन लागत और पर्यावरणीय आघात को न्यूनतम करने के लिए विकेन्द्रीयकृत प्रसंस्करण को अधिमान्यता देना जैसे.-

(क) जैव-मिथैनिकरण, सूक्ष्म जैविक कंपोस्टिंग, वर्मी कंपोस्टिंग, अनारोबिक डाईजेशन या जैव निम्नकरणीय-अपशिष्टों के जैव स्थिरीकरण के लिए कोई अन्य समुचित प्रसंस्करण;

(ख) अपशिष्ट के दहनशील भाग के लिए अवशिष्ट जनित ईंधन सहित अपशिष्ट से ऊर्जा प्रक्रियाएं या अपशिष्ट आधारित विद्युत प्लांटों या सीमेंट भट्टियों को फीड स्टॉक के रूप में आपूर्ति;

(ब) इन नियमों के अधीन विहित रीति से अवशेष अपशिष्टों के निपटान के लिए अनुसूची-I के अनुसार स्वास्थ्यकर भरण स्थलों और आनुषंगिक अवसंरचना का निर्माण, प्रचालन और अनुरक्षण स्वयं या किसी अन्य अभिकरण के माध्यम से करना;

(भ) वार्षिक बजट में पूंजी निवेश के साथ-साथ ठोस अपशिष्ट प्रबंधन सेवाओं के प्रचालन और अनुरक्षण के लिए निधियों का पर्याप्त उपबंध करना और यह सुनिश्चित करना कि स्थानीय निकाय के वैवेकिक कृत्यों के लिए निधियां ठोस अपशिष्ट प्रबंधन तथा इन नियमों के अनुसार स्थानीय निकाय के अन्य बाध्यकारी कृत्यों के लिए आवश्यक निधियों की अपेक्षा पूर्ण करने के पश्चात् की आबंटित की जाएं;

(म) प्ररूप-1 में अपशिष्ट प्रसंस्करण, शोधन या निस्तारण सुविधा स्थापित करने के लिए प्राधिकार अनुदत्त करने के लिए आवेदन करना जिसके अंतर्गत यथास्थिति राज्य प्रदूषण नियंत्रण बोर्ड या प्रदूषण नियंत्रण समिति से स्वास्थ्यकर भरण स्थल सहित प्रतिदिन 5 मीट्रिक टन से अधिक अपशिष्ट हो;

(य) प्राधिकार की विधिमान्यता समाप्त होने से कम से कम साठ दिन पूर्व प्राधिकार के नवीकरण के लिए आवेदन करना;

(यक) उत्तरवर्ती वर्ष के 30 अप्रैल या उसके पूर्व आयुक्त या निदेशक, नगरपालिका प्रशासन को या प्राधिकृत अधिकारी को प्ररूप-4 में वार्षिक रिपोर्ट तैयार और प्रस्तुत करना;

(यख) वार्षिक रिपोर्ट प्रत्येक वर्ष के 31 मई तक शहरी विकास विभाग के प्रभारी सचिव या ग्राम पंचायत या ग्रामीण विकास विभाग और संबंधित राज्य प्रदूषण नियंत्रण बोर्ड या प्रदूषण नियंत्रण समिति को भेजी जाएगी;

(यग) कार्मिकों जिसके अंतर्गत संविदा कार्मिकों और पर्यवेक्षकों भी है, को पृथक किए गए अपशिष्ट के द्वार-द्वार से संग्रहण के लिए और प्रसंस्करण या निपटान सुविधा को प्राथमिक और द्वितीयक परिवहन के दौरान अमिश्रित अपशिष्ट के संबंध में प्रशिक्षण;

(यघ) यह सुनिश्चित करना कि प्रसुविधा का प्रचालक व्यक्तिगत सुरक्षा उपकरण अर्थात् वर्दी, प्रदीप्त जैकट, हाथ के दस्ताने, बरसाती, समुचित जूते और मास्क ठोस अपशिष्ट के प्रहस्तन में लगे सभी कार्मिकों को उपलब्ध कराए और कार्यबल द्वारा इनका उपयोग सुनिश्चित किया जाए;

(यड.) किसी ग्रुप हाउसिंग सोसाइटी या मार्केट काम्पलैक्स की निर्माण योजना के अनुमोदन से पूर्व सुनिश्चित करने की भवन योजना में पृथक किए गए अपशिष्टों के संग्रहण, पृथक्करण और भंडारण के लिए अपशिष्ट संग्रहण केन्द्र स्थापित किया जाना सुनिश्चित किया जाए;

(यच) कचरा फैलाने वाले या इन नियमों के उपबंधों का अनुपालन करने में असफल रहने वाले व्यक्तियों के लिए स्थल ही जुर्माना लगाने के लिए उपविधि बनाना और मापदंड विहित करना तथा बनाई गई उपविधियों के अनुसार स्थल पर ही जुर्माना लगाने की शक्तियां उचित अधिकारियों या स्थानीय निकायों को प्रत्यायोजित करना; और

(यछ) सूचना, शिक्षण और संचार अभियान के माध्यम से लोक जागरुकता का सृजन करना और निम्नलिखित के संबंध में अपशिष्ट उत्पन्न करने वालों को जानकारी देना;

i. कचरा न फैलाना;

ii. कम अपशिष्ट उत्पन्न करना;

iii. संभव सीमा तक अपशिष्ट का पुन:उपयोग;

iv. अपशिष्ट का जैव निम्नीकरणीय, गैर-जैव निम्नीकरणीय (पुनर्चक्रण योग्य तथा दहनयोग्य), स्वास्थ्यकर अपशिष्ट और घरेलू परिसंकटमय अपशिष्ट के रूप में स्रोत पर पृथक्करण;

v. घरेलू कंपोस्टिंग, वर्मिन कंपोस्टिंग, बायोगैस उत्पादन या समुदाय स्तरीय कंपोस्टिंग/बायोगैस उत्पादन का व्यवहार करना;

vi. उपयोग हुए प्रसाधन अपशिष्ट को ब्रांड स्वामियों द्वारा उपलब्ध कराए गए पाउचों या स्थानीय निकाय द्वारा विहित उपयुक्त लपेटने वाली सामग्री में लपेटना और इसे गैर जैव निम्नीकरणीय अपशिष्ट के लिए रखे गए डिब्बों में डालना;

vii. स्त्रोत पर पृथक्कृत अपशिष्टों का अलग-अलग डिब्बों में भंडारण करना;

viii. अपशिष्ट चुनने वालों, अपशिष्ट संग्राहकों, पुन:चक्रणकर्ताओं या अपशिष्ट संग्रहण अभिकरणों को पृथक्कृत अपशिष्ट सौंपना; और

ix. अपशिष्ट एकत्र करने वालों या स्थानीय निकायों या स्थानीय निकाय द्वारा प्राधिकृत किसी अन्य व्यक्ति को ठोस अपशिष्ट प्रबंधन के लिए मासिक उपयोक्ता फीस या प्रभार का संदाय करना।

(यज) स्वास्थ्यकर स्थल की स्थापना और प्रचालन के लिए नियम 23 में यथाविनिर्दिष्ट समय सीमा के समाप्त होने के तुरंत पश्चात् मिश्रित अपशिष्ट से भरण स्थल को भरना या एकत्र करना बंद किया जाए;

(यझ) अपशिष्ट प्रसंस्करण सुविधाओं से केवल अप्रयोजनीय, गैर-पुनर्चक्रणयोग्य, गैर-जैवनिम्नीकरणीय, गैर-दहनशील और गैर-सक्रिय अपशिष्ट और पूर्व प्रसंस्करण अपशिष्टों तथा अवशिष्टों को ही स्वास्थ्यकर भरण स्थल पर जाने देने की अनुमति दी जाए और स्वास्थ्यकर भरण स्थलों द्वारा अनुसूची 1 में दी गई विशिष्टयों का अनुपालन किया जाएगा। तथापि, अवशिष्टों का यथासंभव पुनर्चक्रण या पुनप्रयोग किए जाने के प्रयास किए जाने चाहिए ताकि भरण स्थल तक शून्य अपशिष्ट जाने के अपेक्षित लक्ष्य की प्राप्ति हो सके;

(यञ) सभी पुराने खुले मलबा स्थलों तथा विद्यमान प्रचालनरत मलबा स्थलों के जैव-खनन तथा जैव-उपचार की संभाव्यता के लिए जांच और विश्लेषण करना और जहां कहीं व्यवहार्य हो स्थलों के जैव-खनन या जैव-उपचार हेतु आवश्यक कार्रवाई करना;

(यट) मलबा स्थल के जैव-खनन और जैव-उपचार की संभाव्यता न होने की स्थिति में पर्यावरण को होने वाली क्षति को रोकने के लिए इसे भरण स्थल कैपिंग मानकों के अनुसार वैज्ञानिक रूप से आच्छादित जाएगा।

16. राज्य प्रदूषण नियंत्रण बोर्ड या प्रदूषण नियंत्रण समिति के कर्तव्य.- (1) राज्य प्रदूषण नियंत्रण बोर्ड या प्रदूषण नियंत्रण समिति द्वारा -

(क) अपनी-अपनी अधिकारिता में स्थानीय निकायों के माध्यम से राज्य में इन नियमों का प्रवर्तन किया जाएगा तथा संबंधित नगरपालिका प्रशासन निदेशालय या राज्य शहरी विकास विभाग के प्रभारी सचिव के निकट समन्वय से वर्ष में कम से कम दो बार इन नियमों के क्रियान्वयन की समीक्षा की जाएगी;

(ख) अपशिष्ट प्रसंस्करण और निस्तारण स्थलों के लिए अनुसूची । और अनुसूची ।। के अधीन यथा विर्निदिष्ट पर्यावरणीय मानकों को मॉनीटर करना तथा शर्त का पालन करना;

(ग) स्थानीय निकाय या स्थानीय निकाय द्वारा प्राधिकृत किसी अन्य अभिकरण से प्ररूप 1 में आवेदन की प्राप्ति के पश्चात् प्रस्ताव का परीक्षण करना और ऐसी जांच करना जो उचित समझा जाए;

(घ) प्राधिकार के प्रस्ताव की जांच करते समय, संबंधित अधिनियमितियों के अधीन सहमति की अपेक्षा और अन्य अभिकरणों जैसे राज्य शहरी विकास विभाग, नगर और ग्राम योजना विभाग, जिला योजना समिति या महानगरीय क्षेत्र योजना समिति, जैसा लागू हो, विमानपत्तन या एयरबेस प्राधिकरण, भू-जल बोर्ड, रेलवे, विद्युत वितरण कंपनियां, राजमार्ग विभाग और अन्य संबंधित अभिकरणों के विचारों को ध्यान में रखा जाएगा और उन्हें अपने विचार, यदि कोई हों, देने के लिए चार सप्ताह का समय दिया जाएगा;

(ड.) स्थानीय निकाय या किसी सुविधा प्रचालक या स्थानीय प्राधिकरण द्वारा प्राधिकृत किसी अन्य अभिकरण को प्ररूप 2 में साठ दिन की अवधि के भीतर प्राधिकार जारी करना जिसमें यथाआवश्यक अन्य शर्तों सहित अनुसूची 1 और 2 में यथाविर्निदिष्ट अनुपालन मापदंड और पर्यावरण मानक अधिकथित हों;

(च) ऐसे प्राधिकार की विधिमान्यता सहमतियों की विधिमान्यता के साथ समकालिक होगी;

(छ) यदि स्थानीय प्राधिकरण या सुविधा प्रचालक सुविधा का प्रचालन विहित शर्तों के अनुसार करने में असफल रहता है तो राज्य प्रदूषण नियंत्रण बोर्ड द्वारा खंड (क) के अधीन जारी उक्त प्राधिकार को निलंबित या रद्द किया जा सकेगा;

परंतु यथास्थिति, स्थानीय निकाय या प्रचालक को सूचना दिए बिना ऐसा कोई प्राधिकार निलंबित या रद्द नहीं किया जाएगा; और

(ज) नवीकरण के लिए आवेदन की प्राप्ति पर, प्रत्येक आवेदन को गुणागुण के आधार पर परीक्षा करने के पश्चात् और इस शर्त के अधीन रहते हुए कि सुविधा के प्रचालन में नियमों के सभी उपबंधों, प्राधिकार, सहमति या पर्यावरण अनापत्ति में विनिर्दिष्ट मानकों या शर्तों को पूर्ण कर दिया है, अगले पांच वर्षों के लिए प्राधिकार का नवीकरण करेगा;

(2) राज्य प्रदूषण नियंत्रण बोर्ड या प्रदूषण नियंत्रण समिति आवेदक को सुने जाने का युक्तियुक्त अवसर देने के पश्चात् और लिखित में कारणों को लेखबद्ध करने के पश्चात् प्राधिकार अनुदत्त करने या नवीकरण करने से इंकार कर सकेगा।

(3) नई प्रोद्यौगिकियों के मामले में, जहां यथास्थिति, केन्द्रीय प्रदूषण नियंत्रण बोर्ड, राज्य प्रदूषण नियंत्रण बोर्ड या प्रदूषण नियंत्रण समिति द्वारा कोई मानक विहित नहीं किया गया है, मानक विनिर्दिष्ट करने के लिए केन्द्रीय प्रदूषण नियंत्रण बोर्ड से निवेदन करेगा ।

(4) यथास्थिति, राज्य प्रदूषण नियंत्रण बोर्ड या प्रदूषण नियंत्रण समिति जब कभी उचित समझा जाए किन्तु वर्ष में कम से कम एक बार, यथाअभिहित या अधिकथित मानकों तथा यथाअनुमोदित उपचार प्रोद्यौगिकी तथा प्राधिकार में निर्दिष्ट शर्तों और इन नियमों के अधीन अनुसूची-1 और अनुसूची-2 में विनिर्दिष्ट मानकों का अनुपालन मॉनीटर करेगा ।

(5) राज्य प्रदूषण नियंत्रण बोर्ड या प्रदूषण नियंत्रण समिति परिसंकटमय अपशिष्ट भंडारण सुविधाओं में अपशिष्ट उत्पादकों द्वारा एकत्रित घरेलू परिसंकटमय अपशिष्ट के सुरक्षित प्रहस्तन और निस्तारण के लिए स्थानीय निकायों को निदेश देगा ।

(6) राज्य प्रदूषण नियंत्रण बोर्ड या प्रदूषण नियंत्रण समिति द्वारा अपशिष्ट के अंतर राज्य प्रचालन को विनियमित किया जाएगा।

17. निपटानयोग्य उत्पादों तथा स्वास्थ्यकर नैपकिनों और डायपरों के विनिर्माताओं या ब्रांड स्वामियों के कर्तव्य.- (1) निपटान योग्य उत्पादों जैसे टिन, कांच, प्लास्टिक पैकेजिंग इत्यादि के सभी निर्माता या ऐसे उत्पादों को बाजार में लाने वाले ब्रांड स्वामी अपशिष्ट प्रबंधन प्रणाली की स्थापना के लिए स्थानीय निकायों को आवश्यक वित्तीय सहायता उपलब्ध कराएंगे।

(2) गैर जैव-निम्नीकरणीय पैकेजिंग सामग्री में अपने उत्पादों की बिक्री या विपणन करने वाले ऐसे सभी ब्रांड स्वामी उनके उत्पाद के कारण उत्पन्न हुए पैकेजिंग अपशिष्ट को वापस ग्रहण करने के लिए प्रणाली की व्यवस्था करेंगे।

(3) स्वास्थ्यकर नैपकिनों तथा डायपरों के विनिर्माताओं या ब्रांड स्वामियों या विपणन कंपनियों द्वारा अपने उत्पादों में सभी पुनर्चक्रणयोग्य सामग्रियों के प्रयोग की संभाव्यता का पता लगाएंगे या अपने स्वास्थ्यकर उत्पादों के पैकेट के साथ प्रत्येक नैपकिन या डायपर के निस्तारण के लिए एक पाउच या रैपर उपलब्ध कराएंगे।

(4) ऐसे सभी विनिर्माताओं, ब्रांड स्वामियों या विपणन कंपनियों द्वारा अपने उत्पादों को लपेटने और उनका निस्तारण करने के संबंध में लोगों को जानकारी दी जाएगी।

18. कचरा व्युत्पन ईंधन से सौ कि.मी. के अंदर अवस्थित औद्योगिक इकाईयों और ठोस अपशिष्ट आधारित ऊर्जा संयंत्रों के कर्तव्य.- ईंधन का प्रयोग करने वाली और ठोस अपशिष्ट आधारित कचरा व्युत्पन ईंधन संयंत्र से सौ कि.मी. के भीतर अवस्थित सभी औद्योगिक इकाइयां इस प्रकार उत्पन्न कचरा व्युत्पन ईंधन द्वारा अपनी ईंधन अपेक्षा के कम से कम 5 प्रतिशत का प्रतिस्थापन करने के लिए इन नियमों की अधिसूचना की तारीख से छह मास के भीतर व्यवस्था करेंगे।

19. ठोस अपशिष्ट प्रसंस्करण और शोधन सुविधा की स्थापना के लिए मानदंड.- (1) भूमि समनुदेशन कार्य आबंटन विभाग ठोस अपशिष्ट प्रसंस्करण और शोधन सुविधाओं की स्थापना के लिए उपयुक्त भूमि उपलब्ध कराने और राज्य सरकार या संघ राज्य क्षेत्र प्रशासन से ऐसे स्थलों को अधिसूचित करने के लिए उत्तरदायी होंगे।

(2) सुविधा का प्रचालक समय-समय पर इस संबंध में केन्द्रीय प्रदूषण नियंत्रण बोर्ड द्वारा जारी तकनीकी मार्गदर्शी सिद्धांतों और शहरी विकास मंत्रालय द्वारा तैयार किए गए ठोस अपशिष्ट प्रबंधन संबंधी मैनुअल के अनुसार सुविधा का डिजाइन करेगा और इसकी स्थापना करेगा।

(3) सुविधा के प्रचालक द्वारा राज्य प्रदूषण नियंत्रण बोर्ड या प्रदूषण नियंत्रण समिति से आवश्यक अनुमोदन प्राप्त किया जाएगा।

(4) राज्य प्रदूषण नियंत्रण बोर्ड या प्रदूषण नियंत्रण समिति द्वारा ठोस अपशिष्ट प्रसंस्करण और शोधन सुविधाओं के प्रचालन के पर्यावरण मानकों की मॉनीटरी की जाएगी।

(5) सुविधा के प्रचालक का उत्तरदायित्व समय-समय पर केन्द्रीय प्रदूषण नियंत्रण बोर्ड द्वारा जारी मार्गदर्शी सिद्धांतों और समय-समय पर शहरी विकास मंत्रालय द्वारा प्रकाशित नगरीय ठोस अपशिष्ट प्रबंधन संबंधी मैनुअल के अनुसार ठोस अपशिष्ट प्रसंस्करण और शोधन सुविधाओं के पर्यावरण के दृष्टि से अनुकूल प्रचालन की होगी।

(6) ठोस अपशिष्ट प्रसंस्करण और शोधन सुविधा के प्रचालक द्वारा राज्य प्रदूषण नियंत्रण बोर्ड/प्रदूषण नियंत्रण समिति और स्थानीय प्राधिकरण को प्रत्येक वर्ष 30 अप्रैल तक प्ररूप 3 में वार्षिक रिपोर्ट प्रस्तुत करेगा।

20. पर्वतीय क्षेत्रों में ठोस अपशिष्ट प्रबंधन के मानदंड और की जाने वाली कार्रवाईयां.- पर्वतीय क्षेत्रों में स्थानीय प्राधिकरणों के कर्तव्य और दायित्व निम्नलिखित अतिरिक्त खंडों के सहित नियम 15 में उल्लिखित के समान होंगे :

(क) पर्वत पर भरण स्थल के संनिर्माण से बचना होगा। प्रसंस्करण सुविधा से अवशिष्ट अपशिष्ट और निष्क्रिय अपशिष्ट का संग्रहण करने के लिए एक उपयुक्त निकटतम अवस्थान पर एक अंतरण स्थान स्थापित किया जाएगा। स्वास्थ्यकर भरण की स्थापना करने के लिए 25 किलोमीटर के भीतर पहाड़ी के नीचे समतल भूमि क्षेत्र में योग्य भूमि का पहचान की जाएगी। अंतरण स्थान से अवशिष्ट अपशिष्ट का निपटान इस स्वास्थ्यकर भरण स्थल पर किया जाएगा।

(ख) ऐसी भूमि उपलब्ध न होने पर की दशा में निष्क्रिय और अवशिष्ट अपशिष्ट के लिए क्षेत्रीय स्वास्थ्यकर भरण स्थल स्थापित करने के प्रयास किए जाएंगे।

(ग) स्थानीय निकाय उपविधि बनाएगा और नागरिकों को गलियों में अपशिष्ट फैंकने से प्रतिषिद्ध करने तथा पर्यटकों को गलियों में या पहाड़ियों से नीचे न फैंकने किसी अपशिष्ट जैसे कागज, पानी की बोतल, शराब की बोतल, सॉफ्ट ड्रिंक के केन, टेट्रा पैक, अन्य कोई प्लास्टिक या कागज अपशिष्ट के स्थान पर सभी पर्यटक स्थलों पर स्थानीय निकाय द्वारा रखे गए कूड़ेदान में फेंकने के निर्देश देना।

(घ) स्थानीय निकाय द्वारा, पर्वतीय क्षेत्रों का भ्रमण करने वाले सभी पर्यटकों को उपविधियों के अधीन ठोस अपशिष्ट प्रबंधन के उपबंधों को नगर में प्रवेश बिंदु के साथ-साथ होटलों तथा अतिथि गृहों इत्यादि के माध्यम से, जहां वे ठहरते हैं और पर्यटन स्थलों पर उपयुक्त विज्ञापन बोर्ड लगाकर, व्यवस्था करेगा।

(ड.) स्थानीय निकाय ठोस अपशिष्ट प्रबंधन सेवाएं संवहनीय बनाने को प्रवेश द्वार पर पर्यटक से ठोस प्रबंधन प्रभार उदगृहीत कर सकेगा ।

(च) भूमि समनुदेशन का प्रभारी विभाग विकेन्द्रीकृत अपशिष्ट प्रसंस्करण सुविधाओं की स्थापना के लिए पर्वतों पर उपयुक्त स्थल की पहचान और आबंटन करेगा। स्थानीय निकाय द्वारा ऐसी सुविधाएं स्थापित की जाएंगी। पर्वतीय स्थान का अनुकूलतम उपयोग करने के लिए सीढ़ी उद्यान प्रणाली को अपनाया जा सकेगा।

21. अपशिष्ट से उर्जा प्रसंस्करण के लिए मानदंड - (1) 1500 कि./कैल./कि.ग्रा. या अधिक के कैलोरिफिक मान रखने वाले गैर पुनःचक्रण अपशिष्टों को भरण स्थलों में निस्तारित नहीं किया जाएगा और उनका उपयोग या तो केवल व्युत्पन्न ईंधन

अवशेष के माध्यम से या अवशेष व्युत्पन्न ईंधन तैयार करने के लिए फीड स्टॉक के रूप में देकर या ऊर्जा का उत्पादन करने के लिए ही किया जाएगा।

(2) उच्च कैलोरिफिक अपशिष्टों का उपयोग सीमेंट या ताप विद्युत संयंत्रों में सह-प्रसंस्करण के लिए किया जाएगा।

(3) स्थानीय निकाय या सुविधा का प्रचालक या उनके द्वारा नामनिर्दिष्ट अभिकरण जो पांच टन प्रतिदिन से अधिक प्रसंस्करण क्षमता वाली सुविधा के अपशिष्ट के ऊर्जा संयंत्र की स्थापना करना चाहते हों, वे यथास्थिति, राज्य प्रदूषण नियंत्रक बोर्ड या प्रदूषण नियंत्रण समिति को प्राधिकार के लिए प्ररुप-1 में आवेदन प्रस्तुत करेंगे।

(4) अपशिष्ट से ऊर्जा सुविधा की स्थापना करने के लिए ऐसे आवेदनों की प्राप्ति पर राज्य प्रदूषण नियंत्रण बोर्ड या प्रदूषण नियंत्रण समिति उसका परीक्षण करेगा और साठ दिनों के अंदर अनुमति प्रदान करेगा।

22. क्रियान्वयन की समय-सीमा - इन नियमों के क्रियान्वयन के लिए आवश्यक अवसंरचना यथास्थिति, स्थानीय निकायों और अन्य संबंधित प्राधिकरणों द्वारा प्रत्यक्ष तथा स्वयं या नियोजित अभिकरणों द्वारा निम्नलिखित विनिर्दिष्ट समय-सीमा में सृजित की जाएंगी :

क्रम सं.	क्रियाकलाप	नियमों की अधिसूचना की तारीख से समय-सीमा
(1)	ठोस अपशिष्ट प्रसंस्करण सुविधा को स्थापित करने के लिए उपयुक्त स्थलों की पहचान करना	1 वर्ष
(2)	0.5 करोड़ जनसंख्या से कम के स्थानीय निकायों के योग्य उपयुक्त समूह के लिए साझा क्षेत्रीय स्वास्थ्यकर भरण सुविधा को स्थापित करने के लिए और 0.5 करोड़ या अधिक की जनसंख्या वाले सभी स्थानीय प्राधिकरणों द्वारा साझा क्षेत्रीय स्वास्थ्यकर भरण स्थल सुविधाओं या एकल भरण सुविधाओं की स्थापना करने के लिए उपयुक्त स्थलों की पहचान।	1 वर्ष
(3)	ठोस अपशिष्ट प्रसंस्करण सुविधा और स्वास्थ्यकर भरण स्थल सुविधाओं के लिए उपयुक्त स्थलों का उपापन।	2 वर्ष
(4)	जैव निम्नीकरणीय, पुनःचक्रण योग्य, दहन योग्य, स्वास्थ्यकर अपशिष्ट, घरेलू परिसंकटमय तथा निष्क्रिय ठोस अपशिष्टों का स्रोत पर पृथक्करण के लिए चलन के लिए अपशिष्ट उत्पन्नकर्ताओं को बाध्य करना ।	2 वर्ष
(5)	पृथक्कृत अपशिष्ट घर-घर से एकत्र करके और प्रसंस्करण या निपटान सुविधाओं का परिवहन आच्छादित वाहनों में सुनिश्चित करना।	2 वर्ष
(6)	संनिर्माण तथा विध्वंस अपशिष्टों का अलग-अलग भंडारण, संग्रहण और परिवहन सुनिश्चित करना।	2 वर्ष
(7)	100000 से अधिक जनसंख्या वाले सभी स्थानीय निकायों द्वारा ठोस अपशिष्ट प्रसंस्करण सुविधाओं की स्थापना करना।	2 वर्ष
(8)	100000 से कम जनसंख्या वाले स्थानीय निकायों और नगरों द्वारा ठोस अपशिष्ट प्रसंस्करण सुविधाओं की स्थापना करना।	3 वर्ष
(9)	इन नियमों के अधीन यथा अनुज्ञात प्रसंस्करण सुविधाओं से केवल ऐसे अवशिष्ट अपशिष्टों के साथ-साथ अशोधित निष्क्रिय अपशिष्ट के निपटान के	3 वर्ष

	लिए 0.5 करोड़ या उससे अधिक की जनसंख्या वाले सभी स्थानीय निकायों द्वारा या के लिए सम्मिलित या एकल भरण की स्थापना।	
(10)	इन नियमों के अधीन अनुज्ञात अपशिष्ट के निपटान के लिए 0.5 करोड़ से कम के अधीन सभी स्थानीय निकायों और जनसंख्या नगरों द्वारा सम्मिलित या क्षेत्रीय भरण स्थलों की स्थापना।	3 वर्ष
(11)	पुराने या परित्यक्त कूड़ा स्थलों का जैविक उपचार करना या उन्हें ढकना।	5 वर्ष

23. राज्य स्तरीय सलाहकार निकाय.- (1) संबंधित राज्य सरकार या संघ राज्य क्षेत्र प्रशासन के स्थानीय निकायों का प्रत्येक विभाग प्रभारी इन नियमों की अधिसूचना की तारीख से छह मास के भीतर एक राज्य स्तरीय सलाहकार समिति का गठन करेगा जिसमें निम्नलिखित सदस्य शामिल होंगे:-

क्रम संख्या	पदनाम	सदस्य
(1)	(2)	(3)
1.	राज्य के शहरी विकास विभाग/स्थानीय स्वशासन विभाग के सचिव	अध्यक्ष, पदेन
2	राज्य सरकार के पंचायत या ग्रामीण विकास विभाग का संयुक्त सचिव से अन्यून पंक्ति का एक प्रतिनिधि	सदस्य, पदेन
3.	राज्य सरकार के राजस्व विभाग का एक प्रतिनिधि	सदस्य, पदेन
4.	पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय, भारत सरकार का एक प्रतिनिधि	सदस्य, पदेन
5.	शहरी विकास मंत्रालय, भारत सरकार का एक प्रतिनिधि	सदस्य, पदेन
6.	ग्रामीण विकास मंत्रालय, भारत सरकार का एक प्रतिनिधि	सदस्य, पदेन
7.	केंद्रीय प्रदूषण नियंत्रण बोर्ड का एक प्रतिनिधि	सदस्य, पदेन
8.	राज्य प्रदूषण नियंत्रण बोर्ड .या प्रदूषण नियंत्रण समिति का एक प्रतिनिधि	सदस्य, पदेन
9.	भारतीय प्रौद्योगिकी संस्थान या राष्ट्रीय प्रौद्योगिकी संस्थान का एक प्रतिनिधि	सदस्य, पदेन
10.	राज्य का मुख्य नगर नियोजक	सदस्य
11.	स्थानीय निकायों के चक्रानुक्रम द्वारा तीन प्रतिनिधि,	सदस्य
12.	जनगणना नगरों/शहरी समुदायों के दो प्रतिनिधि	सदस्य
13.	अपशिष्ट चुनने वालों/अनौपचारिक पुनर्चक्रणकर्ता या ठोस अपशिष्ट प्रबंधन के लिए काम करने वाले विख्यात गैर सरकारी संगठन या सिविल सोसायटी का एक प्रतिनिधि	सदस्य

14.	राज्य या केन्द्रीय स्तर पर उद्योगों का प्रतिनिधित्व करने वाले निकाय का एक प्रतिनिधि	सदस्य
15.	अपशिष्ट पुनर्चक्रण उद्योग का एक प्रतिनिधि	सदस्य
16.	दो विषय विशेषज्ञ	सदस्य
17.	राज्य सरकार के राजस्व विभाग, कृषि विभाग और श्रम विभाग का सहयोजित एक प्रतिनिधि	सदस्य

(2) इन नियमों के क्रियान्वयन से संबंधित सभी विषयों, ठोस अपशिष्ट प्रबंध संबंधी राज्य की नीति तथा कार्यनीति की समीक्षा करने और इन नियमों के त्वरित और समुचित क्रियान्वयन के लिए आवश्यक उपाय करने के लिए राज्य सरकार को सलाह देने के लिए राज्य स्तरीय सलाहकार निकाय प्रत्येक छह माह में कम से कम एक बैठक करेगी।

(3) समीक्षा रिपोर्ट की प्रतियां आवश्यक कार्रवाई हेतु राज्य प्रदूषण नियंत्रण बोर्ड/प्रदूषण नियंत्रण समिति को अग्रेषित की जाएंगी।

24. वार्षिक रिपोर्ट.- (1) सुविधा के प्रचालक द्वारा प्रत्येक वर्ष 30 अप्रैल को या इससे पूर्व प्ररुप III में स्थानीय निकाय को वार्षिक रिपोर्ट प्रस्तुत की जाएगी।

(2) स्थानीय नगरीय निकाय प्ररुप IV में अपनी वार्षिक रिपोर्ट राज्य प्रदूषण नियंत्रण बोर्ड या प्रदूषण समिति और संबंधित राज्य या संघ राज्य क्षेत्र के शहरी विकास विभाग के प्रभारी सचिव या मेट्रोपालिटिन नगर की दशा में नगर पालिका प्रशासन के निदेशक या नगरपालिका प्रशासन के आयुक्त या राज्य के अन्य सभी स्थानीय निकायों के मामले में राज्य के स्थानीय निकायों प्रभारी अधिकारी को प्रत्येक वर्ष के 30 जून या उससे पहले अग्रेषित करेगी ।

(3) यथास्थिति, प्रत्येक राज्य प्रदूषण नियंत्रण बोर्ड या प्रदूषण नियंत्रण समिति, इन नियमों के क्रियान्वयन और अनुपालन न करने वाले स्थानीय निकायों पर की गई कार्रवाई की समेकित वार्षिक रिपोर्ट प्ररुप V में तैयार करेगी और प्रत्येक वर्ष के 31 जुलाई तक केद्रीय प्रदूषण नियंत्रण बोर्ड और शहरी विकास मंत्रालय को प्रस्तुत करेगी ।

(4) केद्रीय प्रदूषण नियंत्रण बोर्ड, देश में स्थानीय निकायों द्वारा इन नियमों के क्रियान्वयन की स्थिति पर एक समेकित समीक्षा रिपोर्ट तैयार की जाएगी और शहरी विकास मंत्रालय और पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय को अपनी सिफारिशों के साथ प्रत्येक वर्ष 31 अगस्त से पहले अग्रेषित की जाएगी।

(5) पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय द्वारा केन्द्रीय निगरानी समिति की बैठक के दौरान वार्षिक रिपोर्ट का पुनर्विलोकन किया जाएगा।

25. दुर्घटना की रिपोर्ट देना - किसी ठोस अपशिष्ट प्रसंसकरण या सुविधा केंद्र या भराव भूमि स्थल पर कोई दुर्घटना होने की दशा में, तब सुविधा का प्रभारी अधिकारी प्ररुप VI में घटना की रिपोर्ट स्थानीय निकाय को भेजेगा। स्थानीय निकाय द्वारा समीक्षा की जाएगी और सुविधा के प्रभारी अधिकारी को अनुदेश, यदि कोई हो, जारी किया जाएगा।

अनुसूची I

[नियम 15 (ब),(यङ्ग),16(1)(ख)(ड.),16(4) देखें]

स्वास्थ्यकर भरण स्थलों के लिए विनिर्देश

क. स्थल चयन के लिए मानदंड. -

(i) भूमि निर्धारण के कार्य आबंटन में विभाग द्वारा ठोस अपशिष्ट प्रसंस्करण और शोधन सुविधाओं की स्थापना करने के लिए उपयुक्त स्थल उपलब्ध कराया जाएगा और ऐसे स्थलों को अधिसूचित किया जाएगा।

(ii) भूमि भरण स्थल योजनाबद्ध, तथा निर्माण योजना के साथ-साथ चरणबद्ध रीति से बंदी योजना के उचित प्रलेखन के साथ अभिकल्पित और विकसित किए जाएंगे। किसी विद्यमान भूमि भरण स्थल से लगी हुई कोई नई भूमि भरण सुविधा तैयार किए जाने की दशा में विद्यमान भूमि भरण स्थल की बंदी योजना, ऐसे नए भूमि भरण स्थल के प्रस्ताव का भाग होगी।

(iii) भरण स्थलों का चयन आसपास की अपशिष्ट प्रसंस्करण सुविधाओं का प्रयोग करने के लिए किया जाएगा। अन्यथा अपशिष्ट प्रसंस्करण सुविधा की योजना भरण स्थल के अभिन्न भाग के रूप में बनाई जाएगी।

(iv) भूमि भरण स्थल शहरी विकास मंत्रालय, भारत सरकार और केन्द्रीय प्रदूषण नियंत्रण बोर्ड के मार्गदर्शी सिद्धांतों के अनुसार स्थापित किए जाएंगे।

(v) विद्यमान भूमि भरण स्थल, जो पांच वर्षों से अधिक से उपयोग में हैं, इस अनुसूची में दिए गए विनिर्देशों के अनुसरण में उन्नत किए जाएंगे।

(vi) भूमि भरण स्थल कम से कम 20-25 वर्षों तक चलने के लिए पर्याप्त रूप से बड़े होंगे तथा जल जमाव और दुरूपयोग को रोकने के लिए चरणबद्ध रीति से "भूमि भरण सेल" विकसित किए जाएंगे।

(vii) भूमि भरण स्थल नदी से 100 मीटर, तालाब से 200 मीटर, राजमार्गों, आवास स्थलों, सार्वजनिक उद्यानों और जल आपूर्ति कुंओं से 200 मीटर तथा विमानपत्तनों या हवाई अड्डे से 20 किमी की दूरी पर होंगे । तथापि, विशेष मामले में, भूमि भरण स्थल को नागर विमानन प्राधिकरण/वायु सेना, जैसा भी मामला हो, से अनापत्ति प्रमाण पत्र प्राप्त कर लेने के बाद विमानपत्तन/हवाईअड्डे से 10 और 20 किमी की दूरी के अंदर स्थापित किया जा सकता है। तटीय विनियम जोन, नमभूमि, महत्वपूर्ण आवासीय क्षेत्रों, संवेदनशील पारि-भंगुर क्षेत्रों और गत 100 वर्षों से यथा दर्ज बाढ़ के मैदानों के अंदर भूमि भरण स्थल के लिए अनुमति नहीं दी जाएगी।

(viii) भरण स्थल और ठोस अपशिष्ट के शोधन तथा निस्तारण के लिए स्थलों को नगर आयोजना विभाग की भूमि उपयोग योजनाओं में शामिल किया जाएगा।

(ix) पांच टन प्रतिदिन से अधिक की संस्थापित क्षमता वाली ठोस अपशिष्ट प्रसंस्करण तथा निस्तारण सुविधा के आसपास गैर विकास का बफर जोन बनाए रखा जाएगा। इसका अनुरक्षण ठोस अपशिष्ट प्रसंस्करण तथा निस्तारण सुविधा के कुल क्षेत्र के अंदर किया जाएगा। बफर जोन का निर्धारण स्थानीय प्राधिकरण द्वारा संबंधित राज्य प्रदूषण नियंत्रण बोर्ड के परामर्श से मामला दर मामला आधार पर किया जाएगा।

(x) जैव-चिकित्सीय अपशिष्ट का निपटान समय-समय पर यथा संशोधित जैव-चिकित्सीय अपशिष्ट प्रबंधन नियम, 2016 के अनुसार किया जाएगा। परिसंकटमय अपशिष्टों का प्रबंधन समय-समय पर यथासंशोधित परिसंकटमय और अन्य अपशिष्ट (प्रबंधन और सीमा-पारीय संचलन) नियम, 2016 के अनुसार किया जाएगा। ई-अपशिष्टों का प्रबंधन समय-समय पर यथासंशोधित ई-अपशिष्ट (प्रबंधन) नियम, 2016 के अनुसार किया जाएगा।

(xi) अपशिष्ट प्रसंस्करण का कार्य न हो पाने और आपातकाल या प्राकृतिक आपदाओं के दौरान अपशिष्ट को रखने के लिए प्रत्येक भरण स्थल पर ठोस अपशिष्ट के लिए अस्थाई भंडारण सुविधा स्थापित की जाएगी।

ख. स्वास्थ्यकर भरण स्थलों पर सुविधाओं के विकास के लिए मानदंड .-

(i) भूमि भरण स्थल पर चार-दीवारी या बाड़ होगी और अंदर आने वाले वाहनों की निगरानी करने, अनधिकृत व्यक्तियों तथा आवारा पशुओं के प्रवेश को रोकने के लिए उचित उपयुक्त दरवाजा लगाया जाएगा।

(ii) वाहनों और अन्य मशीनरी का मुक्त संचलन सुनिश्चित करने के लिए पहुंच और/आंतरिक सड़कें ठोस या पक्की बनाई जाएगी ताकि वाहनीय संचलन के कारण धूल कणों को उड़ने से रोका जा सके।

(iii) भूमि भरण स्थल पर भूमि भरण के लिए लाए जाने वाले अपशिष्ट की मॉनीटरी करने के लिए अपशिष्ट निरीक्षण सुविधा, अभिलेख रखने के लिए कार्यालय सुविधा तथा प्रदूषण मॉनीटरी उपस्कर सहित उपस्कर और मशीनरी रखने के लिए आश्रय स्थल होंगे। सुविधा का प्रचालक अपशिष्ट प्राप्ति, प्रसंस्करण और निपटान का लेखा-जोखा रखेगा।

(iv) भूमि भरण स्थल पर लाए जाने वाले अपशिष्ट की मात्रा को मापने के लिए धर्मकांटा, अग्नि सुरक्षा उपस्कर और अन्य सुविधाएं, जो भी अपेक्षित हों, जैसे प्रावधान किए जाएंगे ।

(v) पेयजल और स्वास्थ्य सुविधाओं (अधिमानत: कर्मकारों के लिए धोने/नहाने की सुविधाओं) जैसी उपयोगिताओं और सहज भूमि भरण प्रचालनों, जब रात्रि के समय किए जाते हैं, के लिए प्रकाश व्यवस्था का प्रावधान होगा।

(vi) भूमि भरण स्थलों पर कार्मिकों के स्वास्थ्य की जांच सहित सुरक्षा प्रावधान किए जाएंगे।

(vii) परिवहन वाहनों की पार्किंग और सफाई या धुलाई के लिए प्रावधान किए जाएंगे। इस प्रकार उत्पन्न मल जल का शोधन विनिर्दिष्ट मानकों को पूरा करने के लिए किया जाएगा।

ग. भूमि भरण प्रचालनों और भूमि भरण पूर्ण होने पर उनको बंद करने के विनिर्देशों के लिए मानदण्ड.-

(i) अपशिष्ट का उच्च घनत्व प्राप्त करने के लिए भूमि भरण किए जाने वाले अपशिष्ट को भारी कम्पेक्टरों का प्रयोग करते हुए पतली परतों में संहत किया जाएगा । अधिक वर्षा वाले क्षेत्रों, जहां भारी कम्पेक्टरों का प्रयोग नहीं किया जा सकता, में वैकल्पिक उपाय अपनाए जाएंगे ।

(ii) अपशिष्टों को तत्काल या प्रत्येक कार्य दिवस के अंत में कम से कम 10 सेमी मिट्टी, अक्रिय मलबे या निर्माण सामग्री से उस समय तक ढक दिया जाएगा जब तक कि कम्पोस्टिंग या पुनर्चक्रण या ऊर्जा पुनर्प्राप्ति के लिए अपशिष्ट प्रसंस्करण सुविधाएं स्थापित न कर दी जाएं।

(iii) मानसून ऋतु के आरंभ होने से पूर्व भूमि भरण स्थल पर मानसून के दौरान पानी के रिसाव को रोकने के लिए उचित संहनन और श्रेणीकरण के साथ 40-65 सेमी मोटी मिट्टी का मध्यवर्ती आवरण बिछा दिया जाएगा। भूमि भरण स्थल के प्रभावी क्षेत्र से पानी के बहाव को विपथित करने के लिए उचित निकास नालियों का निर्माण किया जाएगा।

(iv) भूमि भरण स्थल के पूरा हो जाने के पश्चात उसके रिसाव और अपरदन को न्यूनतम करने के लिए अंतिम आवरण डिजाइन किया जाएगा। अंतिम आवरण निम्नलिखित विनिर्देशों के अनुसार होगा, अर्थात् -

(क) अंतिम आवरण में $1x10^{-7}$ सेमी/सेकंड से कम के पारगम्यता गुणांक सहित 60 सेमी की चिकनी मिट्टी या शोधित मिट्टी से युक्त अवरोधक मिट्टी की परत होगी।

(ख) अवरोधक मिट्टी की परत के ऊपर 15 सेमी की एक निकास परत होगी।

(ग) निकास परत के ऊपर प्रकृतिजन्य पादपों की वृद्धि में सहायता करने और अपरदन को कम करने के लिए 45 सेमी की एक वनस्पतिक परत होगी।

घ. प्रदूषण निवारण के मानदंड.- भूमि भरण प्रचालनों से प्रदूषण समस्याओं को रोकने के क्रम में निम्नलिखित प्रावधान किए जाएंगे, अर्थात्-

(i) तूफान जल नाले को इस तरीके से डिजाइन और निर्मित किया जाए कि सतही जल बहाव, भूमि भरण स्थल से विपथित हो जाए और ठोस अपशिष्ट स्थानों से निक्षालक, सतही जल बहाव में मिश्रित न हो। निक्षालक उत्पत्ति को कम करने और सतही जल के प्रदूषण को रोकने तथा बाढ़ और दलदली स्थितियों से बचने के लिए भी तूफान जल प्रवाह नालियों के विपथन का प्रावधान किया जाएगा।

(ii) अपशिष्ट निपटान क्षेत्र के आधार और दीवारों पर गैर-पारगम्य लाइनिंग प्रणाली का निर्माण। ऐसी अपशिष्ट प्रसंस्करण सुविधाओं के अवशिष्ट अथवा मिश्रित अपशिष्ट या खतरनाक सामग्रियों (जैसे कि ऐरोसोल, ब्लीच, पालिश, बैटरी, अपशिष्ट तेल, पेंट उत्पाद और कीटनाशक) के संदूषण वाले अपशिष्ट को भरने के लिए प्रयुक्त होने वाले भरण स्थलों के लिए न्यूनतम लाइनर विनिर्देश, एक ऐसा मिश्र अवरोधक होगा जो 1.5 मिमी मोटी उच्च घनत्व वाली पॉलीईथाइलीन (एचडीपीई) जियो-मेम्ब्रेन या जियो-सिंथेटिक लाइनर या उसके समतुल्य होगा तथा मिट्टी (चिकनी अथवा शोधित मिट्टी) के 90 सेमी के ऊपर होगी तथा इसका पारगम्यता गुणांक $1x10^{-7}$ सेमी/सेकंड से अधिक नहीं होगा। जल सारणी का अधिकतम स्तर, भूमि भरण स्थलों के निचले भाग पर उपलब्ध कराई गई चिकनी अथवा शोधित मिट्टी के अवरोधक परत के आधार से कम से कम दो मीटर नीचे होगा।

(iii) निक्षालकों के संग्रहण और शोधन सहित इनके प्रबंधन के लिए प्रावधान किए जाएंगे । शोधित निक्षालक, अनुसूची-II में निर्दिष्ट मानकों को पूरा करने के पश्चात् पुनर्चक्रित या उपयोग में लाए जाएंगे। अन्यथा इन्हें मलनिर्यास लाइन में विमुक्त कर दिया जाएगा। किसी भी हाल में निक्षालक को खुले वातावरण में विमुक्त नहीं किया जाएगा।

(iv) भूमि भरण क्षेत्र से बहने वाले जल को किसी नाले, धारा, नदी, झील या तालाब में प्रवेश करने से रोकने की व्यवस्था की जाएगी। जल बहाव के निक्षालक या ठोस अपशिष्ट के साथ मिश्रित होने के मामले में, समस्त मिश्रित जल को संबंधित प्राधिकरण द्वारा शोधित किया जाएगा।

ङ. जल गुणवत्ता मॉनीटरी के लिए मानदंड.-

(i) किसी भूमि भरण स्थल को स्थापित करने से पूर्व, क्षेत्र में भूमि जल गुणवत्ता के मूलाधार आंकड़े एकत्रित किए जाएंगे और उन्हें भविष्य में संदर्भ के लिए रिकार्ड में रखा जाएगा। भूमि भरण स्थल की परिधि के 50 मीटर के अंदर भूमि जल गुणवत्ता को वर्ष में विभिन्न ऋतुओं अर्थात ग्रीष्म, मानसून और मानसून-पश्च अवधि के दौरान आवधिक रूप से मॉनीटर किया जाएगा ताकि यह सुनिश्चित हो सके कि भू- जल, स्वीकार्य सीमा से अधिक संदूषित न हो।

(ii) किसी भी प्रयोजन (पेय जल और सिंचाई सहित) के लिए भूमि भरण स्थलों में और उनके आस-पास भूमि जल के उपयोग पर उसकी गुणवत्ता को सुनिश्चित करने के बाद विचार किया जाएगा। मॉनीटरी प्रयोजन के लिए पेयजल गुणवत्ता हेतु निम्नलिखित विनिर्देश लागू होंगे, अर्थात् :-

क्र.सं.	पैरामीटर	आईएस 10500:2012, संस्करण 2.2 (2003-09) वांछनीय सीमा (मिग्रा/ली., पीएच को छोड़कर
(1)	(2)	(3)
(1)	आर्सेनिक	0.01
(2)	कैडमियम	0.01
(3)	क्रोमियम (Cr^{6+} के रूप में)	0.05
(4)	तांबा	0.05
(5)	साइनाइड	0.05
(6)	सीसा	0.05
(7)	पारा	0.001
(8)	निकल	-
(9)	नाइट्रेट, एनओ$_3$ के रूप में	45.0
(10)	पीएच (pH)	6.5-8.5
(11)	लोहा	0.3
(12)	कुल कठोरता (सीएसीओ$_3$ के रूप में)	300.0
(13)	क्लोराइड	250
(14)	विलीन ठोस	500
(15)	फेनोलिक यौगिक (सी$_6$एच$_5$ओएच के रूप में)	0.001
(16)	जस्ता	5.0
(17)	सल्फेट (एसओ$_4$ के रूप में)	200

च. परिवेशी वायु गुणवत्ता की मानीटरी के लिए मानदंड. -

(i) भूमि भरण स्थल पर दुर्गंध को कम करने, गैसों को अपस्थलीय फैलने से रोकने, पुनर्वासित भूमि भरण स्थल सतह पर उगाई गई वनस्पति को बचाने के लिए गैस संग्रहण प्रणाली सहित भूमि भरण गैस नियंत्रण प्रणाली संस्थापित की जाएगी। भूमि भरण गैस पुनर्प्राप्ति को बढ़ाने के लिए गैस संग्रहण कुओं के साथ आच्छादन प्रणालियों में जियो मेम्ब्रेन के प्रयोग पर विचार किया जाएगा।

(ii) भूमि भरण स्थल पर निकलने वाली मीथेन गैस का सान्द्रण, निम्न विस्फोटक सीमा (एलईएल) के 25 प्रतिशत से अधिक नहीं होगा।

(iii) किसी भूमि भरण स्थल पर संग्रहण सुविधा से प्राप्त भूमि भरण गैस का उपयोग व्यवहार्यता के अनुसार या तो सीधे तापीय अनुप्रयोगों या विद्युत उत्पादन में किया जाएगा। अन्यथा, भूमि भरण गैस को जला (प्रदीप्त) दिया जाएगा और सीधे वायुमंडल में या अवैध रूप से निकासी के लिए नहीं छोड़ा जाएगा। यदि इसका उपयोग या प्रदीप्त संभव न हो तो निष्क्रिय निकास की अनुमति दी जाएगी।

(iv) भूमि भरण स्थल पर और इसके आसपास परिवेशी वायु गुणवत्ता के नियमित रूप से मॉनीटरी की जाएगी। परिवेशी वायु गुणवत्ता औद्योगिक क्षेत्र के लिए केन्द्रीय प्रदूषण नियंत्रण बोर्ड द्वारा विहित मानकों के अनुसार होगी।

छ. भूमि भरण स्थल पर पौधरोपण के लिए मानदंड.- तैयार स्थल के ऊपर निम्नलिखित विनिर्देशों के अनुसार वनस्पतिक आवरण बनाया जाएगा, अर्थात् :

(क) स्थानीय रूप से अंगीकृत अखाद्य बारहमासी पौधों, जो सूखे तथा अत्यधिक तापमान के प्रतिरोधी हैं, को उगाया जाएगा;

(ख) पौधे ऐसे प्रजाति के होंगे कि उनकी जड़ें 30 सेमी से अधिक गहरी न हों। यह शर्त, भूमि भरण स्थल के स्थिर होने तक लागू रहेगी;

(ग) चयनित पौधों में न्यूनतम पोषक वृद्धि के साथ न्यून-पोषक मिट्टी में पनपने की क्षमता होगी;

(घ) मिट्टी के अपरदन को कम करने के लिए पर्याप्त घनत्व में पौधरोपण किया जाएगा;

(ड.) राज्य प्रदूषण नियंत्रण बोर्डों या प्रदूषण नियंत्रण समितियों के परामर्श से भूमि भरण स्थल की सीमा के चारों ओर हरित क्षेत्र विकसित किए जाएंगे।

ज. भूमि भरण स्थल पर पश्चात्वर्ती देखरेख के लिए मानदंड. – (1) भूमि भरण स्थल की बंदी-पश्च देखरेख कम से कम पंद्रह वर्षों के लिए की जाएगी और दीर्घकालिक मॉनीटरी या देखरेख योजना निम्नलिखित से युक्त होगी, अर्थात् :-

(क) सबसे ऊपरी परत की अखंडता और प्रभाविता को बनाए रखना, मरम्मत करते रहना तथा सबसे ऊपरी परत को अपरदन या अन्य प्रकार के नुकसान के जारी रहने और बहने को रोकना;

(ख) अपेक्षानुसार निक्षालक संग्रहण प्रणाली की मॉनीटरी करना;

(ग) भरण स्थल में और इसके आसपास भू-जल की मॉनीटरी करना;

(घ) मानकों के अनुरूप भूमि भरण गैस संग्रहण प्रणाली का अनुरक्षण और प्रचालन करना।

(2) पंद्रह वर्ष की बंदी-पश्च मॉनीटरी के बाद बंद पड़े भूमि भरण स्थलों के उपयोग पर मानव बस्ती या अन्यथा प्रयोग किए जाने के बारे में यह सुनिश्चित करने के बाद ही विचार किया जाएगा कि गैसीय उत्सर्जन और निक्षालक गुणवत्ता विश्लेषण, विनिर्दिष्ट मानकों के अनुपालन में हैं और मृदा स्थिरता सुनिश्चित की गई है।

झ. पहाड़ी क्षेत्रों के लिए विशेष प्रावधानों हेतु मानदंड - पहाड़ों पर बसे नगरों और शहरों में स्थानीय प्राधिकरण द्वारा संबंधित राज्य बोर्ड या प्रदूषण नियंत्रण समिति के अनुमोदन से ठोस अपशिष्ट के अंतिम निपटान के लिए विकसित की गई स्थान-विशिष्ट पद्धतियां अपनाई जाएंगी। नगरपालिका प्राधिकरण जैवअवक्रमणीय जैविक अपशिष्ट को उपयोगी बनाने के लिए प्रसंस्करण सुविधाएं स्थापित करेगा। गैर-जैवअवक्रमणीय पुनर्चक्रण योग्य सामग्रियों का भण्डारण किया जाएगा और

इन्हें पुनर्चक्रण के लिए आवधिक रूप से भेजा जाएगा। अक्रिय और गैर-जैवअवक्रमणीय अपशिष्ट का उपयोग, सड़कें बनाने या पहाड़ों पर उपयुक्त क्षेत्रों की भराई करने के लिए किया जाएगा। पहाडी क्षेत्रों में पर्याप्त भूमि प्राप्त करने में आ रही कठिनाईयों के कारण सड़क पर बिछाने या भराई के लिए उपयुक्त न पाए गए अपशिष्ट का निपटान मैदानी क्षेत्रों में क्षेत्रीय भरण स्थलों में किया जाएगा।

ञ. पुराने मलबा स्थलों को बंद और बहाल करना - ठोस अपशिष्ट के मलबा स्थल जिन्होंने अपनी क्षमता पूरी कर ली है या नए और उपयुक्त रूप से डिजाइन किए गए भरण स्थलों की स्थापना के बाद जिनमें अतिरिक्त अपशिष्ट नहीं डाले जाते हैं, उन्हें बंद कर दिया जाना चाहिए और निम्नलिखित विकल्पों की जांच करने के बाद बहाली की जानी चाहिए :

(i) जैव खनन और अपशिष्ट प्रसंस्करण द्वारा अपशिष्ट को कम करना जिसके बाद नए भरण स्थलों या नीचे (ii) के अनुसार आच्छादन में अवशिष्टों को रखा जाएगा।

(ii) ग्रीन हाऊस गैसों के संग्रहण और चमकाने/उपयोग में समर्थ बनाने के लिए ठोस अपशिष्ट आवरण या जियो मेम्ब्रेन से संवर्धित ठोस अपशिष्ट आवरण से आच्छादित किया जाना।

(iii) ऊपर (ii) के अनुसार अतिरिक्त उपायों (जलोढ़ और अन्य खुरदरी दानेदार मिट्टियों में) जैसे संदूषित भू-जल को निकालने और शोधित करने के लिए कट-ऑफ वॉल और निष्कर्षण कुओं में आच्छादन।

(iv) स्वीकार्य स्तर तक पर्यावरणीय प्रभाव को कम करने के लिए उपयुक्त कोई अन्य पद्धति।

अनुसूची II

[नियम 16(1), (ख), (ड.),16(4) देखें]

ठोस अपशिष्ट के प्रसंस्करण और शोधन के मानक

क. खाद के मानक.- अपशिष्ट प्रसंस्करण सुविधाओं में जैव अवक्रमणीय अपशिष्ट के प्रसंस्करण हेतु प्रौद्योगिकियों में से एक के रूप में कंपोस्टिंग शामिल होगा। कंपोस्ट संयंत्र से होने वाले प्रदूषण को रोकने के उद्देश्य से निम्नलिखित का पालन किया जाएगा अर्थात् :

(क) स्थल पर पहुंचने वाले जैविक अपशिष्ट का आगे के प्रसंस्करण से पूर्व समुचित रखरखाव किया जाएगा। जहां तक संभव हो, अपशिष्ट भण्डारण क्षेत्र ढका हुआ होना चाहिए। यदि ऐसा भण्डारण खुले में किया गया हो तो निक्षालक शोधन और निपटान सुविधा तक पहुंचने वाले पंक्तिबद्ध नालों में निक्षालक और सतही जल बहाव को एकत्रित करने की सुविधा के साथ अपारगम्य आधार उपलब्ध कराया जाना चाहिए;

(ख) गंध, मक्खियों, कृंतकों, पक्षी के खतरे और आग के जोखिम की बाधा को कम करने के लिए आवश्यक सावधानियां बरती जाएंगी;

(ग) संयंत्र के ब्रेकडाउन या रखरखाव के मामले में, अपशिष्ट अंतर्ग्राही को बंद कर दिया जाएगा और अपशिष्ट को अस्थाई प्रसंस्करण स्थल या अस्थायी भूमि भरण स्थलों की दिशा में विपथित करने की व्यवस्था की जाएगी, जिनका संयंत्र के ठीक-ठाक हो जाने पर पुन:प्रसंस्करण किया जाएगा;

(घ) प्रसंस्करण सुविधा से प्रक्रिया पूर्व और प्रक्रिया-पश्च अवशिष्टों को नियमित आधार पर हटा दिया जाएगा और स्थल पर इकट्ठा नहीं होने दिया जाएगा। पुनर्चक्रण योग्य सामग्री, उपयुक्त विक्रेताओं के माध्यम से भेजी जाएगी। गैर-पुनर्चक्रण योग्य उच्च तापजनक अंशों को पृथक किया जाएगा और सीमेंट संयंत्रों में या विद्युत संयंत्रों को आरडीएफ उत्पादन, सह-प्रसंस्करण के लिए भेजा जाएगा। भूमि भरण स्थलों में केवल सभी प्रक्रियाओं के अवशिष्ट भेजे जाएंगे।

(ड.) अपारगम्य आधार के साथ विंड्रो क्षेत्र उपलब्ध कराया जाएगा। ऐसा आधार बजरी या ठोस चिकनी मिट्टी, 50 सेमी मोटी, जिसका पारगम्यता गुणांक 10^{-7} सेमी/सेकंड से कम हो, का बनाया जाएगा। आधार में 1 से 2 प्रतिशत ढाल होगी और निक्षालक या सतही बहाव का संग्रहण करने के लिए इसकी चारों तरफ नालियों का घेरा होगा।

(च) परिवेशी वायु गुणवत्ता की नियमित रूप से मॉनीटरी की जाएगी। प्रसंस्करण संयंत्र की बाहरी दीवार पर या नीचे की हवा की दिशा में गंध की समस्या की भी नियमित रूप से जांच की जाएगी।

(छ) नमी बनाए रखने के लिए खाद संयंत्र में निक्षालक को पुन:परिचालित किया जाएगा।

(ज) अंतिम उत्पाद खाद, समय-समय पर अधिसूचित उर्वरक नियंत्रण आदेश के अंतर्गत विनिर्दिष्ट मानकों के अनुसार होगा।

(झ) खाद का सुरक्षित अनुप्रयोग सुनिश्चित करने हेतु खाद गुणवत्ता के लिए निम्नलिखित विनिर्देशों को पूरा किया जाएगा, अर्थात् :-

पैरामीटर	**जैविक खाद (एफसीओ 2009)**	**फॉस्फेट संपन्न जैविक खाद (एफसीओ 2013)**
(1)	**(2)**	**(3)**
आर्सेनिक (मिग्रा/किग्रा)	10.00	10.00
कैडमियम (मिग्रा/किग्रा)	5.00	5.00
क्रोमियम (मिग्रा/किग्रा)	50.00	50.00
तांबा (मिग्रा/किग्रा)	300.00	300.00
सीसा (मिग्रा/किग्रा)	100.00	100.00
पारा (मिग्रा/किग्रा)	0.15	0.15
निकल (मिग्रा/किग्रा)	50.00	50.00
जस्ता (मिग्रा/किग्रा)	1000.00	1000.00
सी/एन अनुपात	<20	20:1 से कम
पीएच (pH)	6.5-7.5	(1:5 घोल) अधिकतम 6.7
नमी, भार का प्रतिशत, अधिकतम	15.0-25.0	25.0
थोक घनत्व (ग्राम/सेमी^{3})	<1.0	1.6 से कम
कुल जैविक कार्बन, भार द्वारा प्रतिशत, न्यूनतम	12.0	7.9
कुल नाइट्रोजन (एन के रूप में), भार द्वारा प्रतिशत, न्यूनतम	0.8	0.4

कुल फॉस्फेट (पी2ओ5 के रूप में) भार द्वारा प्रतिशत, न्यूनतम	0.4	10.4
कुल पोटेशियम ($के_2$ओ के रूप में), भार द्वारा प्रतिशत, न्यूनतम	0.4	-
रंग	गहरे भूरे से काले तक	-
गंध	बदबू की अनुपस्थिति	-
कण आकार	कम से कम 90% सामग्री, 4.0 मिमी आईएस छलनी से होकर गुजरनी चाहिए	कम से कम 90% सामग्री, 4.0 मिमी आईएस छलनी से होकर गुजरनी चाहिए
प्रवाहकत्व (डीएसएम-1 के रूप में), से कम	4.0	8.2

*उपरोक्त कथित संकेन्द्रण सीमाओं से अधिक वाली खाद (अंतिम उत्पाद) का उपयोग खाद्य फसलों के लिए नहीं किया जाएगा। तथापि, इसका उपयोग खाद्य फसलों को उगाने से भिन्न प्रयोजनों के लिए किया जा सकता है।

ख. शोधित निक्षालकों के लिए मानक. - शोधित निक्षालकों के निपटान में निम्नलिखित मानकों का पालन किया जाएगा, अर्थात्:-

क्र.सं.	**मापदंड**	**मानक (निपटान का तरीका)**		
		अंतर्देशीय सतही जल	**सार्वजनिक सीवर**	**भूमि निपटान**
(1)	(2)	(3)	(4)	(5)
1.	निलंबित ठोस, मिग्रा/ली, अधिकतम	100	600	200
2.	विलीन ठोस (अजैविक), मिग्रा/ली, अधिकतम	2100	2100	2100
3.	पीएच (ph) मान	5.5 से 9.0	5.5 से 9.0	5.5 से 9.0
4.	अमोनिकल नाइट्रोजन (एन के रूप में) मिग्रा/ली., अधिकतम	50	50	--
5.	कुल केल्डाल नाइट्रोजन (एन के रूप में) मिग्रा/ली, अधिकतम	100	--	--

6.	जैव रासायनिक ऑक्सीजन मांग (27^0 से. पर 3 दिन) अधिकतम (मिग्रा/ली)	30	350	100
7.	रासायनिक ऑक्सीजन मांग, मिग्रा/ली, अधिकतम	250	--	--
8.	आर्सेनिक (एएस के रूप में), मिग्रा/ ली, अधिकतम	0.2	0.2	0.2
9.	पारा (एचजी के रूप में), मिग्रा/ली, अधिकतम	0.01	0.01	--
10.	सीसा (पीबी के रूप में), मिग्रा/ली, अधिकतम	0.1	1.0	--
11.	कैडमियम (सीडी के रूप में), मिग्रा/ली, अधिकतम	2.0	1.0	--
12.	कुल क्रोमियम (सीआर के रूप में), मिग्रा/ली, अधिकतम	2.0	2.0	--
13.	तांबा (सीयू के रूप में), मिग्रा/ली, अधिकतम	3.0	3.0	--
14.	जस्ता ((जेडएन के रूप में), मिग्रा/ली, अधिकतम	5.0	15	--
15.	निकल (एनआई के रूप में), मिग्रा/ली, अधिकतम	3.0	3.0	--
16.	साइनाइड (सीएन के रूप में), मिग्रा/ली, अधिकतम	0.2	2.0	0.2
17.	क्लोराइड (सीएल के रूप में), मिग्रा/ली, अधिकतम	1000	1000	600
18.	फ्लोराइड (एफ के रूप में), मिग्रा/ली, अधिकतम	2.0	1.5	--
19.	फेनोलिक यौगिक ($सी_6एच_5$ ओएच के रूप में), मिग्रा/ली, अधिकतम	1.0	5.0	--

नोट : आंतरिक सतही जल-निकायों में शोधित निक्षालकों को बहाते समय, बहाए जाने वाले निक्षालकों की मात्रा और प्राप्त करने वाले जल निकाय में उपलब्ध मिश्रित जल की मात्रा पर उचित रूप से ध्यान दिया जाएगा ।

ग. भस्मीकरण के मानक : ठोस अपशिष्ट शोधन/निपटान सुविधा में भस्मकों/ताप प्रौद्योगिकियों से होने वाले उत्सर्जन में निम्नलिखित मानकों का अनुपालन किया जाएगा, अर्थात् :

मानदण्ड	उत्सर्जन मानक	
(1)	(2)	(3)
विविक्त-कण	50 मिग्रा/एनएम^3	मानक का अर्थ आधे घंटे के औसत मान से है
एचसीएल	50 मिग्रा/एनएम^3	मानक का अर्थ आधे घंटे के औसत मान से है
एसओ2	200 मिग्रा/एनएम^3	मानक का अर्थ आधे घंटे के औसत मान से है
सीओ	100 मिग्रा/एनएम^3	मानक का अर्थ आधे घंटे के औसत मान से है
	50 मिग्रा/एनएम^3	मानक का अर्थ दैनिक औसत मान से है
कुल जैविक कार्बन	20 मिग्रा/एनएम^3	मानक का अर्थ आधे घंटे के औसत मान से है
एचएफ	4 मिग्रा/एनएम^3	मानक का अर्थ आधे घंटे के औसत मान से है
एनओएक्स (एनओ2 के रूप में व्यक्त एनओ और एनओ2)	400 मिग्रा/एनएम^3	मानक का अर्थ आधे घंटे के औसत मान से है
कुल डाइऑक्सिन और फ्यूरन	0.1 एनजी टीईक्यू/एनएम^3	मानक का अर्थ 6-8 घंटे के नमूने से है। कृपया कुल विषाक्त समतुल्यता प्राप्त करने के लिए विषाक्त समतुल्यता मानों हेतु 17 संबंधित समप्रकारी वस्तु के दिशानिर्देशों का संदर्भ लें।
सीडी+टीएच+उनके यौगिक	0.05 एमजी/एनएम^3	मानक का अर्थ 30 मिनट और 8 घंटे के बीच कहीं भी नमूना लिए गए समय से है।
एचजी और इसके यौगिक	0.05 एमजी/एनएम^3	मानक का अर्थ 30 मिनट और 8 घंटे के बीच कहीं भी नमूना लिए गए समय से है।
एसबी+एएस+पीबी+सीआर+ सीओ+सीयू+एमएन+एनआई+वी+ उनके यौगिक	0.5 एमजी/एनएम^3	मानक का अर्थ 30 मिनट और 8 घंटे के बीच कहीं भी नमूना लिए गए समय से है।
नोट : सभी मानों में शुष्क आधार पर 11% ऑक्सीजन तक शुद्धि की गई है।		

टिप्पणी :

(क) उपरोक्त उत्सर्जन सीमाओं को प्राप्त करने के लिए भस्मीकरण यंत्र के साथ उपयुक्त प्रकार के डिजाइन किए गए प्रदूषण नियंत्रण उपकरण संस्थापित या पुन:संयोजित किए जाएंगे।

(ख) भस्मीकृत किए जाने वाले अपशिष्ट को किसी क्लोरीनयुक्त कीटाणुनाशक के साथ रासायनिक तरीके से शोधित नहीं किया जाएगा।

(ग) क्लोरीनयुक्त प्लास्टिक के भस्मीकरण को दो वर्षों के अंदर क्रमबद्ध रूप से समाप्त किया जाएगा।

(घ) यदि भस्मीकरण राख में विषाक्त धातुओं की सांद्रता समय-समय पर यथासंशोधित परिसंकटमय अपशिष्ट (प्रबंधन, हथालन और सीमा-पारीय संचलन) नियम, 2008 में यथाविनिर्दिष्ट सीमाओं से अधिक हो तो ऐसे राख को परिसंकटमय अपशिष्ट शोधन, भंडारण और निपटान सुविधा को भेजा जाएगा।

(ड.) भस्मीकरण-यंत्र में ईंधन के रूप में केवल एलडीओ, एलएसएचएस, डीजल, बायोमास, कोयला, एलएनजी, सीएनजी, आरडीएफ और बायोगैस जैसे निम्न सल्फर ईंधन का ही प्रयोग किया जाएगा।

(च) अधोवायु गैस में सीओ2 संकेन्द्रण 7% से अधिक नहीं होगा।

(छ) ट्विन चैम्बर भस्मीकरण-यंत्रों में सभी सुविधाएं इस प्रकार से डिजाइन की जाएंगी कि द्वितीय ज्वलन चैम्बर में 950° से. के न्यूनतम तापमान को प्राप्त करने के लिए और 2 (दो) सेकंड से अधिक के द्वितीय ज्वलन चैम्बर में गैस रह सके।

(ज) भस्मीकरण संयंत्र (दहन चैम्बर) ऐसे तापमान, अवधारण समय और विक्षोभ के साथ परिचालित किए जाएंगे ताकि लावा और तलहटी राखों में कुल जैविक कार्बन (टीओसी) तत्व को 3% से कम किया जा सके या प्रज्वलन पर उनकी क्षति सूखे वजन के 5% से कम हो।

(झ) स्थलों से निकलने वाली गंध का प्रबंधन केन्द्रीय प्रदूषण नियंत्रण बोर्ड द्वारा समय-समय पर जारी मार्गदर्शी सिद्धांतों के साथ किया जाएगा।

प्ररूप -I

[नियम 15 (म), 16(1)(ग), 21(3) देखें]

ठोस अपशिष्ट के प्रसंस्करण/पुनर्चक्रण/शोधन और निपटान के लिए
ठोस अपशिष्ट प्रबंधन नियमों के अंतर्गत प्राधिकार प्राप्त करने के लिए आवेदन

सेवा में,

..... के

सदस्य सचिव

राज्य प्रदूषण नियंत्रण बोर्ड/प्रदूषण नियंत्रण समिति

महोदय,

मैं/हम ठोस अपशिष्ट के प्रसंस्करण, पुनर्चक्रण, शोधन और निपटान के लिए ठोस अपशिष्ट नियम, 2016 के अंतर्गत प्राधिकार के लिए एतददारा आवेदन करता हूँ/करते हैं।

1.	उनके/सुविधा के प्रचालक द्वारा नियुक्त स्थानीय निकाय/अभिकरण का नाम	
2.	पत्राचार का पता दूरभाष सं. फैक्स सं.	

	ई-मेल	
3.	नोडल अधिकारी और पदनाम (प्रसंस्करण/शोधन या निपटान सुविधा के प्रचालन के लिए उत्तरदायी स्थानीय निकाय या अभिकरण द्वारा प्राधिकृत अधिकारी)	
4.	सुविधा की स्थापना करने और प्रचालन के लिए अपेक्षित प्राधिकार (कृपया निशान लगाएं)	i. अपशिष्ट प्रसंस्करण ii. पुनर्चक्रण iii. शोधन iv. भूमि भरण स्थल पर निपटान
5.	इन दस्तावेजों की प्रतियां संलग्न करें	i. स्थल स्वीकृति (स्थानीय प्राधिकरण) ii. पर्यावरणीय स्वीकृति का प्रमाण iii. स्थापना के लिए अनुमति iv. नगरपालिका प्राधिकरण और प्रचालन अभिकरण के बीच करार v. परियोजना में निवेश और अपेक्षित आय
6.	**ठोस अपशिष्ट का प्रसंस्करण/पुनर्चक्रण/शोधन** i. प्रतिदिन प्रसंस्करित अपशिष्ट की कुल मात्रा क) पुनर्चक्रित किए जाने वाले अपशिष्ट की मात्रा ख) शोधित किए जाने वाले अपशिष्ट की मात्रा ग) भूमिभरण स्थल में निपटाए जाने वाले अपशिष्ट की मात्रा ii. प्रसंस्करित अपशिष्ट के लिए उपयोगिता कार्यक्रम (उत्पाद उपयोग) iii. निपटान के लिए कार्य-पद्धति (ब्यौरा संलग्न करें) क) निक्षालक की मात्रा ख) निक्षालक के लिए शोधन प्रौद्योगिकी iv. पर्यावरणीय प्रदूषण के निवारण और नियंत्रण के लिए किए जाने वाले उपाय v. संयंत्र में कार्यरत कर्मकारों की सुरक्षा के लिए किए जाने वाले उपाय vi. ठोस अपशिष्ट प्रसंस्करण/पुनर्चक्रण/शोधन/	

	निपटान सुविधा संबंधी ब्यौरा (संलग्न किया जाए)	
7.	**ठोस अपशिष्ट का निपटान** अभिज्ञात स्थलों की संख्या प्रतिदिन निपटाए जाने वाले अपशिष्ट की मात्रा स्थल चयन के लिए अपनाई गई कार्य-पद्धति या मानदण्ड का ब्यौरा (संलग्न करें) प्रचालन के अंतर्गत विद्यमान स्थल का ब्यौरा भूमि भरण की कार्य-पद्धति और प्रचालनात्क ब्यौरा पर्यावरणीय प्रदूषण को रोकने के लिए किए गए उपाय	
8.	कोई अन्य सूचना	

हस्ताक्षर :.....

पदनाम .....

तारीख :

स्थान :

प्ररुप-II

[नियम 16(1)(ड.) देखें]

प्राधिकार जारी करने के लिए प्रपत्र

फाइल सं. : _____

दिनांक : _____

प्राधिकार सं. : _____

सेवा में,

_____

_____

_____

संदर्भ : आपका आवेदन सं. _____ दिनांक _____

_____ राज्य प्रदूषण नियंत्रण बोर्ड/प्रदूषण नियंत्रण समिति द्वारा प्रस्ताव का परीक्षण करने के पश्चात _____ को जिनका प्रशासनिक कार्यालय _____ में है, पर अपशिष्ट प्रसंस्करण/पुनर्चक्रण/शोधन/ निपटान सुविधा स्थापित और प्रचालित करने के लिए प्राधिकृत किया जाता है।

यह प्राधिकार ठोस अपशिष्ट के प्रसंस्करण, पुनर्चक्रण, शोधन और निपटान के लिए सुविधा के प्रचालन हेतु प्रदान किया जाता है।

यह प्राधिकार नीचे उल्लिखित निबंधन एवं शर्तों और इन नियमों में अन्यथा यथानिर्दिष्ट ऐसी शर्तों और इन नियमों के अंतर्गत अनुसूचियों I और II में विनिर्धारित मानकों के अध्यधीन है।

_____ राज्य प्रदूषण नियंत्रण बोर्ड/संघ राज्य क्षेत्र प्रदूषण नियंत्रण समिति द्वारा किसी भी समय, प्राधिकार के अंतर्गत लागू किसी शर्त को रद्द किया जा सकता है और इसकी लिखित सूचना दी जाएगी।

ठोस अपशिष्ट प्रबंधन नियम, 2016 के उपबंध का उल्लंघन होने पर पर्यावरण (संरक्षण) अधिनियम, 1986 (1986 का 29) के दंडात्मक उपबंध लागू होंगे।

दिनांक : (सदस्य सचिव)

स्थान : राज्य प्रदूषण नियंत्रण बोर्ड/संघ राज्य क्षेत्र

प्रदूषण नियंत्रण समिति

(हस्ताक्षर और पदनाम)

प्ररुप-III

[नियम 19(6), 24(1) देखें]

सुविधा के प्रचालक द्वारा स्थानीय निकाय को प्रस्तुत किए जाने के लिए वार्षिक रिपोर्ट का प्रपत्र

1.	शहर/नगर का नाम	
2.	जनसंख्या	
3.	क्षेत्रफल वर्ग किलो मीटर में	
4.	स्थानीय निकाय का नाम और पता दूरभाष सं. फैक्स ई-मेल :	
5.	सुविधा के प्रचालक का नाम और पता	
6.	सुविधा के प्रभारी अधिकारी का नाम दूरभाष सं. फैक्स ई-मेल :	

7.	शहर/नगर में परिवारों की संख्या शहर में गैर आवासीय परिसरों की संख्या शहर/नगर में चुनाव/प्रशासनिक वार्डों की संख्या	
8.	ठोस अपशिष्ट की मात्रा	
	प्रति दिन स्थानीय निकाय के क्षेत्र में उत्पन्न ठोस अपशिष्ट की अनुमानित मात्रा मीट्रिक टन में	/टीपीडी
	प्रतिदिन संग्रहित ठोस अपशिष्ट की मात्रा	/टीपीडी
	प्रतिदिन संग्रहित प्रति व्यक्ति अपशिष्ट	/ग्रा./दिन
	प्रसंसकृत ठोस अपशिष्ट की मात्रा	/टीपीडी
	भरण स्थल पर निपटान किए गए ठोस अपशिष्ट की मात्रा	/टीपीडी
9.	ठोस अपशिष्ट प्रबंधन सेवा की स्थिति	
	स्रोत पर अपशिष्ट का पृथक्करण और भंडारण	हां/नहीं
	क्या घरेलू/वाणिज्यिक/संस्थागत बिनों में स्रोत पर ठोस अपशिष्ट का भंडारण किया जाता है, यदि हां	%
	घरेलू बिनों में स्रोत पर अपशिष्ट के भंडारण की घरेलू रीति की प्रतिशतता	%
	वाणिज्यिक/संस्थागत बिनों में स्रोत पर अपशिष्ट का गैर आवासीय परिसरों में भंडारण करने की प्रतिशतता	%
	गलियों में घरों के ठोस अपशिष्ट का निपटान करने या फेंकने की प्रतिशतता	%
	गलियों में गैर आवासीय परिसरों के ठोस अपशिष्ट का निपटान करने या फेंकने की प्रतिशतता	%
	क्या ठोस अपशिष्ट को स्रोत पर पृथककृत स्वरूप में भंडारित किया जाता है	हां/नहीं
	यदि हां, तो स्रोत पर अपशिष्ट का पृथककरण करने वाले परिसरों की प्रतिशतता	%
	ठोस अपशिष्ट का घर-घर जाकर संग्रहण	
	क्या शहर/नगर में ठोस अपशिष्ट का घर-घर जाकर संग्रहण किया जाता है	हां/नहीं
	यदि हां, तो अपशिष्ट के घर-घर जाकर संग्रहण किए जाने में शामिल वार्डों की संख्या	
	शामिल किए गए घरों की संख्या	
	शामिल किए गए वाणिज्यिक संस्थापनाओं, होटलों, रेस्तराओं, शैक्षिक संस्थाओं/कार्यालय इत्यादि सहित गैर आवासीय परिसरों की संख्या	
	निम्न के माध्यम से घर-घर जाकर संग्रहण किए जाने में शामिल आवासीय और गैर आवासीय परिसरों की प्रतिशतता : मोटरकृत वाहन कंटेनरकृत तिपहिया साइकिल/हैंड कार्ट अन्य साधन	

		%
		%
		%
	यदि नहीं, तो संग्रहण में अपनाई गई प्राथमिक पद्धति	
	गलियों में झाड़ू लगाया जाना	
	शहर में सड़कों, गलियों, लेनों, बाइलेनों की लम्बाई जिनकी सफाई किए जाने की आवश्यकता है	कि.मी.
	गली में झाड़ू लगाए जाने की बारंबारता और लाभान्वित जनसंख्या की प्रतिशतता	

बारंबारता	रोजाना	एकांतर दिवस पर	सप्ताह में दो बार	कभी-कभी
लाभान्वित जनसंख्या की प्रतिशतता				

	प्रयुक्त साधन	%
	हाथ से झाड़ू लगाया जाना	%
	यांत्रिक रूप से झाड़ू लगाया जाना	
	क्या सफाई कर्मचारियों द्वारा लंबी हैंडल वाले झाड़ू का प्रयोग किया जाता है	हां/नही
	क्या प्रत्येक सफाई कर्मचारी को अपशिष्ट का संग्रहण करने के लिए हैंडकार्ट/तिपहिया साइकिल दी जाती है	हां/नही
	क्या हैंडकार्ट/तिपहिया साइकिल में कंटेनर लगा है	हां/नही
	क्या संग्रहण का साधन प्रयोग किए गए संग्रहण/अपशिष्ट भंडारण के कंटेनरों समकालिक है	हां/नही
	द्वितीयक अपशिष्ट भंडारण सुविधाएं	
	शहर/नगर में अपशिष्ट भंडारण डिपो की संख्या और प्रकार	संख्या क्षमता घन मीटर में
	खुले अपशिष्ट भंडारण स्थल	
	चिनाई किए गए बिन	

	सीमेंट कंक्रीट सिलिंडर के बिन ढलाव/ढ़के हुए कक्ष/स्थान ढ़के हुए धातु/प्लास्टिक के कंटेनर 1.1 घन मीटर तक के बिन 2 से 5 घन मीटर के बिन 5 घन मीटर से बड़े कंटेनर बिन रहित शहर		
	बिन/जनसंख्या अनुपात		
	अपशिष्ट भंडारण डिपो का वार्डवार विवरण (संलग्न करें) : वार्ड सं. : क्षेत्रफल : जनसंख्या : रखे हुए बिनों की संख्या रखे गए बिनों का कुल आयतन		
	अपशिष्ट भंडारण सुविधाओं की कुल भंडारण क्षमता घन मीटर में		
	अपशिष्ट भंडारण डिपो में प्रतिदिन वास्तविक रूप से भंडारित कुल अपशिष्ट		
	डिपो से अपशिष्ट के संग्रहण की बारंबारता बताएं साफ किए गए बिनों की संख्या	बारंबारता	बिनों की संख्या
		प्रतिदिन	
		एकांतर दिवस	
		सप्ताह में दो बार	
		सप्ताह में एक बार	
		कभी-कभी	
	क्या भंडारण डिपो में पृथक्कृत अपशिष्ट को हरे, नीले और काले बिनों में भंडार करके रखने की सुविधा है	हां/नहीं (यदि हां तो विवरण दें) हरे बिनों की संख्या : नीले बिनों की संख्या : काले बिनों की संख्या :	
	भंडारण डिपो से ठोस अपशिष्ट उठाने का कार्य हाथ से किया जाता है		

	या यांत्रिक तरीके से? प्रतिशत बताएं ठोस अपशिष्ट को हाथ से उठाए जाने की प्रतिशतता यात्रिक तरीके से उठाने की प्रतिशतता	 % %
	यदि यांत्रिक है तो प्रयुक्त पद्धति का स्पष्ट उल्लेख करें	फ्रंट-एंड लोडर/टॉप लोडर
	क्या ठोस अपशिष्ट को घर-घर से उठाया जाता है और पृथककृत स्वरूप में सीधे शोधन संयंत्र तक भेजा जाता है	हां/नहीं (यदि हां तो स्पष्ट उल्लेख करें)
	प्रतिदिन अपशिष्ट का परिवहन प्रयोग किए गए वाहनों का प्रकार और संख्या (कृपया टिक करें या जोड़ें)	अपशिष्ट का परिवहन करने में लगाए गए फेरों की संख्या
	पशु गाड़ी ट्रैक्टर नॉन टीपिंग ट्रक टीपिंग ट्रक डम्पर प्लेसर अवशिष्ट संग्राहक कम्पैक्टर अन्य जेसीबी - लोडर	
	अपशिष्ट के परिवहन की बारंबारता	बारंबारता — परिवहन किए गए अपशिष्ट का प्रतिशत प्रतिदिन एकांतर दिवस पर सप्ताह में दो बार सप्ताह में एक बार कभी-कभी
	प्रत्येक दिन परिवहन किए गए अपशिष्ट की मात्रा	/टीपीडी
	प्रतिदिन परिवहन किए गए कुल अपशिष्ट की प्रतिशतता	%
	प्रयोग की गई अपशिष्ट शोधन प्रौद्योगिकियां	
	क्या ठोस अपशिष्ट का प्रसंस्करण किया जाता है	हां/नहीं

	यदि हां, तो प्रतिदिन प्रसंस्करण किए गए अपशिष्ट की मात्रा	/टीपीडी
	अपशिष्ट प्रसंस्करण के लिए स्थानीय निकाय के पास उपलब्ध भूमि (हेक्टेयर में)	
	अपशिष्ट प्रसंस्करण के लिए वर्तमान में प्रयुक्त भूमि	
	प्रचालनरत ठोस अपशिष्ट प्रसंस्करण सुविधाएं	
	निर्माणाधीन ठोस अपशिष्ट प्रसंस्करण सुविधाएं	
	शहर/नगर की सीमा से प्रसंस्करण सुविधाओं की दूरी	
	अपनाई गई प्रौद्योगिकियों का विवरण	
	कंपोस्टिंग	प्रसंस्करण की गई कच्ची सामग्री की मात्रा उत्पन्न किए गए अंतिम उत्पाद की मात्रा बेची गई मात्रा भरण स्थल में डाले गए शेष अपशिष्ट की मात्रा
	वर्मी कंपोस्टिंग	प्रसंस्करण की गई कच्ची सामग्री की मात्रा उत्पन्न किए गए अंतिम उत्पाद की मात्रा बेची गई मात्रा भरण स्थल में डाले गए शेष अपशिष्ट की मात्रा
	बायो-मिथेनेशन	प्रसंस्करण की गई कच्ची सामग्री की मात्रा उत्पन्न किए गए अंतिम उत्पाद की मात्रा बेची गई मात्रा भरण स्थल में डाले गए शेष अपशिष्ट की मात्रा
	अवशिष्ट जनित ईंधन	प्रसंस्करण की गई कच्ची सामग्री की मात्रा उत्पन्न किए गए अंतिम उत्पाद की मात्रा बेची गई मात्रा भरण स्थल में डाले गए शेष अपशिष्ट की मात्रा
	अपशिष्ट से ऊर्जा प्रौद्योगिकी जैसे कि भष्मीकरण, गैसीकरण, पाइरोलेसिस या कोई अन्य प्रौद्योगिकी (विवरण दें)	प्रसंस्करण की गई कच्ची सामग्री की मात्रा उत्पन्न किए गए अंतिम उत्पाद की मात्रा बेची गई मात्रा भरण स्थल में डाले गए शेष अपशिष्ट की मात्रा
	सह-प्रसंस्करण	प्रसंस्करण की गई कच्ची सामग्री
	सीमेंट संयंत्र को आपूर्तित दहनशील अपशिष्ट	

	ठोस अपशिष्ट आधारित विद्युत संयंत्रों को आपूर्तित दहनशील अपशिष्ट	
	अन्य	मात्रा
	ठोस अपशिष्ट निपटान सुविधाएं	
	स्थानीय निकाय के पास उपलब्ध मलबा स्थलों की संख्या	
	स्थानीय निकाय के पास उपलब्ध स्वास्थ्यकर भरण स्थलों की संख्या	
	अपशिष्ट के निपटान हेतु उपलब्ध ऐसे प्रत्येक स्थल का क्षेत्रफल	
	अपशिष्ट के निपटान के लिए वर्तमान में प्रयुक्त भूमि का क्षेत्रफल	
	शहर/नगर से मलबा स्थल/भरण सुविधा की दूरी	कि.मी.
	निकटतम वसावट से दूरी	कि.मी.
	जल निकाय से दूरी	कि.मी.
	राज्य/राष्ट्रीय राजमार्ग से दूरी	कि.मी.
	विमानपत्तन से दूरी	कि.मी.
	महत्वपूर्ण धार्मिक स्थलों या ऐतिहासिक स्मारक से दूरी	कि.मी.
	क्या यह बाढ़ संभावित क्षेत्र में पड़ता है	हां/नहीं
	क्या यह भूकंप संभावित क्षेत्र में पड़ता है	हां/नहीं
	प्रत्येक दिन भरण में डाले गए अपशिष्ट की मात्रा	टीपीडी
	क्या भरण स्थल को घेरा गया है	हां/नहीं
	क्या स्थल पर रोशनी की सुविधा उपलब्ध है	हां/नहीं
	क्या धर्मकांटा सुविधा उपलब्ध है	हां/नहीं
	भरण स्थल पर प्रयुक्त वाहन और उपकरण (स्पष्ट करें)	उपलब्ध बुलडोजर, कम्पैक्टर इत्यादि
	भरण स्थल पर नियोजित जनशक्ति	हां/नहीं (यदि हां तो विवरण संलग्न करें)
	क्या ढ़कने का काम दैनिक आधार पर किया जाता है	हां/नहीं
	यदि नहीं, तो भरण स्थल पर जमा अपशिष्ट को ढ़कने की बारंबारता	
	ढ़कने के लिए प्रयुक्त सामग्री	
	क्या ढ़कने की पर्याप्त सामग्री उपलब्ध है	हां/नहीं
	क्या गैस निकलने की व्यवस्था की गई है	हां/नहीं (यदि हां, तो तकनीकी डाटा शीट संलग्न करें)
	निक्षालन संग्रहण का प्रावधान	हां/नहीं (यदि हां, तो तकनीकी डाटा शीट संलग्न करें)
10.	क्या शहर में ठोस अपशिष्ट प्रबंधन पद्धतियों में सुधार लाने के लिए	हां/नहीं

	कार्ययोजना बनाई गई है	(यदि हां, तो तकनीकी डाटा शीट संलग्न करें)
11.	निम्न के लिए कौन से पृथक प्रावधान किए गए हैं : डेयरी से संबंधित कार्यकलाप : बूचड़खाने के अपशिष्ट : निर्माण एवं विध्वंस अपशिष्ट (निर्माण मलबा) :	प्रस्तावों, उठाए गए कदमों के संबंध में विवरण संलग्न करें हां/नहीं हां/नहीं हां/नहीं
12.	पश्च संवृत्ति योजना का विवरण	योजना संलग्न करें
13.	कितनी मलिन बस्तियों का निर्धारण किया गया है और क्या इनमें ठोस अपशिष्ट प्रबंधन सुविधाएं उपलब्ध कराई गई हैं :	हां/नहीं (यदि हां, तो विवरण संलग्न करें)
14.	गली में झाड़ू लगाने, अपशिष्ट के द्वितीयक भंडारण, परिवहन, प्रसंस्करण और निपटान सहित संग्रहण के लिए ठेकेदार/रियायतग्राही की नियोजित जनशक्ति का विवरण दें	
15.	इन नियमों के प्रावधानों का अनुपालन करने में स्थानीय निकाय द्वारा महसूस की जा रही कठिनाइयों का संक्षेप में उल्लेख करें	
16.	ठोस अपशिष्ट से संबंधित समस्या से निपटने के लिए किसी अभिनव विचार का संक्षेप में उल्लेख करें जिसे अन्य स्थानीय निकायों द्वारा अपनाया जा सके	

प्रचालक के हस्ताक्षर

तारीख :

स्थान :

प्ररुप-IV

[नियम 15 (यक), 24(2) देखें]

स्थानीय निकाय द्वारा प्रस्तुत किए जाने के लिए ठोस अपशिष्ट प्रबंधन संबंधी

वार्षिक रिपोर्ट का प्रारूप

कैलेंडर वर्ष	**रिपोर्ट प्रस्तुत करने की तारीख**

1.	शहर/नगर का नाम	
2.	जनसंख्या	
3.	क्षेत्रफल वर्ग किलो मीटर में	
4.	स्थानीय निकाय का नाम और पता दूरभाष सं. फैक्स ई-मेल :	
5.	ठोस अपशिष्ट प्रबंधन (वेस्टेम) से संबंधित प्रभारी अधिकारी का नाम दूरभाष सं. फैक्स ई-मेल :	
6.	शहर/नगर में परिवारों की संख्या शहर में गैर आवासीय परिसरों की संख्या शहर/नगर में चुनाव/प्रशासनिक वार्डों की संख्या	
7.	ठोस अपशिष्ट की मात्रा	
	प्रति दिन स्थानीय निकाय के क्षेत्र में उत्पन्न ठोस अपशिष्ट की अनुमानित मात्रा मीट्रिक टन में	/टीपीडी
	प्रतिदिन संग्रहित ठोस अपशिष्ट की मात्रा	/टीपीडी
	प्रतिदिन संग्रहित प्रति व्यक्ति अपशिष्ट	/ग्रा./दिन
	प्रसंसकृत ठोस अपशिष्ट की मात्रा	/टीपीडी
	मलबा स्थल/भरण स्थल पर निपटान किए गए ठोस अपशिष्ट की मात्रा	/टीपीडी
8.	ठोस अपशिष्ट प्रबंधन सेवा की स्थिति	
	स्रोत पर अपशिष्ट का पृथक्करण और भंडारण	
	क्या घरेलू/वाणिज्यिक/संस्थागत बिनों में स्रोत पर ठोस अपशिष्ट का भंडारण किया जाता है, यदि हां	हां/नहीं

	घरेलू बिनों में स्रोत पर अपशिष्ट के भंडारण की घरेलू रीति की प्रतिशतता	%
	वाणिज्यिक/संस्थागत बिनों में स्रोत पर अपशिष्ट का गैर आवासीय परिसरों में भंडारण करने की प्रतिशतता	%
	गलियों में घरों के ठोस अपशिष्ट का निपटान करने या फेंकने की प्रतिशतता	%
	गलियों में गैर आवासीय परिसरों के ठोस अपशिष्ट का निपटान करने या फेंकने की प्रतिशतता	%
	ठोस अपशिष्ट का घर-घर जाकर संग्रहण	
	क्या शहर/नगर में ठोस अपशिष्ट का घर-घर जाकर संग्रहण किया जाता है	हां/नहीं
	यदि हां, तो अपशिष्ट के घर-घर जाकर संग्रहण किए जाने में शामिल वार्डों की संख्या	
	शामिल किए गए घरों की संख्या	
	शामिल किए गए वाणिज्यिक संस्थापनाओं, होटलों, रेस्तराओं, शैक्षिक संस्थाओं/कार्यालय इत्यादि सहित गैर आवासीय परिसरों की संख्या	
	निम्न के माध्यम से घर-घर जाकर संग्रहण किए जाने में शामिल आवासीय और गैर आवासीय परिसरों की प्रतिशतता : मोटरकृत वाहन कंटेनरकृत तिपहिया साइकिल/हैंड कार्ट अन्य साधन	 % % %
	यदि नहीं, तो संग्रहण में अपनाई गई प्राथमिक पद्धति	
	गलियों में झाड़ू लगाया जाना	
	शहर में सड़कों, गलियों, लेनों, बाइलेनों की लम्बाई जिनकी सफाई किए जाने की आवश्यकता है	कि.मी.
	गली में झाड़ू लगाए जाने की बारंबारता और लाभान्वित जनसंख्या की प्रतिशतता	

बारंबारता	रोजाना	एकांतर दिवस पर	सप्ताह में दो बार	कभी-कभी
लाभान्वित जनसंख्या की प्रतिशतता				

	प्रयुक्त साधन हाथ से झाड़ू लगाया जाना यांत्रिक रूप से झाड़ू लगाया जाना	 % %

	क्या सफाई कर्मचारियों द्वारा लंबी हैंडल वाले झाड़ू का प्रयोग किया जाता है	हां/नही
	क्या प्रत्येक सफाई कर्मचारी को अपशिष्ट का संग्रहण करने के लिए हैंडकार्ट/तिपहिया साइकिल दी जाती है	हां/नही
	क्या हैंडकार्ट/तिपहिया साइकिल में कंटेनर लगा है	हां/नही
	क्या संग्रहण का साधन प्रयोग किए गए संग्रहण/अपशिष्ट भंडारण के कंटेनरों समकालिक है	हां/नही
	द्वितीयक अपशिष्ट भंडारण सुविधाएं	
	शहर/नगर में अपशिष्ट भंडारण डिपो की संख्या और प्रकार खुले अपशिष्ट भंडारण स्थल चिनाई किए गए बिन सीमेंट कंक्रीट सिलिंडर के बिन ढलाव/ढ़के हुए कक्ष/स्थान ढ़के हुए धातु/प्लास्टिक के कंटेनर 1.1 घन मीटर तक के बिन 2 से 5 घन मीटर के बिन 5 घन मीटर से बड़े कंटेनर बिन रहित शहर	संख्या क्षमता घन मीटर में
	बिन/जनसंख्या अनुपात	
	अपशिष्ट भंडारण डिपो का वार्डवार विवरण (संलग्न करें) : वार्ड सं. : क्षेत्रफल : जनसंख्या : रखे हुए बिनों की संख्या रखे गए बिनों का कुल आयतन	
	अपशिष्ट भंडारण सुविधाओं की कुल भंडारण क्षमता घन मीटर में	
	अपशिष्ट भंडारण डिपो में प्रतिदिन वास्तविक रूप से भंडारित कुल अपशिष्ट	

	डिपो से अपशिष्ट के संग्रहण की बारंबारता बताएं साफ किए गए बिनों की संख्या	बारंबारता	बिनों की संख्या
		प्रतिदिन	
		एकांतर दिवस	
		सप्ताह में दो बार	
		सप्ताह में एक बार	
		कभी-कभी	
	क्या भंडारण डिपो में पृथककृत अपशिष्ट को हरे, नीले और काले बिनों में भंडार करके रखने की सुविधा है	हां/नहीं (यदि हां तो विवरण दें) हरे बिनों की संख्या : नीले बिनों की संख्या : काले बिनों की संख्या :	
	भंडारण डिपो से ठोस अपशिष्ट उठाने का कार्य हाथ से किया जाता है या यांत्रिक तरीके से? प्रतिशत बताएं ठोस अपशिष्ट को हाथ से उठाए जाने की प्रतिशतता यात्रिक तरीके से उठाने की प्रतिशतता	% %	
	यदि यांत्रिक है तो प्रयुक्त पद्धति का स्पष्ट उल्लेख करें	फ्रंट-एंड लोडर/टॉप लोडर	
	क्या ठोस अपशिष्ट को घर-घर से उठाया जाता है और पृथककृत स्वरूप में सीधे शोधन संयंत्र तक भेजा जाता है	हां/नहीं (यदि हां तो स्पष्ट उल्लेख करें)	
	प्रतिदिन अपशिष्ट का परिवहन प्रयोग किए गए वाहनों का प्रकार और संख्या	अपशिष्ट का परिवहन करने में लगाए गए फेरों की संख्या	

	पशु गाड़ी ट्रैक्टर नॉन टीपिंग ट्रक टीपिंग ट्रक डम्पर प्लेसर अवशिष्ट संग्राहक कम्पैक्टर अन्य जेसीबी - लोडर	
	अपशिष्ट के परिवहन की बारंबारता	बारंबारता — परिवहन किए गए अपशिष्ट का प्रतिशत प्रतिदिन एकांतर दिवस पर सप्ताह में दो बार सप्ताह में एक बार कभी-कभी
	प्रत्येक दिन परिवहन किए गए अपशिष्ट की मात्रा	/टीपीडी
	प्रतिदिन परिवहन किए गए कुल अपशिष्ट की प्रतिशतता	%
	प्रयोग की गई अपशिष्ट शोधन प्रौद्योगिकियां	
	क्या ठोस अपशिष्ट का प्रसंस्करण किया गया है	हां/नहीं
	यदि हां, तो प्रतिदिन प्रसंस्करण किए गए अपशिष्ट की मात्रा	/टीपीडी
	क्या शोधन का कार्य स्थानीय निकाय या किसी अभिकरण के माध्यम से किया जाता है	
	अपशिष्ट प्रसंस्करण के लिए स्थानीय निकाय के पास उपलब्ध भूमि (हेक्टेयर में)	
	अपशिष्ट प्रसंस्करण के लिए वर्तमान में प्रयुक्त भूमि	
	प्रचालनरत ठोस अपशिष्ट प्रसंस्करण सुविधाएं	
	निर्माणाधीन ठोस अपशिष्ट प्रसंस्करण सुविधाएं	
	शहर/नगर की सीमा से प्रसंस्करण सुविधाओं की दूरी	

	अपनाई गई प्रौद्योगिकियों का विवरण	
	कंपोस्टिंग	प्रसंस्करण की गई कच्ची सामग्री की मात्रा उत्पन्न किए गए अंतिम उत्पाद की मात्रा बेची गई मात्रा भरण स्थल में डाले गए शेष अपशिष्ट की मात्रा
	वर्मी कंपोस्टिंग	प्रसंस्करण की गई कच्ची सामग्री की मात्रा उत्पन्न किए गए अंतिम उत्पाद की मात्रा बेची गई मात्रा भरण स्थल में डाले गए शेष अपशिष्ट की मात्रा
	बायो-मिथेनेशन	प्रसंस्करण की गई कच्ची सामग्री की मात्रा उत्पन्न किए गए अंतिम उत्पाद की मात्रा बेची गई मात्रा भरण स्थल में डाले गए शेष अपशिष्ट की मात्रा
	अवशिष्ट जनित ईंधन	प्रसंस्करण की गई कच्ची सामग्री की मात्रा उत्पन्न किए गए अंतिम उत्पाद की मात्रा बेची गई मात्रा भरण स्थल में डाले गए शेष अपशिष्ट की मात्रा
	सह-प्रसंस्करण	प्रसंस्करण की गई कच्ची सामग्री
	सीमेंट संयंत्र को आपूर्तित दहनशील अपशिष्ट	
	ठोस अपशिष्ट आधारित विद्युत संयंत्रों को आपूर्तित दहनशील अपशिष्ट	
	अन्य	मात्रा
	ठोस अपशिष्ट निपटान सुविधाएं	
	स्थानीय निकाय के पास उपलब्ध मलबा स्थलों की संख्या	
	स्थानीय निकाय के पास उपलब्ध स्वास्थ्यकर भरण स्थलों की संख्या	

	अपशिष्ट के निपटान हेतु उपलब्ध ऐसे प्रत्येक स्थल का क्षेत्रफल	
	अपशिष्ट के निपटान के लिए वर्तमान में प्रयुक्त भूमि का क्षेत्रफल	
	शहर/नगर से मलबा स्थल/भरण सुविधा की दूरी	कि.मी.
	निकटतम वसावट से दूरी	कि.मी.
	जल निकाय से दूरी	कि.मी.
	राज्य/राष्ट्रीय राजमार्ग से दूरी	कि.मी.
	विमानपत्तन से दूरी	कि.मी.
	महत्वपूर्ण धार्मिक स्थलों या ऐतिहासिक स्मारक से दूरी	कि.मी.
	क्या यह बाढ़ संभावित क्षेत्र में पड़ता है	हां/नहीं
	क्या यह भूकंप संभावित क्षेत्र में पड़ता है	हां/नहीं
	प्रत्येक दिन भरण में डाले गए अपशिष्ट की मात्रा	टीपीडी
	क्या भरण स्थल को घेरा गया है	हां/नहीं
	क्या स्थल पर रोशनी की सुविधा उपलब्ध है	हां/नहीं
	क्या धर्मकांटा सुविधा उपलब्ध है	हां/नहीं
	भरण स्थल पर प्रयुक्त वाहन और उपकरण (स्पष्ट करें)	उपलब्ध बुलडोजर, कम्पैक्टर इत्यादि
	भरण स्थल पर नियोजित जनशक्ति	हां/नहीं (यदि हां तो विवरण संलग्न करें)
	क्या ढ़कने का काम दैनिक आधार पर किया जाता है	हां/नहीं
	यदि नहीं, तो भरण स्थल पर जमा अपशिष्ट को ढ़कने की बारंबारता	
	ढ़कने के लिए प्रयुक्त सामग्री	
	क्या ढ़कने की पर्याप्त सामग्री उपलब्ध है	हां/नहीं
	क्या गैस निकलने की व्यवस्था की गई है	हां/नहीं (यदि हां, तो तकनीकी डाटा शीट संलग्न करें)
	निक्षालन संग्रहण का प्रावधान	हां/नहीं (यदि हां, तो तकनीकी डाटा शीट संलग्न करें)
9.	क्या शहर में ठोस अपशिष्ट प्रबंधन पद्धतियों में सुधार लाने के लिए कार्ययोजना बनाई गई है	हां/नहीं (यदि हां, तो तकनीकी डाटा शीट संलग्न करें)
10.	निम्न के लिए कौन से पृथक प्रावधान किए गए हैं : डेयरी से संबंधित कार्यकलाप : बूचड़खाने के अपशिष्ट : निर्माण एवं विध्वंस अपशिष्ट (निर्माण मलबा) :	प्रस्तावों, उठाए गए कदमों के संबंध में विवरण संलग्न करें हां/नहीं

		हां/नहीं हां/नहीं
11.	पश्च संवृत्ति योजना का विवरण	योजना संलग्न करें
12.	कितनी मलिन बस्तियों का निर्धारण किया गया है और क्या इनमें ठोस अपशिष्ट प्रबंधन सुविधाएं उपलब्ध कराई गई हैं :	हां/नहीं (यदि हां, तो विवरण संलग्न करें)
13.	कृपया विवरण दें : गली में झाड़ू लगाने, अपशिष्ट के द्वितीयक भंडारण, परिवहन, प्रसंस्करण और निपटान सहित संग्रहण के लिए स्थानीय निकाय की स्वयं की जनशक्ति	
14.	कृपया विवरण दें : गली में झाड़ू लगाने, अपशिष्ट के द्वितीयक भंडारण, परिवहन, प्रसंस्करण और निपटान सहित संग्रहण के लिए ठेकेदार/रियायतग्राही की नियोजित जनशक्ति	
15.	इन नियमों के प्रावधानों का अनुपालन करने में स्थानीय निकाय द्वारा महसूस की जा रही कठिनाइयों का संक्षेप में उल्लेख करें	
16.	ठोस अपशिष्ट से संबंधित समस्या से निपटने के लिए किसी अभिनव विचार का संक्षेप में उल्लेख करें जिसे अन्य स्थानीय निकायों द्वारा अपनाया जा सके	

मुख्य कार्यकारी अधिकारी/

नगरपालिका आयुक्त/कार्यकारी अधिकारी/

मुख्य अधिकारी के हस्ताक्षर

तारीख :

स्थान :

प्ररुप-V

[नियम 24(3) देखें]

राज्य प्रदूषण नियंत्रण बोर्ड या प्रदूषण नियंत्रण समितियों द्वारा केन्द्रीय प्रदूषण नियंत्रण बोर्ड को प्रस्तुत की जाने वाली वार्षिक रिपोर्ट का प्रपत्र

भाग क

सेवा में,

अध्यक्ष,

केन्द्रीय प्रदूषण नियंत्रण बोर्ड,
परिवेश भवन, पूर्वी अर्जुन नगर,

दिल्ली-110032

1.	राज्य/संघ राज्य क्षेत्र का नाम	:	
2.	राज्य प्रदूषण नियंत्रण बोर्ड का नाम और पता	:	
3.	इन नियमों के अंतर्गत राज्य/संघ राज्य क्षेत्र में ठोस अपशिष्टों के प्रबंधन के लिए उत्तरदायी स्थानीय निकायों की संख्या	:	
4.	प्राप्त हुए प्राधिकार आवेदनों की संख्या	:	
5.	ठोस अपशिष्ट प्रबंधन के संबंध में स्थानीय निकाय द्वारा की गई प्रगति के संबंध में सारांश विवरण	:	कृपया अनुबंध- I के रूप में संलग्न करें
6.	अपशिष्ट संग्रहण, पृथक्करण, परिवहन और निपटान के संबंध में स्थानीय निकायों द्वारा की गई प्रगति के संबंध में सारांश विवरण	:	कृपया अनुबंध- II के रूप में संलग्न करें
7.	अनुसूची II के कार्यान्वयन के संबंध में स्थानीय निकायों द्वारा की गई प्रगति के संबंध में सारांश विवरण	:	कृपया अनुबंध- III के रूप में संलग्न करें

तारीख :	अध्यक्ष या सदस्य सचिव
स्थान :	राज्य प्रदूषण नियंत्रण बोर्ड/
	प्रदूषण नियंत्रण समिति

भाग ख

नगर/शहर

नगरों/शहरों की कुल संख्या

शहरी स्थानीय निकायों की कुल संख्या

श्रेणी-I तथा श्रेणी-II नगरों/शहरों की संख्या

प्राधिकार की स्थिति (नाम/संख्या)

प्राप्त हुए आवेदनों की संख्या

प्रदान किए गए प्राधिकारों की संख्या

जांच के अधीन प्राधिकार

ठोस अपशिष्ट उत्पादन की स्थिति

राज्य में ठोस अपशिष्ट उत्पादन (टीपीडी)

संग्रहित

शोधित

खत्ते में डाले गए

ठोस अपशिष्ट नियम की अनुसूची I का अनुपालन (नगरों की संख्या/नाम/क्षमता)

शहरों/नगरों में अच्छी रीतियां

घर-घर से संग्रहण

पृथक्करण

भंडारण

आवृत्त परिवहन

ठोस अपशिष्ट का प्रसंस्करण (नगरों की संख्या/नाम/क्षमता)

ठोस अपशिष्ट प्रसंस्करण सुविधाओं की स्थापना :

क्रम सं.	कम्पोस्टिंग	वर्मी-कम्पोस्टिंग	बायो गैस	आरडीएफ/गुटिकाकरण

प्रचालनरत प्रसंस्करण सुविधा

क्रम सं.	कम्पोस्टिंग	वर्मी -कम्पोस्टिंग	बायो गैस	आरडीएफ/गुटिकाकरण

संस्थापनाधीन/योजनाकृत प्रसंस्करण सुविधा

क्रम सं.	कम्पोस्टिंग	वर्मी-कम्पोस्टिंग	बायो गैस	आरडीएफ/गुटिकाकरण

अपशिष्ट से ऊर्जा संयंत्र : (नगरों की संख्या/नाम/क्षमता)

क्रम सं.	संयंत्र का स्थान	प्रचालन की स्थिति	विद्युत उत्पादन (मेगा वाट)	अभ्युक्ति

ठोस अपशिष्ट का निपटान (नगरों की संख्या/नाम/क्षमता)

अभिनिर्धारित भरण स्थल

निर्मित भरण स्थल

निर्माणाधीन भरण स्थल

प्रचालनरत भरण स्थल

निश्शेषित भरण स्थल

आच्छादित भरण स्थल

ठोस अपशिष्ट मलबा स्थल (नगरों की संख्या/नाम/क्षमता)

विद्यमान मलबा स्थलों की कुल संख्या

पुनर्निर्मित/आच्छादित भरण स्थल

स्वास्थ्यकर भरण स्थल में परिवर्तित मलबा स्थल

अपशिष्ट प्रसंस्करण/भरण स्थलों पर निगरानी

क्रम सं.	सुविधाओं का नाम	परिवेशी वायु	भू जल	निक्षालन की गुणवत्ता	कंपोस्ट की गुणवत्ता	वीओसी
1.						
2.						
3.						

नगरपालिकाओं द्वारा तैयार की गई कार्य योजनाओं की स्थिति

नगरपालिकाओं की कुल संख्या:

प्रस्तुत की गई कार्य योजना की संख्या:

प्ररुप-VI

[नियम 25 देखें]

दुर्घटना का प्रतिवेदन

1.	दुर्घटना की तारीख और समय	:	
2.	दुर्घटना के लिए कारकों का अनुक्रम	:	
3.	दुर्घटना में शामिल अपशिष्ट	:	
4.	मानव स्वास्थ्य और पर्यावरण पर दुर्घटनाओं के प्रभावों का मूल्यांकन	:	
5.	किए गए आपातकालीन उपाय	:	
6.	दुर्घटनाओं के प्रभावों को कम करने के लिए उठाए गए कदम	:	
7.	ऐसी किसी दुर्घटना की पुनरावृत्ति को रोकने के लिए उठाए गए कदम	:	
तारीख		हस्ताक्षर	
स्थान		पदनाम	

[फा. सं.18-3/2004-एचएसएमडी]

विश्वनाथ सिन्हा, संयुक्त सचिव

MINISTRY OF ENVIRONMENT, FOREST AND CLIMATE CHANGE

NOTIFICATION

New Delhi, the 8th April, 2016

S.O. 1357(E).—Whereas the draft of the Solid Waste Management Rules, 2015 were published under the notification of the Government of India in the Ministry of Environment, Forest and Climate Change number G.S.R. 451 (E), dated the 3rd June, 2015 in the Gazette of India, part II, Section3, sub- section (i) of the same date inviting objections or suggestions from the persons likely to be affected thereby, before the expiry of the period of sixty days from the publication of the said notification on the Solid Waste Management Rules, 2015 in supersession of the Municipal Solid Waste (Management and Handling) Rules, 2000;

And whereas, copies of the said Gazette were made available to the public on the 3rd June, 2015;

And whereas, the objections or comments received within the stipulated period were duly considered by the Central Government;

Now, therefore, in exercise of the powers conferred by sections 3, 6 and 25 of the Environment (Protection) Act, 1986 (29 of 1986) and in supersession of the Municipal Solid Waste (Management and Handling) Rules, 2000, except as respect things done or omitted to be done before such supersession, the Central Government hereby makes the following rules for management of Solid Waste, namely:-

1. **Short title and commencement.-**

(1) These rules may be called the Solid Waste Management Rules, 2016.

(2) They shall come into force on the date of their publication in the Official Gazette.

2. **Application.-** These rules shall apply to every urban local body, outgrowths in urban agglomerations, census towns as declared by the Registrar General and Census Commissioner of India, notified areas, notified industrial townships, areas under the control of Indian Railways, airports, airbases, Ports and harbours, defence establishments, special economic zones, State and Central government organisations, places of pilgrims, religious and historical importance as may be notified by respective State government from time to time and to every domestic, institutional, commercial and any other non residential solid waste generator situated in the areas except industrial waste, hazardous waste, hazardous chemicals, bio medical wastes, e-waste, lead acid batteries and radio-active waste, that are covered under separate rules framed under the Environment (Protection) Act, 1986**.**

3. **Definitions –**(1) In these rules, unless the context otherwise requires,- (1) **"aerobic composting"** means a controlled process involving microbial decomposition of organic matter in the presence of oxygen;

2. **"anaerobic digestion"** means a controlled process involving microbial decomposition of organic matter in absence of oxygen;

3. **"authorisation"** means the permission given by the State Pollution Control Board or Pollution Control Committee, as the case may be, to the operator of a facility or urban local suthority, or any other agency responsible for processing and disposal of solid waste;

4. **"biodegradable waste "** means any organic material that can be degraded by micro-organisms into simpler stable compounds;

5. **"bio-methanation"** means a process which entails enzymatic decomposition of the organic matter by microbial action to produce methane rich biogas;

6. **"brand owner"** means a person or company who sells any commodity under a registered brand label.

7. "**buffer zone**" means zone of no development to be maintained around solid waste processing and disposal facility, exceeding 5 TPD of installed capacity. This will be maintained within total and area allotted for the solid waste processing and disposal facility.

8. **"bulk waste generator"** means and includes buildings occupied by the Central government departments or undertakings, State government departments or undertakings, local bodies, public sector undertakings or private companies, hospitals, nursing homes, schools, colleges, universities, other educational institutions, hostels, hotels, commercial establishments, markets, places of worship, stadia and sports complexes having an average waste generation rate exceeding 100kg per day**;**

9. **"bye-laws"** means regulatory framework notified by local body, census town and notified area townships for facilitating the implementation of these rules effectively in their jurisdiction**.**

10. **"census town"** means an urban area as defined by the Registrar General and Census Commissioner of India;

11. **"combustible waste"** means non-biodegradable, non-recyclable, non-reusable, non hazardous solid waste having minimum calorific value exceeding 1500 kcal/kg and excluding chlorinated materials like plastic, wood pulp, etc**;**

12. "**composting"** means a controlled process involving microbial decomposition of organic matter;

13. "**contractor**" means a person or firm that undertakes a contract to provide materials or labour to perform a service or do a job for service providing authority;

14. **"co-processing"** means use of non-biodegradable and non recyclable solid waste having calorific value exceeding 1500k/cal as raw material or as a source of energy or both to replace or supplement the natural mineral resources and fossil fuels in industrial processes;

15. **"decentralised processing"** means establishment of dispersed facilities for maximizing the processing of bio-degradable waste and recovery of recyclables closest to the source of generation so as to minimize transportation of waste for processing or disposal;

16. "**disposal"** means the final and safe disposal of post processed residual solid waste and inert street sweepings and silt from surface drains on land as specified in Schedule I to prevent contamination of ground water, surface water, ambient air and attraction of animals or birds;

17. **"domestic hazardous waste"** means discarded paint drums, pesticide cans, CFL bulbs, tube lights, expired medicines, broken mercury thermometers, used batteries, used needles and syringes and contaminated gauge, etc., generated at the household level;

18. **"door to door collection" m**eans collection of solid waste from the door step of households, shops, commercial establishments , offices , institutional or any other non residential premises and includes collection of such waste from entry gate or a designated location on the ground floor in a housing society , multi storied building or apartments , large residential, commercial or institutional complex or premises;**.**
19. **"dry waste"** means waste other than bio-degradable waste and inert street sweepings and includes recyclable and non recyclable waste, combustible waste and sanitary napkin and diapers, etc;
20. **"dump sites"** means a land utilised by local body for disposal of solid waste without following the principles of sanitary land filling;
21. **"extended producer responsibility" (EPR)** means responsibility of any producer of packaging products such as plastic, tin, glass and corrugated boxes, etc., for environmentally sound management, till end-of-life of the packaging products;
22. **"facility"** means any establishment wherein the solid waste management processes namely segregation, recovery, storage, collection, recycling, processing, treatment or safe disposal are carried out;
23. **"fine" means** penalty imposed on waste generators or operators of waste processing and disposal facilities under the bye-laws for non-compliance of the directions contained in these rules and/or bye- laws
24. **"Form"** means a F8orm appended to these rules;
25. **"handling"** includes all activities relating to sorting, segregation, material recovery, collection, secondary storage, shredding, baling, crushing, loading, unloading, transportation, processing and disposal of solid wastes;
26. **"inerts"** means wastes which are not bio-degradable, recyclable or combustible street sweeping or dust and silt removed from the surface drains;
27. **"incineration"** means an engineered process involving burning or combustion of solid waste to thermally degrade waste materials at high temperatures;
28. **"informal waste collector"** includes individuals, associations or waste traders who are involved in sorting, sale and purchase of recyclable materials;
29. "**leachate"** means the liquid that seeps through solid waste or other medium and has extracts of dissolved or suspended material from it;
30. **" local body"** for the purpose of these rules means and includes the municipal corporation, nagar nigam, municipal council, nagarpalika, nagar Palikaparishad, municipal board, nagar panchayat and town panchayat, census towns, notified areas and notified industrial townships with whatever name they are called in different States and union territories in India;
31. "**materials recovery facility" (MRF)** means a facility where non-compostable solid waste can be temporarily stored by the local body or any other entity mentioned in rule 2 or any person or agency authorised by any of them to facilitate segregation, sorting and recovery of recyclables from various components of waste by authorised informal sector of waste pickers, informal recyclers or any other work force engaged by the local body or entity mentioned in rule 2for the purpose before the waste is delivered or taken up for its processing or disposal;
32. **"non-biodegradable waste"** means any waste that cannot be degraded by micro organisms into simpler stable compounds;
33. **"operator of a facility"** means a person or entity, who owns or operates a facility for handling solid waste which includes the local body and any other entity or agency appointed by the local body;
34. **primary collection"** means collecting, lifting and removal of segregated solid waste from source of its generation including households, shops, offices and any other non-residential premises or from any collection points or any other location specified by the local body;
35. "**processing"** means any scientific process by which segregated solid waste is handled for the purpose of reuse, recycling or transformation into new products**;**
36. **"recycling**" means the process of transforming segregated non-biodegradable solid waste into new material or product or as raw material for producing new products which may or may not be similar to the original products;
37. **"redevelopment"** means rebuilding of old residential or commercial buildings at the same site, where the existing buildings and other infrastructures have become dilapidated;

38. **"refused derived fuel**"(RDF) means fuel derived from combustible waste fraction of solid waste like plastic, wood, pulp or organic waste, other than chlorinated materials, in the form of pellets or fluff produced by drying, shredding, dehydrating and compacting of solid waste ;

39. "**residual solid waste"** means and includes the waste and rejects from the solid waste processing facilities which are not suitable for recycling or further processing;

40. **"sanitary land filling "** means the final and safe disposal of residual solid waste and inert wastes on land in a facility designed with protective measures against pollution of ground water, surface water and fugitive air dust, wind-blown litter, bad odour, fire hazard, animal menace, bird menace, pests or rodents, greenhouse gas emissions, persistent organic pollutants slope instability and erosion;

41. **"sanitary waste"** means wastes comprising of used diapers, sanitary towels or napkins, tampons, condoms, incontinence sheets and any other similar waste;

42. **"Schedule"** means the Schedule appended to these rules;

43. "**secondary storage**" means the temporary containment of solid waste after collection at secondary waste storage depots or MRFs or bins for onward transportation of the waste to the processing or disposal facility;

44. **"segregation"** means sorting and separate storage of various components of solid waste namely biodegradable wastes including agriculture and dairy waste, non biodegradable wastes including recyclable waste, non-recyclable combustible waste, sanitary waste and non recyclable inert waste, domestic hazardous wastes, and construction and demolition wastes;

45. **"service provider"** means an authority providing public utility services like water, sewerage, electricity, telephone, roads, drainage, etc;

46. **"solid waste"** means and includes solid or semi-solid domestic waste, sanitary waste, commercial waste, institutional waste, catering and market waste and other non residential wastes, street sweepings, silt removed or collected from the surface drains, horticulture waste, agriculture and dairy waste, treated bio-medical waste excluding industrial waste, bio-medical waste and e-waste, battery waste, radio-active waste generated in the area under the local authorities and other entities mentioned in rule 2;

47. **"sorting"** means separating various components and categories of recyclables such as paper, plastic, card-boards, metal, glass, etc., from mixed waste as may be appropriate to facilitate recycling;

48. **"stabilising"** means the biological decomposition of biodegradable wastes to a stable state where it generates no leachate or offensive odours and is fit for application to farm land ,soil erosion control and soil remediation;

49. **"street vendor"** means any person engaged in vending of articles, goods, wares, food items or merchandise of everyday use or offering services to the general public, in a street, lane, side walk, footpath, pavement, public park or any other public place or private area, from a temporary built up structure or by moving from place to place and includes hawker, peddler, squatter and all other synonymous terms which may be local or region specific; and the words "street vending" with their grammatical variations and cognate expressions, shall be construed accordingly;

50. **"tipping fee"** means a fee or support price determined by the local authorities or any state agency authorised by the State government to be paid to the concessionaire or operator of waste processing facility or for disposal of residual solid waste at the landfill;

51. **"transfer station"** means a facility created to receive solid waste from collection areas and transport in bulk in covered vehicles or containers to waste processing and, or, disposal facilities;

52. **"transportation"** means conveyance of solid waste, either treated, partly treated or untreated from a location to another location in an environmentally sound manner through specially designed and covered transport system so as to prevent the foul odour, littering and unsightly conditions;

53. **"treatment"** means the method, technique or process designed to modify physical, chemical or biological characteristics or composition of any waste so as to reduce its volume and potential to cause harm;

54. **"user fee"** means a fee imposed by the local body and any entity mentioned in rule 2 on the waste generator to cover full or part cost of providing solid waste collection, transportation, processing and disposal services.

55. "**vermi composting"** means the process of conversion of bio-degradable waste into compost using earth worms;

56. "**waste generator**" means and includes every person or group of persons, every residential premises and non residential establishments including Indian Railways, defense establishments, which generate solid waste;

57. **"waste hierarchy"** means the priority order in which the solid waste is to should be managed by giving

emphasis to prevention, reduction, reuse, recycling, recovery and disposal, with prevention being the most preferred option and the disposal at the landfill being the least;

58. **"waste picker"** means a person or groups of persons informally engaged in collection and recovery of reusable and recyclable solid waste from the source of waste generation the streets, bins, material recovery facilities, processing and waste disposal facilities for sale to recyclers directly or through intermediaries to earn their livelihood.

(2) Words and expressions used herein but not defined, but defined in the Environment (Protection) Act, 1986, the Water (Prevention and Control of Pollution) Act, 1974, Water (Prevention and Control of Pollution) Cess Act, 1977 and the Air (prevention and Control of Pollution) Act, 1981 shall have the same meaning as assigned to them in the respective Acts.

4 Duties of waste generators.- (1) Every waste generator shall,-

(a) segregate and store the waste generated by them in three separate streams namely bio-degradable, non bio-degradable and domestic hazardous wastes in suitable bins and handover segregated wastes to authorised waste pickers or waste collectors as per the direction or notification by the local authorities from time to time;

(b) wrap securely the used sanitary waste like diapers, sanitary pads etc., in the pouches provided by the manufacturers or brand owners of these products or in a suitable wrapping material as instructed by the local authorities and shall place the same in the bin meant for dry waste or non- bio-degradable waste;

(c) store separately construction and demolition waste, as and when generated, in his own premises and shall dispose off as per the Construction and Demolition Waste Management Rules, 2016; and

(d) store horticulture waste and garden waste generated from his premises separately in his own premises and dispose of as per the directions of the local body from time to time.

(2) No waste generator shall throw**,** burn or burry the solid waste generated by him, on streets, open public spaces outside his premises or in the drain or water bodies.

(3) All waste generators shall pay such user fee for solid waste management, as specified in the bye-laws of the local bodies.

(4) No person shall organise an event or gathering of more than one hundred persons at any unlicensed place without intimating the local body, at least three working days in advance and such person or the organiser of such event shall ensure segregation of waste at source and handing over of segregated waste to waste collector or agency as specified by the local body.

(5) Every street vendor shall keep suitable containers for storage of waste generated during the course of his activity such as food waste, disposable plates, cups, cans, wrappers, coconut shells, leftover food, vegetables, fruits, etc., and shall deposit such waste at waste storage depot or container or vehicle as notified by the local body**.**

(6) All resident welfare and market associations shall, within one year from the date of notification of these rules and in partnership with the local body ensure segregation of waste at source by the generators as prescribed in these rules, facilitate collection of segregated waste in separate streams, handover recyclable material to either the authorised waste pickers or the authorised recyclers. The bio-degradable waste shall be processed, treated and disposed off through composting or bio-methanation within the premises as far as possible. The residual waste shall be given to the waste collectors or agency as directed by the local body.

(7) All gated communities and institutions with more than 5,000 sqm area shall, within one year from the date of notification of these rules and in partnership with the local body, ensure segregation of waste at source by the generators as prescribed in these rules, facilitate collection of segregated waste in separate streams, handover recyclable material to either the authorised waste pickers or the authorizsd recyclers. The bio-degradable waste shall be processed, treated and disposed off through composting or bio-methanation within the premises as far as possible. The residual waste shall be given to the waste collectors or agency as directed by the local body.

(8) All hotels and restaurants shall, within one year from the date of notification of these rules and in partnership with the local body ensure segregation of waste at source as prescribed in these rules, facilitate collection of segregated waste in separate streams, handover recyclable material to either the authorised waste pickers or the authorised recyclers. The bio-degradable waste shall be processed, treated and disposed off through composting or bio-methanation within the premises as far as possible. The residual waste shall be given to the waste collectors or agency as directed by the local body.

5. Duties of Ministry of Environment, Forest and Climate Change.- (1) The Ministry of Environment, Forest and Climate Change shall be responsible for over all monitoring the implementation of these rules in the country. It shall constitute a Central Monitoring Committee under the Chairmanship of Secretary, Ministry of Environment, Forest and Climate Change comprising officer not below the rank of Joint Secretary or Advisor from the following namely,-

1) Ministry of Urban Development

2) Ministry of Rural Development

3) Ministry of Chemicals and Fertilizers

4) Ministry of Agriculture

5) Central Pollution Control Board

6) Three State Pollution Control Boards or Pollution Control Committees by rotation

7) Urban Development Departments of three State Governments by rotation

8) Rural Development Departments from two State Governments by rotation

9) Three Urban Local bodies by rotation

10) Two census towns by rotation

11) FICCI, CII

12) Two subject experts

2. This Central Monitoring Committee shall meet at least once in a year to monitor and review the implementation of these rules. The Ministry of Environment, Forest and Climate Change may co-opt other experts, if needed. The Committee shall be renewed every three years.

6. Duties of Ministry of Urban Development.- (1) The Ministry of Urban Development shall coordinate with State Governments and Union territory Administrations to,-

(a) take periodic review of the measures taken by the states and local bodies for improving solid waste management practices and execution of solid waste management projects funded by the Ministry and external agencies at least once in a year and give advice on taking corrective measures;

(b) formulate national policy and strategy on solid waste management including policy on waste to energy in consultation with stakeholders within six months from the date of notification of these rules;

(c) facilitate States and Union Territories in formulation of state policy and strategy on solid management based on national solid waste management policy and national urban sanitation policy;

(d) promote research and development in solid waste management sector and disseminate information to States and local bodies;

(e) undertake training and capacity building of local bodies and other stakeholders;and

(f) provide technical guidelines and project finance to states, Union territories and local bodies on solid waste management to facilitate meeting timelines and standards.

7. Duties of Department of Fertilisers, Ministry of Chemicals and Fertilisers.- (1) The Department of Fertilisers through appropriate mechanisms shall,-

(a) provide market development assistance on city compost; and

(b) ensure promotion of co-marketing of compost with chemical fertilisers in the ratio of 3 to 4 bags: 6 to 7 bags by the fertiliser companies to the extent compost is made availablefor marketing to the companies.

8. Duties of Ministry of Agriculture, Government of India.- The Ministry of Agriculture through appropriate mechanisms shall,-

(a) provide flexibility in Fertiliser Control Order for manufacturing and sale of compost;

(b) propagate utlisation of compost on farm land;

(c) set up laboratories to test quality of compost produced by local authorities or their authorised agencies; and

(d) issue suitable guidelines for maintaining the quality of compost and ratio of use of compost visa-a-vis chemical fertilizers while applying compost to farmland.

9. Duties of the Ministry of Power.-The Ministry of Power through appropriate mechanisms shall,-

(a) decide tariff or charges for the power generated from the waste to energy plants based on solid waste.

(b) compulsory purchase power generated from such waste to energy plants by distribution company.

10. Duties of Ministry of New and Renewable Energy Sources- The Ministry of New and Renewable Energy Sources through appropriate mechanisms shall,-

(a) facilitate infrastructure creation for waste to energy plants; and

(b) provide appropriate subsidy or incentives for such waste to energy plants.

11. Duties of the Secretary–in-charge, Urban Development in the States and Union territories.- (1) The Secretary, Urban Development Department in the State or Union territory through the Commissioner or Director of Municipal Administration or Director of local bodies shall,-

(a) prepare a state policy and solid waste management strategy for the state or the union territory in consultation with stakeholders including representative of waste pickers**,** self help group and similar groups working in the field of waste management consistent with these rules, national policy on solid waste management and national urban sanitation policy of the ministry of urban development, in a period not later than one year from the date of notification of these rules;

(b) while preparing State policy and strategy on solid waste management, lay emphasis on waste reduction, reuse, recycling, recovery and optimum utilisation of various components of solid waste to ensure minimisation of waste going to the landfill and minimise impact of solid waste on human health and environment;

(c) state policies and strategies should acknowledge the primary role played by the informal sector of waste pickers, waste collectors and recycling industry in reducing waste and provide broad guidelines regarding integration of waste picker or informal waste collectors in the waste management system.

(d) ensure implementation of provisions of these rules by all local authorities;

(e) direct the town planning department of the State to ensure that master plan of every city in the State or Union territory provisions for setting up of solid waste processing and disposal facilities except for the cities who are members of common waste processing facility or regional sanitary landfill for a group of cities; and

(f) ensure identification and allocation of suitable land to the local bodies within one year for setting up of processing and disposal facilities for solid wastes and incorporate them in the master plans (land use plan) of the State or as the case may be, cities through metropolitan and district planning committees or town and country planning department;

(h) direct the town planning department of the State and local bodies to ensure that a separate space for segregation, storage, decentralised processing of solid waste is demarcated in the development plan for group housing or commercial, institutional or any other non-residential complex exceeding 200 dwelling or having a plot area exceeding 5,000 square meters;

(i) direct the developers of Special Economic Zone, Industrial Estate, Industrial Park to earmark at least five percent of the total area of the plot or minimum five plots or sheds for recovery and recycling facility.

(j) facilitate establishment of common regional sanitary land fill for a group of cities and towns falling within a distance of 50 km (or more) from the regional facility on a cost sharing basis and ensure professional management of such sanitary landfills;

(k) arrange for capacity building of local bodies in managing solid waste, segregation and transportation or processing of such waste at source;

(l) notify buffer zone for the solid waste processing and disposal facilities of more than five tons per day in consultation with the State Pollution Control Board; and

(m) start a scheme on registration of waste pickers and waste dealers.

12. Duties of District Magistrate or District Collector or Deputy Commissioner.- The District Magistrate or District Collector or as the case may be , the Deputy Commissioner shall, -

(a) facilitate identification and allocation of suitable land as per clause (f) of rules 11 for setting up solid waste processing and disposal facilities to local authorities in his district in close coordination with the Secretary-in-charge of State Urban Development Department within one year from the date of notification of these rules;

(b) review the performance of local bodies, at least once in a quarter on waste segregation, processing, treatment and disposal and take corrective measures in consultation with the Commissioner or Director of Municipal Administration or Director of local bodies and secretary-in-charge of the State Urban Development.

13. Duties of the Secretary–in-charge of Village Panchayats or Rural Development Department in the State and Union territory.- (1) The Secretary–in-charge of Village Panchayats or Rural Development Department in the State and Union territory shall have the same duties as the Secretary–in-charge, Urban Development in the States and Union territories, for the areas which are covered under these rules and are under their jurisdictions.

14. Duties of Central Pollution Control Board.-The Central Pollution Control Board shall, -

(a) co-ordinate with the State Pollution Control Boards and the Pollution Control Committees for implementation of these rules and adherence to the prescribed standards by local authorities;

(b) formulate the standards for ground water, ambient air, noise pollution, leachate in respect of all solid waste processing and disposal facilities;

(c) review environmental standards and norms prescribed for solid waste processing facilities or treatment technologies and update them as and when required;

(d) review through State Pollution Control Boards or Pollution Control Committees, at least once in a year, the implementation of prescribed environmental standards for solid waste processing facilities or treatment technologies and compile the data monitored by them;

(e) review the proposals of State Pollution Control Boards or Pollution Control Committees on use of any new technologies for processing, recycling and treatment of solid waste and prescribe performance standards, emission norms for the same within 6 months;

(f) monitor through State Pollution Control Boards or Pollution Control Committees the implementation of these rules by local bodies;

(g) prepare an annual report on implementation of these rules on the basis of reports received from State Pollution Control Boards and Committees and submit to the Ministry of Environment, Forest and Climate Change and the report shall also be put in public domain;

(h) publish guidelines for maintaining buffer zone restricting any residential, commercial or any other construction activity from the outer boundary of the waste processing and disposal facilities for different sizes of facilities handling more than five tons per day of solid waste;

(i) publish guidelines, from time to time, on environmental aspects of processing and disposal of solid waste to enable local bodies to comply with the provisions of these rules; and

(j) provide guidance to States or Union territories on inter-state movement of waste.

15. Duties and responsibilities of local authorities and village Panchayats of census towns and urban agglomerations.- The local authorities and Panchayats shall,-

(a) prepare a solid waste management plan as per state policy and strategy on solid waste management within six months from the date of notification of state policy and strategy and submit a copy to respective departments of State Government or Union territory Administration or agency authorised by the State Government or Union territory Administration;

(b) arrange for door to door collection of segregated solid waste from all households including slums and informal settlements, commercial, institutional and other non residential premises. From multi-storage buildings, large commercial complexes, malls, housing complexes, etc., this may be collected from the entry gate or any other designated location;

(c) establish a system to recognise organisations of waste pickers or informal waste collectors and promote and establish a system for integration of these authorised waste-pickers and waste collectors to facilitate their participation in solid waste management including door to door collection of waste;

(d) facilitate formation of Self Help Groups, provide identity cards and thereafter encourage integration in solid waste management including door to door collection of waste;

(e) frame bye-laws incorporating the provisions of these rules within one year from the date of notification of these rules and ensure timely implementation;

(f) prescribe from time to time user fee as deemed appropriate and collect the fee from the waste generators on its own or through authorised agency;

(g) direct waste generators not to litter i.e throw or dispose of any waste such as paper, water bottles, liquor bottles, soft drink canes, tetra packs, fruit peel, wrappers, etc., or burn or burry waste on streets, open public spaces, drains, waste bodies and to segregate the waste at source as prescribed under these rules and hand over the segregated waste to authorised the waste pickers or waste collectors authorised by the local body;

(h) setup material recovery facilities or secondary storage facilities with sufficient space for sorting of recyclable materials to enable informal or authorised waste pickers and waste collectors to separate recyclables from the waste and provide easy access to waste pickers and recyclers for collection of segregated recyclable waste such as paper, plastic, metal, glass, textile from the source of generation or from material recovery facilities; Bins for storage of bio-degradable wastes shall be painted green, those for storage of recyclable wastes shall be printed white and those for storage of other wastes shall be printed black;

(i) establish waste deposition centres for domestic hazardous waste and give direction for waste generators to deposit domestic hazardous wastes at this centre for its safe disposal. Such facility shall be established in a city or town in a manner that one centre is set up for the area of twenty square kilometers or part thereof and notify the timings of receiving domestic hazardous waste at such centres;

(j) ensure safe storage and transportation of the domestic hazardous waste to the hazardous waste disposal facility or as may be directed by the State Pollution Control Board or the Pollution Control Committee;

(k) direct street sweepers not to burn tree leaves collected from street sweeping and store them separately and handover to the waste collectors or agency authorised by local body;

(l) provide training on solid waste management to waste-pickers and waste collectors;

(m) collect waste from vegetable, fruit, flower, meat, poultry and fish market on day to day basis and promote setting up of decentralised compost plant or bio-methanation plant at suitable locations in the markets or in the vicinity of markets ensuring hygienic conditions;

(n) collect separately waste from sweeping of streets, lanes and by-lanes daily, or on alternate days or twice a week depending on the density of population, commercial activity and local situation;

(o) set up covered secondary storage facility for temporary storage of street sweepings and silt removed from surface drains in cases where direct collection of such waste into transport vehicles is not convenient. Waste so collected shall be collected and disposed of at regular intervals as decided by the local body;

(p) collect horticulture, parks and garden waste separately and process in the parks and gardens, as far as possible;

(q) transport segregated bio-degradable waste to the processing facilities like compost plant, bio-methanation plant or any such facility. Preference shall be given for on site processing of such waste;

(r) transport non-bio-degradable waste to the respective processing facility or material recovery facilities or secondary storage facility;

(s) transport construction and demolition waste as per the provisions of the Construction and Demolition Waste management Rules, 2016;

(t) involve communities in waste management and promotion of home composting, bio-gas generation, decentralised processing of waste at community level subject to control of odour and maintenance of hygienic conditions around the facility;

(u) phase out the use of chemical fertilizer in two years and use compost in all parks, gardens maintained by the local body and wherever possible in other places under its jurisdiction. Incentives may be provided to recycling initiatives by informal waste recycling sector.

(v) facilitate construction, operation and maintenance of solid waste processing facilities and associated infrastructure on their own or with private sector participation or through any agency for optimum utilisation of various components of solid waste adopting suitable technology including the following technologies and adhering to the guidelines issued by the Ministry of Urban Development from time to time and standards prescribed by the Central Pollution Control Board. Preference shall be given to decentralised processing to minimize transportation cost and environmental impacts such as-

a) bio-methanation, microbial composting, vermi-composting, anaerobic digestion or any other appropriate processing for bio-stabilisation of biodegradable wastes;

b) waste to energy processes including refused derived fuel for combustible fraction of waste or supply as feedstock to solid waste based power plants or cement kilns;

(w) undertake on their own or through any other agency construction, operation and maintenance of sanitary landfill and associated infrastructure as per Schedule 1 for disposal of residual wastes in a manner prescribed under these rules;

(x) make adequate provision of funds for capital investments as well as operation and maintenance of solid waste management services in the annual budget ensuring that funds for discretionary functions of the local body have been allocated only after meeting the requirement of necessary funds for solid waste management and other obligatory functions of the local body as per these rules;

(y) make an application in Form-I for grant of authorisation for setting up waste processing, treatment or disposal facility, if the volume of waste is exceeding five metric tones per day including sanitary landfills from the State Pollution Control Board or the Pollution Control Committee, as the case may be;

(z) submit application for renewal of authorisation at least sixty days before the expiry of the validity of authorisation;

(za) prepare and submit annual report in Form IV on or before the 30th April of the succeeding year to the Commissioner or Director, Municipal Administration or designated Officer;

(zb) the annual report shall then be sent to the Secretary -in-Charge of the State Urban Development Department or village panchayat or rural development department and to the respective State Pollution Control Board or Pollution Control Committee by the 31st May of every year;

(zc) educate workers including contract workers and supervisors for door to door collection of segregated waste and transporting the unmixed waste during primary and secondary transportation to processing or disposal facility;

(zd) ensure that the operator of a facility provides personal protection equipment including uniform, fluorescent jacket, hand gloves, raincoats, appropriate foot wear and masks to all workers handling solid waste and the same are used by the workforce;

(ze) ensure that provisions for setting up of centers for collection, segregation and storage of segregated wastes, are incorporated in building plan while granting approval of building plan of a group housing society or market complex; and

(zf) frame bye-laws and prescribe criteria for levying of spot fine for persons who litters or fails to comply with the provisions of these rules and delegate powers to officers or local bodies to levy spot fines as per the bye laws framed; and

(zg) create public awareness through information, education and communication campaign and educate the waste generators on the following; namely:-

(i) not to litter;

(ii) minimise generation of waste;

(iii) reuse the waste to the extent possible;

(iv) practice segregation of waste into bio–degradable, non-biodegradable (recyclable and combustible), sanitary waste and domestic hazardous wastes at source;

(v) practice home composting, vermi-composting, bio-gas generation or community level composting;

(vi) wrap securely used sanitary waste as and when generated in the pouches provided by the brand owners or a suitable wrapping as prescribed by the local body and place the same in the bin meant for non-biodegradable waste;

(vii) storage of segregated waste at source in different bins;

(viii) handover segregated waste to waste pickers, waste collectors, recyclers or waste collection agencies; and

(ix) pay monthly user fee or charges to waste collectors or local bodies or any other person authorised by the local body for sustainability of solid waste management.

(zh) stop land filling or dumping of mixed waste soon after the timeline as specified in rule 23 for setting up and operationalisation of sanitary landfill is over;

(zi) allow only the non-usable, non-recyclable, non-biodegradable, non-combustible and non-reactive inert waste and pre-processing rejects and residues from waste processing facilities to go to sanitary landfill and the sanitary landfill sites shall meet the specifications as given in Schedule–I, however, every effort shall be made to recycle or reuse the rejects to achieve the desired objective of zero waste going to landfill;

(zj) investigate and analyse all old open dumpsites and existing operational dumpsites for their potential of bio-mining and bio-remediation and wheresoever feasible, take necessary actions to bio-mine or bio-remediate the sites;

(zk) in absence of the potential of bio-mining and bio-remediation of dumpsite, it shall be scientifically capped as per landfill capping norms to prevent further damage to the environment.

16. Duties of State Pollution Control Board or Pollution Control Committee.- (1) The State Pollution Control Board or Pollution Control Committee shall,-

(a) enforce these rules in their State through local bodies in their respective jurisdiction and review implementation of these rules at least twice a year in close coordination with concerned Directorate of Municipal Administration or Secretary-in-charge of State Urban Development Department;

(b) monitor environmental standards and adherence to conditions as specified under the Schedule I and Schedule II for waste processing and disposal sites;

(c) examine the proposal for authorisation and make such inquiries as deemed fit, after the receipt of the application for the same in Form I from the local body or any other agency authorised by the local body;

(d) while examining the proposal for authorisation, the requirement of consents under respective enactments and views of other agencies like the State Urban Development Department, the Town and Country Planning Department, District Planning Committee or Metropolitan Area Planning Committee, as may be applicable, Airport or Airbase Authority, the Ground Water Board, Railways, power distribution companies, highway department and other relevant agencies shall be taken into consideration and they shall be given four weeks time to give their views, if any;

(e) issue authorisation within a period of sixty days in Form II to the local body or an operator of a facility or any other agency authorised by local body stipulating compliance criteria and environmental standards as specified in Schedules I and II including other conditions, as may be necessary;

(f) synchronise the validity of said authorisation with the validity of the consents;

(g) suspend or cancel the authorization issued under clause (a) any time, if the local body or operator of the facility fails to operate the facility as per the conditions stipulated:

provided that no such authorization shall be suspended or cancelled without giving notice to the local body or operator, as the case may be; and

(h) on receipt of application for renewal, renew the authorisation for next five years, after examining every application on merit and subject to the condition that the operator of the facility has fulfilled all the provisions of the rules, standards or conditions specified in the authorisation, consents or environment clearance.

(2) The State Pollution Control Board or Pollution Control Committee shall, after giving reasonable opportunity of being heard to the applicant and for reasons thereof to be recorded in writing, refuse to grant or renew an authorisation.

(3) In case of new technologies, where no standards have been prescribed by the Central Pollution Control Board, State Pollution Control Board or Pollution Control Committee, as the case may be, shall approach Central Pollution Control Board for getting standards specified.

(4) The State Pollution Control Board or the Pollution Control Committee, as the case may be, shall monitor the compliance of the standards as prescribed or laid down and treatment technology as approved and the conditions stipulated in the authorisation and the standards specified in Schedules I and II under these rules as and when deemed appropriate but not less than once in a year.

(5) The State Pollution Control Board or the Pollution Control Committee may give directions to local bodies for safe handling and disposal of domestic hazardous waste deposited by the waste generators at hazardous waste deposition facilities.

(6) The State Pollution Control Board or the Pollution Control Committee shall regulate Inter-State movement of waste.

17. Duty of manufacturers or brand owners of disposable products and sanitary napkins and diapers.- (1) All manufacturers of disposable products such as tin, glass, plastics packaging, etc., or brand owners who introduce such products in the market shall provide necessary financial assistance to local authorities for establishment of waste management system.

(2) All such brand owners who sell or market their products in such packaging material which are non-biodegradable shall put in place a system to collect back the packaging waste generated due to their production.

(3) Manufacturers or brand owners or marketing companies of sanitary napkins and diapers shall explore the possibility of using all recyclable materials in their products or they shall provide a pouch or wrapper for disposal of each napkin or diapers along with the packet of their sanitary products.

(4) All such manufacturers, brand owners or marketing companies shall educate the masses for wrapping and disposal of their products.

18. Duties of the industrial units located within one hundred km from the refused derived fuel and waste to energy plants based on solid waste- All industrial units using fuel and located within one hundred km from a solid waste based refused derived fuel plant shall make arrangements within six months from the date of notification of these rules to replace at least five percent of their fuel requirement by refused derived fuel so produced.

19. Criteria for Duties regarding setting-up solid waste processing and treatment facility.- (1) The department in- charge of the allocation of land assignment shall be responsible for providing suitable land for setting up of the solid waste processing and treatment facilities and notify such sites by the State Government or Union territory Administration.

(2) The operator of the facility shall design and set up the facility as per the technical guidelines issued by the Central Pollution Control Board in this regard from time to time and the manual on solid waste management prepared by the Ministry of Urban Development.

(3) The operator of the facility shall obtain necessary approvals from the State Pollution Control Board or Pollution Control Committee.

(4) The State Pollution Control Board or Pollution Control Committee shall monitor the environment standards of the operation of the solid waste processing and treatment facilities.

(5) The operator of the facility shall be responsible for the safe and environmentally sound operations of the solid waste processing and or treatment facilities as per the guidelines issued by the Central Pollution Control Board from time to time and the Manual on Municipal Solid Waste Management published by the Ministry of Urban Development and updated from time to time.

(6) The operator of the solid waste processing and treatment facility shall submit annual report in Form III each year by 30th April to the State Pollution Control Board or Pollution Committee and concerned local body.

20. Criteria and actions to be taken for solid waste management in hilly areas.- In the hilly areas, the duties and responsibilities of the local authorities shall be the same as mentioned in rule 15 with additional clauses as under:

(a) Construction of landfill on the hill shall be avoided. A transfer station at a suitable enclosed location shall be setup to collect residual waste from the processing facility and inert waste. A suitable land shall be identified in the plain areas down the hill within 25 kilometers for setting up sanitary landfill. The residual waste from the transfer station shall be disposed of at this sanitary landfill.

(b) In case of non-availability of such land, efforts shall be made to set up regional sanitary landfill for the inert and residual waste.

(c) Local body shall frame Bye-laws and prohibit citizen from littering wastes on the streets and give strict direction to the tourists not to dispose any waste such as paper, water bottles, liquor bottles, soft drink canes, tetra packs, any other plastic or paper waste on the streets or down the hills and instead direct to deposit such waste in the litter bins that shall be placed by the local body at all tourist destinations.

(d) Local body shall arrange to convey the provisions of solid waste management under the bye-laws to all tourists visiting the hilly areas at the entry point in the town as well as through the hotels, guest houses or like where they stay and by putting suitable hoardings at tourist destinations.

(e) Local body may levy solid waste management charge from the tourist at the entry point to make the solid waste management services sustainable.

(f) The department in- charge of the allocation of land assignment shall identify and allot suitable space on the hills for setting up decentralised waste processing facilities. Local body shall set up such facilities. Step garden system may be adopted for optimum utilisation of hill space.

21. Criteria for waste to energy process.- (1) Non recyclable waste having calorific value of 1500 K/cal/kg or more shall not be disposed of on landfills and shall only be utilised for generating energy either or through refuse derived fuel or by giving away as feed stock for preparing refuse derived fuel.

(2) High calorific wastes shall be used for co-processing in cement or thermal power plants.

(3) The local body or an operator of facility or an agency designated by them proposing to set up waste to energy plant of more than five tones per day processing capacity shall submit an application in Form-I to the State Pollution Control Board or Pollution Control Committee, as the case may be, for authorisation.

(4) The State Pollution Control Board or Pollution Control Committee, on receiving such application for setting up waste to energy facility, shall examine the same and grant permission within sixty days.

22. Time frame for implementation.- Necessary infrastructure for implementation of these rules shall be created by the local bodies and other concerned authorities, as the case may be, on their own, by directly or engaging agencies within the time frame specified below:

Sl. No.	Activity	Time limit from the date of notification of rules
(1)	(2)	(3)
1.	identification of suitable sites for setting up solid waste processing facilities	1 year

2.	identification of suitable sites for setting up common regional sanitary landfill facilities for suitable clusters of local authorities under 0.5 million population and for setting up common regional sanitary landfill facilities or stand alone sanitary landfill facilities by all local authorities having a population of 0.5 million or more .	1 year
3.	procurement of suitable sites for setting up solid waste processing facility and sanitary landfill facilities	2 years
4.	enforcing waste generators to practice segregation of bio degradable, recyclable, combustible, sanitary waste domestic hazardous and inert solid wastes at source ,	2 years
5.	Ensure door to door collection of segregated waste and its transportation in covered vehicles to processing or disposal facilities.	2 years
6.	ensure separate storage, collection and transportation of construction and demolition wastes	2 years
7.	setting up solid waste processing facilities by all local bodies having 100000 or more population	2 years
8.	Setting up solid waste processing facilities by local bodies and census towns below 100000 population.	3 years
9	setting up common or stand alone sanitary landfills by or for all local bodies having 0.5 million or more population for the disposal of only such residual wastes from the processing facilities as well as untreatable inert wastes as permitted under the Rules	3 years
10.	setting up common or regional sanitary landfills by all local bodies and census towns under 0.5 million population for the disposal of permitted waste under the rules	3years
11.	bio-remediation or capping of old and abandoned dump sites	5years

23. State Level Advisory Body. – (1) Every Department in-charge of local bodies of the concerned State Government or Union territory administration shall constitute a State Level Advisory Body within six months from the date of notification of these rules comprising the following members, namely:-

Sl. No	**Designation**	**Member**
(1)	**(2)**	**(3)**
1.	Secretary, Department of Urban Development orLocal self government department of the State	Chairperson, ex-officio
2.	One representative of Panchayats or Rural development Department not below the rank of Joint Secretary to State Government	Member, ex-officio
3.	one representative of Revenue Department of State Government	Member,ex-officio
4.	One representative from Ministry of Environment, Forest and Climate Change Government of India	Member, ex-officio

5.	One representative from Ministry of Urban Development, Government of India	Member, ex-officio
6.	One representative from Ministry of Rural Development, Government of India	Member, ex-officio
7.	One representative from the Central Pollution Control Board	Member, ex-officio
8.	One representative from the State Pollution Control Board or Pollution Control Committee	Member, ex-officio
9.	One representative from Indian Institute of Technology or National Institute of Technology	Member,Ex-officio
10.	Chief town planner of the state	Member
11.	Three representatives from the local bodies by rotation	Member
12.	Two representatives from census towns or urban agglomerations by rotation.	Member
13.	One representative from reputed Non-Governmental Organisation or Civil Society working for the waste pickers or informal recycler or solid waste management	Member
14.	One representative from a body representing Industries at the State or Central level	Member
15.	one representative from waste recycling industry	member
16.	Two subject experts	Member
17.	Co-opt one representative each from agriculture department, and labour department of State Government.	Member

(2) The State Level Advisory Body shall meet at least one in every six months to review the matters related to implementation of these rules, state policy and strategy on solid waste management and give advice to state government for taking measures that are necessary for expeditious and appropriate implementation of these rules.

(3) The copies of the review report shall be forwarded to the State Pollution Control Board or Pollution Control Committee for necessary action.

24. Annual report.- (1) The operator of facility shall submit the annual report to the local body in Form-III on or before the 30th day of April every year.

(2) The local body shall submit its annual report in Form-IV to State P Control Board or P Committee and the Secretary-in-Charge of the Department of Urban Development of the concerned State or Union Territory in case of metropolitan city and to the Director of Municipal Administration or Commissioner of Municipal Administration or Officer in -Charge of Urban local bodies in the state in case of all other local bodies of state on or before the 30th day of June every year

(3) Each State Pollution Control Board or Pollution Control Committee as the case may be, shall prepare and submit the consolidated annual report to the Central Pollution Control Board and Ministry of Urban Development on the implementation of these rules and action taken against non complying local body by the 31stday of July of each year in Form-V.

(4) The Central Pollution Control Board shall prepare a consolidated annual review report on the status of implementation of these rules by local bodies in the country and forward the same to the Ministry of Urban Development

and Ministry of Environment, Forest and Climate Change, along with its recommendations before the 31st day of August each year.

(5) The annual report shall be reviewed by the Ministry of Environment, Forest and Climate Change during the meeting of Central Monitoring Committee.

25. Accident reporting- In case of an accident at any solid waste processing or treatment or disposal facility or landfill site, the Officer- in- charge of the facility shall report to the local body in Form-VI and the local body shall review and issue instructions if any, to the in- charge of the facility.

SCHEDULE I

[see rule 15 (w),(zi), 16 (1) (b) (e), 16 (4)]

Specifications for Sanitary Landfills

(A) Criteria for site selection.-

(i) The department in the business allocation of land assignment shall provide suitable site for setting up of the solid waste processing and treatment facilities and notify such sites.

(ii) The sanitary landfill site shall be planned, designed and developed with proper documentation of construction plan as well as a closure planin a phased manner. In case a new landfill facility is being established adjoining an existing landfill site, the closure plan of existing landfill should form a part of the proposal of such new landfill.

(iii) The landfill sites shall be selected to make use of nearby wastes processing facilities. Otherwise, wastes processing facility shall be planned as an integral part of the landfill site.

(iv) Landfill sites shall be set up as per the guidelines of the Ministry of Urban Development, Government of India and Central Pollution Control Board.

(v) The existing landfill sites which are in use for more than five years shall be improved in accordance with the specifications given in this Schedule.

(vi) The landfill site shall be large enough to last for at least 20-25 years and shall develop 'landfill cells' in a phased manner to avoid water logging and misuse.

(vii) The landfill site shall be 100 meter away from river, 200 meter from a pond, 200 meter from Highways, Habitations, Public Parks and water supply wells and 20 km away from Airports or Airbase. However in a special case, landfill site may be set up within a distance of 10 and 20 km away from the Airport/Airbase after obtaining no objection certificate from the civil aviation authority/ Air force as the case may be. The Landfill site shall not be permitted within the flood plains as recorded for the last 100 years, zone of coastal regulation, wetland, Critical habitat areas, sensitive eco-fragile areas..

(viii) The sites for landfill and processing and disposal of solid waste shall be incorporated in the Town Planning Department's land-use plans.

(ix) A buffer zone of no development shall be maintained around solid waste processing and disposal facility, exceeding five Tonnes per day of installed capacity. This will be maintained within the total area of the solid waste processing and disposal facility. The buffer zone shall be prescribed on case to case basis by the local body in consultation with concerned State Pollution Control Board.

(x) The biomedical waste shall be disposed of in accordance with the Bio-medical Waste Management Rules, 2016, as amended from time to time . The hazardous waste shall be managed in accordance with the Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016, as amended from time to time. The E-waste shall be managed in accordance with the e-Waste (Management) Rules, 2016 as amended from time to time.

(xi) Temporary storage facility for solid waste shall be established in each landfill site to accommodate the waste in case of non- operation of waste processing and during emergency or natural calamities.

(B) Criteria for development of facilities at the sanitary landfills.-

(i) Landfill site shall be fenced or hedged and provided with proper gate to monitor incoming vehicles, to prevent entry of unauthorised persons and stray animals

(ii) The approach and / internal roads shall be concreted or paved so as to avoid generation of dust particles due to vehicular movement and shall be so designed to ensure free movement of vehicles and other machinery.

(iii) The landfill site shall have waste inspection facility to monitor waste brought in for landfilling h, office facility for record keeping and shelter for keeping equipment and machinery including pollution monitoring equipment. The operator of the facility shall maintain record of waste received, processed and disposed.

(iv) Provisions like weigh bridge to measure quantity of waste brought at landfill site, fire protection equipment and other facilities as may be required shall be provided.

(v) Utilities such as drinking water and sanitary facilities (preferably washing/bathing facilities for workers) and lighting arrangements for easy landfill operations during night hours shall be provided.

(vi) Safety provisions including health inspections of workers at landfill sites shall be carried out made.

(vii) Provisions for parking, cleaning, washing of transport vehicles carrying solid waste shall be provided. The wastewater so generated shall be treated to meet the prescribed standards.

(C) Criteria for specifications for land filling operations and closure on completion of land filling.-

(i) Waste for land filling shall be compacted in thin layers using heavy compactors to achieve high density of the waste. In high rainfall areas where heavy compactors cannot be used, alternative measures shall be adopted.

(ii) Till the time waste processing facilities for composting or recycling or energy recovery are set up, the waste shall be sent to the sanitary landfill. The landfill cell shall be covered at the end of each working day with minimum 10 cm of soil, inert debris or construction material..

(iii) Prior to the commencement of monsoon season, an intermediate cover of 40-65 cm thickness of soil shall be placed on the landfill with proper compaction and grading to prevent infiltration during monsoon. Proper drainage shall be constructed to divert run-off away from the active cell of the landfill.

(iv) After completion of landfill, a final cover shall be designed to minimise infiltration and erosion. The final cover shall meet the following specifications, namely :--

a) The final cover shall have a barrier soil layer comprising of 60 cm of clay or amended soil with permeability coefficient less than 1 x 10^{-7} cm/sec.

b) On top of the barrier soil layer, there shall be a drainage layer of 15 cm.

c) On top of the drainage layer, there shall be a vegetative layer of 45 cm to support natural plant growth and to minimise erosion.

(D) Criteria for pollution prevention.-In order to prevent pollution from landfill operations, the following provisions shall be made, namely:-

(i) The storm water drain shall be designed and constructed in such a way that the surface runoff water is diverted from the landfilling site and leachates from solid waste locations do not get mixed with the surface runoff water. Provisions for diversion of storm water discharge drains shall be made to minimise leachate generation and prevent pollution of surface water and also for avoiding flooding and creation of marshy conditions.

(ii) Non-permeable lining system at the base and walls of waste disposal area. For landfill receiving residues of waste processing facilities or mixed waste or waste having contamination of hazardous materials (such as aerosols, bleaches, polishes, batteries, waste oils, paint products and pesticides) shall have liner of composite barrier of 1.5 mm thick high density polyethylene (HDPE) geo-membrane or geo-synthetic liners, or equivalent, overlying 90 cm of soil (clay or amended soil) having permeability coefficient not greater than 1 x 10-7 cm/sec. The highest level of water table shall be at least two meter below the base of clay or amended soil barrier layer provided at the bottom of landfills.

(iii) Provisions for management of leachates including its collection and treatment shall be made. The treated leachate shall be recycled or utilized as permitted, otherwise shall be released into the sewerage line, after meeting the standards specified in Schedule- II**.**. In no case, leachate shall be released into open environment.

(iv) Arrangement shall be made to prevent leachate runoff from landfill area entering any drain, stream, river, lake or pond. In case of mixing of runoff water with leachate or solid waste, the entire mixed water shall be treated by the concern authority.

(E) Criteria for water quality monitoring.-

(i) Before establishing any landfill site, baseline data of ground water quality in the area shall be collected and kept in record for future reference. The ground water quality within 50 meter of the periphery of landfill site shall be periodically monitored covering different seasons in a year that is, summer, monsoon and post-monsoon period to ensure that the ground water is not contaminated.

(ii) Usage of groundwater in and around landfill sites for any purpose (including drinking and irrigation) shall be considered only after ensuring its quality. The following specifications for drinking water quality shall apply for monitoring purpose, namely :-

S. No.	Parameters	IS 10500:2012, Edition 2.2(2003-09) Desirable limit (mg/l except for pH)
(1)	(2)`	(3)
	Arsenic	0.01
	Cadmium	0.01
	Chromium(as Cr^{6+})	0.05
	Copper	0.05
	Cyanide	0.05
	Lead	0.05
	Mercury	0.001
	Nickel	-
	Nitrate as NO_3	45.0
	pH	6.5-8.5
	Iron	0.3
	Total hardness (as $CaCO_3$)	300.0
	Chlorides	250
	Dissolved solids	500
	Phenolic compounds (as C_6H_5OH)	0.001
	Zinc	5.0
	Sulphate (as SO_4)	200

(F) Criteria for ambient air quality monitoring.-

(i) Landfill gas control system including gas collection system shall be installed at landfill site to minimize odour, prevent off-site migration of gases, to protect vegetation planted on the rehabilitated landfill surface. For enhancing landfill gas recovery, use of geomembranes in cover systems along with gas collection wells should be considered.

(ii) The concentration of methane gas generated at landfill site shall not exceed 25 per cent of the lower explosive limit (LEL).

(iii) The landfill gas from the collection facility at a landfill site shall be utilized for either direct thermal applications or power generation, as per viability. Otherwise, landfill gas shall be burnt (flared) and shall not be allowed to escape directly to the atmosphere or for illegal tapping. Passive venting shall be allowed in case if its utilisation or flaring is not possible.

(iv) Ambient air quality at the landfill site and at the vicinity shall be regularly monitored. Ambient air quality shall

meet the standards prescribed by the Central Pollution Control Board for Industrial area.

G. Criteria for plantation at landfill Site.- A vegetative cover shall be provided over the completed site in accordance with the following specifications, namely:-

(a) Locally adopted non-edible perennial plants that are resistant to drought and extreme temperatures shall be planted;

(b) The selection of plants should be of such variety that their roots do not penetrate more than 30 cms. This condition shall apply till the landfill is stabilized;

(c) Selected plants shall have ability to thrive on low-nutrient soil with minimum nutrient addition;

(d) Plantation to be made in sufficient density to minimise soil erosion.

(e) Green belts shall be developed all around the boundary of the landfill in consultation with State Pollution Control Boards or Pollution Control Committees .

H. Criteria for post-care of landfill site.- (1) The post-closure care of landfill site shall be conducted for at least fifteen years and long term monitoring or care plan shall consist of the following, namely :-'

(a) Maintaining the integrity and effectiveness of final cover, making repairs and preventing run-on and run-off from eroding or otherwise damaging the final cover;

(b) Monitoring leachate collection system in accordance with the requirement;

(c) Monitoring of ground water in and around landfill;

(d) Maintaining and operating the landfill gas collection system to meet the standards.

(2) Use of closed landfill sites after fifteen years of post-closure monitoring can be considered for human settlement or otherwise only after ensuring that gaseous emission and leachate quality analysis complies with the specified standards and the soil stability is ensured.

I. Criteria for special provisions for hilly areas.-Cities and towns located on hills shall have location-specific methods evolved for final disposal of solid waste by the local body with the approval of the concerned State Pollution Control Board or the Pollution Control Committee. The local body shall set up processing facilities for utilisation of biodegradable organic waste. The non-biodegradable recyclable materials shall be stored and sent for recycling periodically. The inert and non-biodegradable waste shall be used for building roads or filling-up of appropriate areas on hills. In case of constraints in finding adequate land in hilly areas, waste not suitable for road-laying or filling up shall be disposed of in regional landfills in plain areas.

J. Closure and Rehabilitation of Old Dumps- Solid waste dumps which have reached their full capacity or those which will not receive additional waste after setting up of new and properly designed landfills should be closed and rehabilitated by examining the following options:

(i) Reduction of waste by bio mining and waste processing followed by placement of residues in new landfills or capping as in (ii) below.

(i). Capping with solid waste cover or solid waste cover enhanced with geomembrane to enable collection and flaring / utilisation of greenhouse gases.

(iii) Capping as in (ii) above with additional measures (in alluvial and other coarse grained soils) such as cut-off walls and extraction wells for pumping and treating contaminated ground water.

(iv) Any other method suitable for reducing environmental impact to acceptable level.

SCHEDULE II

[see rule 16 (1), (b), (e), 16 (4))

Standards of processing and treatment of solid waste

A. Standards for composting.- The waste processing facilities shall include composting as one of the technologies for processing of bio degradable waste. In order to prevent pollution from compost plant, the following shall be complied with namely :-

(a) The incoming organic waste at site shall be stored properly prior to further processing. To the extent possible, the waste storage area should be covered. If, such storage is done in an open area, it shall be provided with impermeable base with facility for collection of leachate and surface water run-off into lined drains leading to a leachate treatment and disposal facility;

(b) Necessary precaution shall be taken to minimise nuisance of odour, flies, rodents, bird menace and fire hazard;

(c) In case of breakdown or maintenance of plant, waste intake shall be stopped and arrangements be worked out for diversion of waste to the temporary processing site or temporary landfill sites which will be again reprocessed when plant is in order;

(d) Pre-process and post-process rejects shall be removed from the processing facility on regular basis and shall not be allowed to pile at the site. Recyclables shall be routed through appropriate vendors. The non-recyclable high calorific fractions to be segregated and sent to waste to energy or for RDF production, co-processing in cement plants or to thermal power plants. Only rejects from all processes shall be sent for sanitary landfill site(s).

(e) The windrow area shall be provided with impermeable base. Such a base shall be made of concrete or compacted clay of 50 cm thick having permeability coefficient less than 10^{-7} cm/sec. The base shall be provided with 1 to 2 per cent slope and circled by lined drains for collection of leachate or surface run-off;

(f) Ambient air quality monitoring shall be regularly carried out. Odurnuisance at down-wind direction on the boundary of processing plant shall also be checked regularly.

(g) Leachate shall be re-circulated in compost plant for moisture maintenance.

(h) The end product compost shall meet the standards prescribed under Fertilizer Control Order notified from time to time.

(i) In order to ensure safe application of compost, the following specifications for compost quality shall be met, namely:-

Parameters	**Organic Compost (FCO 2009)**	**Phosphate Rich Organic Manure (FCO 2013)**
(1)	**(2)**	**(3)**
Arsenic (mg/Kg)	10.00	10.00
Cadmium (mg/Kg)	5.00	5.00
Chromium (mg/Kg)	50.00	50.00
Copper (mg/Kg)	300.00	300.00
Lead (mg/Kg)	100.00	100.00
Mercury (mg/Kg)	0.15	0.15
Nickel (mg/Kg)	50.00	50.00
Zinc (mg/Kg)	1000.00	1000.00
C/N ratio	<20	Less than 20:1
pH	6.5-7.5	(1:5 solution) maximum 6.7
Moisture, percent by weight, maximum	15.0-25.0	25.0
Bulk density (g/cm^3)	<1.0	Less than 1.6
Total Organic Carbon, per cent by weight, minimum	12.0	7.9

Total Nitrogen (as N), per cent by weight, minimum	0.8	0.4
Total Phosphate (as $P_2 0_5$) percent by weight, minimum	0.4	10.4
Total Potassium (as $K_2 0$), percent by weight, minimum	0.4	-
Colour	Dark brown to black	-
Odour	Absence of foul Odor	-
Particle size	Minimum 90% material should pass through 4.0 mm IS sieve	Minimum 90% material should pass through 4.0 mm IS sieve
Conductivity (as dsm-1), not more than	4.0	8.2

* Compost (final product) exceeding the above stated concentration limits shall not be used for food crops. However, it may be utilized for purposes other than growing food crops.

B. Standards for treated leachates.-The disposal of treated leachates shall meet the following standards, namely:-

S. No	Parameter	Standards (Mode of Disposal)		
		Inland surface water	Public sewers	Land disposal
(1)	(2)	(3)	(4)	(5)
1.	Suspended solids, mg/l, max	100	600	200
2.	Dissolved solids (inorganic) mg/l, max.	2100	2100	2100
3	pH value	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0
4	Ammonical nitrogen (as N), mg/l, max.	50	50	-
5	Total Kjeldahl nitrogen (as N), mg/l, max.	100	-	-
6	Biochemical oxygen demand (3 days at 27^0 C) max.(mg/l)	30	350	100
7	Chemical oxygen demand, mg/l, max.	250	-	-
8	Arsenic (as As), mg/l, max	0.2	0.2	0.2
9	Mercury (as Hg), mg/l, max	0.01	0.01	-
10	Lead (as Pb), mg/l, max	0.1	1.0	-
11	Cadmium (as Cd), mg/l, max	2.0	1.0	-

12	Total Chromium (as Cr), mg/l, max.	2.0	2.0	-
13	Copper (as Cu), mg/l, max.	3.0	3.0	-
14	Zinc (as Zn), mg/l, max.	5.0	15	-
15	Nickel (as Ni), mg/l, max	3.0	3.0	-
16	Cyanide (as CN), mg/l, max.	0.2	2.0	0.2
17	Chloride (as Cl), mg/l, max.	1000	1000	600
18	Fluoride (as F), mg/l, max	2.0	1.5	-
19	Phenolic compounds (as C_6H_5OH) mg/l, max.	1.0	5.0	-

Note : While discharging treated leachates into inland surface waters, quantity of leachates being discharged and the quantity of dilution water available in the receiving water body shall be given due consideration.

C. Standards for incineration: The Emission from incinerators /thermal technologies in Solid Waste treatment/disposal facility shall meet the following standards, namely:-

Parameter	**Emission standard**	
(1)	**(2)**	**(3)**
Particulates	50 mg/Nm^3	Standard refers to half hourly average value
HCl	50 mg/Nm^3	Standard refers to half hourly average value
SO2	200 mg/Nm^3	Standard refers to half hourly average value
CO	100 mg/Nm^3	Standard refers to half hourly average value
	50 mg/Nm^3	Standard refers to daily average value
Total Organic Carbon	20 mg/Nm^3	Standard refers to half hourly average value
HF	4 mg/Nm^3	Standard refers to half hourly average value
NOx (NO and NO2 expressed as NO2)	400 mg/Nm^3	Standard refers to half hourly average value
Total dioxins and furans	0.1 ng TEQ/Nm^3	Standard refers to 6-8 hours sampling. Please refer guidelines for 17 concerned congeners for toxic equivalence values to arrive at total toxic equivalence.
Cd + Th + their compounds	0.05 mg/Nm^3	Standard refers to sampling time anywhere between 30 minutes and 8 hours.
Hg and its compounds	0.05 mg/Nm^3	Standard refers to sampling time anywhere between 30 minutes and 8 hours.

Sb + As + Pb + Cr + Co + Cu + Mn + Ni + V + their compounds	0.5 mg/Nm^3	Standard refers to sampling time anywhere between 30 minutes and 8 hours.
Note.- *All values corrected to 11% oxygen on a dry basis.*		

Note:

(a) Suitably designed pollution control devices shall be installed or retrofitted with the incinerator to achieve the above emission limits..

(b) Waste to be incinerated shall not be chemically treated with any chlorinated disinfectants.

(c) Incineration of chlorinated plastics shall be phased out within two years.

(d) if the concentation of toxic metals in incineration ash exceeds the limits specified in the Hazardous Waste (Management, Handling and Trans boundary Movement) Rules, 2008, as amended from time to time, the ash shall be sent to the hazardous waste treatment, storage and disposal fcaility.

(e) Only low sulphur fuel like LDO, LSHS, Diesel**,** bio-mass, coal, LNG, CNG, RDF and bio-gas shall be used as fuel in the incinerator.

(f) The CO2 concentration in tail gas shall not be more than 7%.

(g) All the facilities in twin chamber incinerators shall be designed to achieve a minimum temperature of 950^0C in secondary combustion chamber and with a gas residence time in secondary combustion chamber not less than 2 (two) seconds.

(h) Incineration plants shall be operated (combustion chambers) with such temperature, retention time and turbulence, as to achieve total Organic Carbon (TOC) content in the slag and bottom ash less than 3%, or the loss on ignition is less than 5% of the dry weight.

(i) Odour from sites shall be managed as per guidelines of CPCB issued from time to time

FORM – I

[see rule 15 (y) 16 (1) (c), 21(3)]

Application for obtaining authorisation under solid waste management rules

for processing/recycling/treatment and disposal of solid waste

To,

The Member Secretary,

State Pollution Control Board or Pollution Control Committee,

of…....

Sir,

I/We hereby apply for authorisation under the Solid Waste Management Rules, 2016 for processing, recycling, treatment and disposal of solid waste.

1.	Name of the local body/agency appointed by them/ operator of facility	
2.	Correspondence address Telephone No. Fax No. ,e-mail:	

3.	Nodal Officer & designation(Officer authorised by the local body or agency responsible for operation of processing/ treatment or disposal facility)	
4.	Authorisation required for setting up and operation of the facility (Please tick mark)	waste processing recycling treatment disposal at landfill
5.	Attach copies of the Documents Site clearance (local body) Proof of Environmental Clearance Consent for establishment Agreement between municipal authority and operating agency Investment on the project and expected return	
6.	**Processing/recycling/treatment of solid waste** (i) Total Quantity of waste to be processed per day Quantity of waste to be recycled Quantity of waste to be treated Quantity of waste to be disposed into landfill (ii)Utilisation programme for waste processed (Product utilisation) (iii)Methodology for disposal (attach details) Quantity of leachate Treatment technology for leachate (iv)Measures to be taken for prevention and control of environmental pollution (v)Measures to be taken for safety of workers working in the plant (vi)Details on solid waste processing/recycling/ treatment/disposal facility (to be attached)	
7.	**Disposal of solid waste** Number of sites identified Quantity of waste to be disposed per day Details of methodology or criteria followed for site selection (attach) Details of existing site under operation Methodology and operational details of landfilling Measures taken to check environmental pollution	
8	Any other information.	

Date: Signature:

Place: Designation

Form- II

[see rule 16 (1) (e)]

Format for issue of authorisation

File No.: _____

Dated:_____

Authorisation No_____

To

Ref: Your application number _____dt. _____

The _____State Pollution Control Board/Pollution Control Committee after examining the proposal hereby authorises_____ having administrative office at _____to set up and operate waste processing/recycling/ treatment/disposal facility at_____

The authorisation is hereby granted to operate the facility for processing, recycling, treatment and disposal of solid waste.

The authorisation is subject to the terms and conditions stated below and such conditions as may be otherwise specified in these rules and the standards laid down in Schedules I and II under these rules.

The _____State Pollution Control Board/Pollution Control Committees of the UT may, at any time, revoke any of the conditions applicable under the authorisation and shall communicate the same in writing.

Any violation of the provision of the Solid Waste Management Rules, 2016will attract the penal provision of the Environment (Protection) Act, 1986 (29 of 1986).

(Member Secretary)

State Pollution Control Board/Pollution Control Committee of the UT

(Signature and designation)

Date:

Place:

Form – III

[see rule 19 (6), 24 (1)]

Format of annual report to be submitted by the operator of facility to the local body

1	Name of the City/Town and State	
2	Population	
3	Area in sq. kilometers	
4	Name & Address of the local body Telephone No. Fax No. E-mail:	
5	Name and address of operator of the facility	
6	Name of officer in-charge of the facility Phone No: Fax No: E-mail:	

7	Number of households in the city/town , Number of non-residential premises in the city Number of election/ administrative wards in the city/town	
8	Quantity of Solid waste	
	Estimated Quantity of solid waste generated in the local body area per day in metric tones	/tpd
	Quantity of solid waste collected per day	/tpd
	Per capita waste collected per day	/gm/day
	Quantity of solid waste processed	/tpd
	Quantity of solid waste disposed at landfill	/tpd
9	Status of Solid Waste Management (SWM) service	
	Segregation and storage of waste at source Whether solid waste is stored at source in domestic/commercial/ institutional bins If yes, Percentage of households practice storage of waste at source in domestic bins Percentage of non-residential premises practice storage of waste at source in commercial /institutional bins Percentage of households dispose of throw solid waste on the streets Percentage of non-residential premises dispose of throw solid waste on the streets Whether solid waste is stored at source in a segregated form If yes, Percentage of premises segregating the waste at source	 Yes/No % % % % Yes/No %
	Door to Door Collection of solid waste	
	Whether door to door collection (D2D) of solid waste is being done in the city/town	Yes/No
	if yes	
	Number of wards covered in D2D collection of waste	
	No. of households covered	
	No. of non-residential premises including commercial establishments ,hotels, restaurants educational institutions/ offices etc covered	

	Percentage of residential and non-residential premises covered in door to door collection through : Motorized vehicle Containerized tricycle/handcart Other device	% % %
	If not, method of primary collection adopted	
	Sweeping of streets	
	Length of roads, streets, lanes, bye-lanes in the city that need to be cleaned	km
	Frequency of street sweepings and percentage of population covered	frequency: Daily / Alternate days / Twice a week / Occasionally % of population covered
	Tools used Manual sweeping Mechanical sweeping Whether long handle broom used by sanitation workers Whether each sanitation worker is given handcart/tricycle for collection of waste Whether handcart / tricycle is containerized Whether the collection tool synchronizes with collection/ waste storage containers utilized	% % Yes/No Yes/No Yes/No Yes/No
.	Secondary Waste Storage facilities	
	No. and type of waste storage depots in the city/town Open waste storage sites Masonry bins Cement concrete cylinder bins Dhalao/covered rooms/space Covered metal/plastic containers Upto 1.1 m^3 bins 2 to 5 m^3 bins Above 5m^3 containers Bin-less city	No. Capacity in m^3
	Bin/ population ratio	

	Ward wise details of waste storage depots (attach) : Ward No: Area: Population: No. of bins placed Total volume of bins placed		
	Total storage capacity of waste storage facilities in cubic meters		
	Total waste actually stored at the waste storage depots daily		
	Give frequency of collection of waste from the depots Number of bins cleared	Frequency	No. of bins
		Daily	
		Alternate day	
		Twice a week	
		Once a week	
		Occasionally	
	Whether storage depots have facility for storage of segregated waste in green, blue and black bins	Yes/ No (if yes, add details) No. of green bins: No. of blue bins: No. of black bins:	
	Whether lifting of solid waste from storage depots is manual or mechanical. Give percentage	(%) of Manual Lifting of SOLID WASTE	%
		(%) of Mechanical lifting	%
	If mechanical – specify the method used	front-end loaders/ Top loaders	
	Whether solid waste is lifted from door to door and transported to treatment plant directly in a segregated form	Yes/ No (if yes, specify)	

	Waste Transportation per day Type and Number of vehicles used (pl tick or add)	No. Trips made waste transported
	Animal cart Tractors Non tipping Truck Tipping Truck Dumper Placers Refuse collectors Compactors Others JCB/loader	
	Frequency of transportation of waste	Frequency (%) of waste transported Daily Alternate day Twice a week Once a week Occasionally
	Quantity of waste transported each day	/tpd
	Percentage of total waste transported daily	%
	Waste Treatment Technologies used Whether solid waste is processed	Yes/No
	If yes, Quantity of waste processed daily Land(s) available with the local body for waste processing (in Hectares)	/tpd
	Land currently utilized for waste processing	
	Solid waste processing facilities in operation	
	Solid waste processing facilities under construction Distance of processing facilities from city/town boundary	
	Details of technologies adopted	

	Composting ,	Qty. raw material processed Qty. final product produced Qty. sold Qty. of residual waste landfilled
	vermi composting	Qty. raw material processed Qty. final product produced Qty. sold Quantity of residual waste landfilled
	Bio-methanation	Qty. raw material processed Qty. final product produced Qty. sold Quantity of residual waste landfilled
	Refuse Derived Fuel	Qty. raw material processed Qty. final product produced Qty. sold Quantity of residual waste landfilled
	Waste to Energy technology such as incineration, gasification, pyrolysis or any other technology (give detail)	Qty. raw material processed Qty. final product produced Qty. sold Quantity of residual waste landfilled
	Co-processing	Qty. raw material processed
	Combustible waste supplied to cement plant	
	Combustible waste supplied to solid waste based power plants	
	Others	Qty.
	Solid waste disposal facilities	
	No. of dumpsites sites available with the local body	
	No. of sanitary landfill sites available with the local body Area of each such sites available for waste disposal	
	Area of land currently used for waste disposal	
	Distance of dumpsite/landfill facility from city/town	kms
	Distance from the nearest habitation	kms
	Distance from water body	kms

	Distance from state/national highway	kms
	Distance from Airport	kms
	Distance from important religious places or historical monument	kms
	Whether it falls in flood prone area	Yes/No
	Whether it falls in earthquake fault line area	Yes/No
	Quantity of waste landfilled each day	tpd
	Whether landfill site is fenced	Yes / No
	Whether Lighting facility is available on site Whether Weigh bridge facility available	Yes / No Yes / No
	Vehicles and equipments used at landfill (specify)	Bulldozer, Compacters etc. available
	Manpower deployed at landfill site	Yes/No (if yes, attach details)
	Whether covering is done on daily basis	Yes/No
	If not, Frequency of covering the waste deposited at the landfill	
	Cover material used	
	Whether adequate covering material is available	Yes/No
	Provisions for gas venting provided	Yes/No, (if yes, attach technical data sheet)
	Provision for leachate collection	Yes/No, (if yes, attach technical data sheet)
10	Whether an Action Plan has been prepared for improving solid waste management practices in the city	Yes/No (if Yes attach Action Plan details)
11	What separate provisions are made for : Dairy related activities : Slaughter houses waste : C&D waste (construction debris) :	Attach details on Proposals, Steps taken, Yes/No Yes/No Yes/No
12	Details of Post Closure Plan	Attach Plan
13	How many slums are identified and whether these are provided with Solid Waste Management facilities :	Yes/ No (if Yes, attach details)
14	Give details of manpower deployed for collection including street sweeping, secondary storage, transportation, processing and disposal of waste	

15	Mention briefly, the difficulties being experienced by the local body in complying with provisions of these rules	
16	Mention briefly, if any innovative idea is implemented to tackle a problem related to solid waste, which could be replicated by other local bodies.	

Signature of Operator

Dated :

Place:

Form – IV

[see rules 15(za), 24(2)]

Format for annual report on solid waste management to be submitted by the local body

CALENDAR YEAR:	**DATE OF SUBMISSION OF REPORT:**

1	Name of the City/Town and State	
2	Population	
3	Area in sq. kilometers	
4	Name & Address of local body Telephone No. Fax No. E-mail:	
5	Name of officer in-charge dealing with solid waste management (SOLID WASTEM)Phone No: Fax No: E-mail:	
6	Number of households in the city/town Number of non-residential premises in the city Number of election/ administrative wards in the city/town	
7	Quantity of Solid waste (solid waste)	
	Estimated Quantity of solid waste generated in the local body area per day in metric tones	/tpd
	Quantity of solid waste collected per day	/tpd

	Per capita waste collected per day	/gm/day
	Quantity of solid waste processed	/tpd
	Quantity of solid waste disposed at dumpsite/ landfill	/tpd
8	Status of Solid Waste Management service	
	Segregation and storage of waste at source	
	Whether SOLID WASTE is stored at source in domestic/commercial/ institutional bins, If yes,	Yes/No
	Percentage of households practice storage of waste at source in domestic bins	%
	Percentage of non-residential premises practice storage of waste at source in commercial /institutional bins	%
	Percentage of households dispose or throw solid waste on the streets	%
	Percentage of non-residential premises dispose of throw solid waste on the streets	%
	Whether solid waste is stored at source in a segregated form, If yes,	Yes/No
	Percentage of premises segregating the waste at source	%
	Door to Door Collection of solid waste	
	Whether door to door collection (D2D) of solid waste is being done in the city/town	Yes/No
	if yes	
	Number of wards covered in D2D collection of waste	
	No. of households covered	
	No. of non-residential premises including commercial establishments ,hotels, restaurants educational institutions/ offices etc covered	
	Percentage of residential and non-residential premises covered in door to door collection through :	
	Motorized vehicle	%
	Containerized tricycle/handcart	%
	Other device	%
	If not, method of primary collection adopted	
	Sweeping of streets	
	Length of roads, streets, lanes, bye-lanes in the city that need to be cleaned	km

	Frequency of street sweepings and percentage of population covered	frequency	Daily	Alternate days	Twice a week	Occasionally
		% of population covered				
	Tools used					
	Manual sweeping			%		
	Mechanical sweeping			%		
	Whether long handle broom used by sanitation workers			Yes/No		
	Whether each sanitation worker is given handcart/tricycle for collection of waste			Yes/No		
	Whether handcart / tricycle is containerized			Yes/No		
	Whether the collection tool synchronizes with collection/ waste storage containers utilized			Yes/No		
.	Secondary Waste Storage facilities					
	No. and type of waste storage depots in the city/town	No. Capacity in m^3				
	Open waste storage sites					
	Masonry bins					
	Cement concrete cylinder bins					
	Dhalao/covered rooms/space					
	Covered metal/plastic containers					
	Upto 1.1 m3 bins					
	2 to 5 m3 bins					
	Above 5m3 containers					
	Bin-less city					
	Bin/ population ratio					
	Ward wise details of waste storage depots (attach) :					
	Ward No:					
	Area:					
	Population:					
	No. of bins placed					
	Total volume of bins placed					
	Total storage capacity of waste storage facilities in cubic meters					
	Total waste actually stored at the waste storage depots daily					

	Give frequency of collection of waste from the depots Number of bins cleared	Frequency	No. of bins
		Daily Alternate day Twice a week Once a week	
		Occasionally	
	Whether storage depots have facility for storage of segregated waste in green, blue and black bins	Yes/ No (if yes, add details) No. of green bins: No. of blue bins: No. of black bins:	
	Whether lifting of solid waste from storage depots is manual or mechanical. Give percentage (%) of Manual Lifting of solid waste (%) of Mechanical lifting	% %	
	If mechanical – specify the method used	front-end loaders/ Top loaders	
	Whether solid waste is lifted from door to door and transported to treatment plant directly in a segregated form	Yes/ No (if yes, specify)	
	Waste transportation per day Type and Number of vehicles used	No. Trips made waste transported	
	Animal cart Tractors Non tipping Truck Tipping Truck Dumper Placers Refuse collectors Compactors Others JCB/loader		

	Frequency of transportation of waste	Frequency (%) of waste transported Daily Alternate day Twice a week Once a week Occasionally
	Quantity of waste transported each day	/tpd
	Percentage of total waste transported daily	%
	Waste Treatment Technologies used	
	Whether solid waste is processed	Yes/No
	If yes, Quantity of waste processed daily	/tpd
	Whether treatment is done by local body or through an agency	
	Land(s) available with the local body for waste processing (in Hectares)	
	Land currently utilized for waste processing	
	Solid waste processing facilities in operation	
	Solid waste processing facilities under construction	
	Distance of processing facilities from city/town boundary	
	Details of technologies adopted	
	Composting ,	Qty. raw material processed Qty. final product produced Qty. sold Quantity of residual waste landfilled
	Vermi composting	Qty. raw material processed Qty. final product produced Qty. sold Quantity of residual waste landfilled
	Bio-methanation	Qty. raw material processed Qty. final product produced Qty. sold Quantity of residual waste landfilled

	Refuse Derived Fuel	Qty. raw material processed Qty. final product produced Qty. sold Quantity of residual waste landfilled
	Waste to Energy technology such as incineration, gasification, pyrolysis or any other technology (give detail)	Qty. raw material processed Qty. final product produced Qty. sold Quantity of residual waste landfilled
	Co-processing	Qty. raw material processed
	Combustible waste supplied to cement plant	
	Combustible waste supplied to solid waste based power plants	
	Others	Qty.
	Solid waste disposal facilities	
	No. of dumpsites sites available with the local body	
	No. of sanitary landfill sites available with the local body	
	Area of each such sites available for waste disposal	
	Area of land currently used for waste disposal	
	Distance of dumpsite/landfill facility from city/town	kms
	Distance from the nearest habitation	kms
	Distance from water body	kms
	Distance from state/national highway	kms
	Distance from Airport	kms
	Distance from important religious places or historical monument	kms
	Whether it falls in flood prone area	Yes/No
	Whether it falls in earthquake fault line area	Yes/No
	Quantity of waste landfilled each day	tpd
	Whether landfill site is fenced	Yes / No
	Whether Lighting facility is available on site	Yes / No

	Whether Weigh bridge facility available	Yes / No
	Vehicles and equipments used at landfill (specify)	Bulldozer, Compacters etc. available
	Manpower deployed at landfill site	Yes/No (if yes, attach details)
	Whether covering is done on daily basis	Yes/No
	If not, Frequency of covering the waste deposited at the landfill	
	Cover material used	
	Whether adequate covering material is available	Yes/No
	Provisions for gas venting provided	Yes/No (if yes, attach technical data sheet)
	Provision for leachate collection	Yes/No (if yes, attach technical data sheet)
9	Whether an Action Plan has been prepared for improving solid waste management practices in the city	Yes/No (if Yes attach Action Plan details)
10	What separate provisions are made for : Dairy related activities : Slaughter houses waste : C&D waste (construction debris) :	Attach details on Proposals,Steps taken, Yes/No Yes/No Yes/No
11	Details of Post Closure Plan	Attach Plan
12	How many slums are identified and whether these are provided with Solid Waste Management facilities :	Yes/ No (if Yes, attach details)
13	Give details of: Local body's own manpower deployed for collection including street sweeping, secondary storage, transportation, processing and disposal of waste	
14	Give details of: Contractor/ concessionaire's manpower deployed for collection including street sweeping, secondary storage, transportation, processing and disposal of waste	
15	Mention briefly, the difficulties being experienced by the local body in complying with provisions of these rules	

16	Mention briefly, if any innovative idea is implemented to tackle a problem related to solid waste, which could be replicated by other local bodies	

Signature of CEO/Municipal Commissioner/

Executive Officer/Chief Officer

Date:

Place:

Form – V

[see rule 24(3)]

Format of annual report to be submitted by the state pollution control board or pollution control committee committees to the central pollution control board

PART A

To,

The Chairman

Central Pollution Control Board

Parivesh Bhawan, East Arjun Nagar

DELHI- 110 0032

1.	Name of the State/Union territory	:	
2.	Name & address of the State Pollution Control	:	
3.	Number of local bodies responsible for management of solid waste in the State/Union territory under these rules	:	
4.	No. of authorisation application Received	:	
5.	A Summary Statement on progress made by local body in respect of solid waste management	:	Please attach as Annexure-I
6.	A Summary Statement on progress made by local bodies in respect of waste collection, segregation, transportation and disposal	:	Please attach as Annexure-II
7.	A summary statement on progress made by local bodies in respect of implementation of Schedule II	:	Please attach as Annexure-III

Date: …….	Chairman or the Member Secretary
Place: ……..	State Pollution Control Board/
	Pollution Control Committee

PART B

Towns/cities

Total number of towns/cities

Total number of ULBs

Number of class I & class II cities/towns

Authorisation status (names/number)

Number of applications received

Number of authorisations granted

Authorisations under scrutiny

SOLID WASTE Generation status

Solid waste generation in the state (TPD)

collected

treated

landfilled

Compliance to Schedule I of SW Rules (Number/names of towns/capacity)

Good practices in cities/towns

House-to-house collection

Segregation

Storage

Covered transportation

Processing of SW (Number/names of towns/capacity)

Solid Waste processing facilities setup:

Sl. No.	Composting	Vermi-composting	Biogas	RDF/Pelletization

Processing facility operational:

Sl. No.	Composting	Vermi-composting	Biogas	RDF/Pelletization

Processing facility under installation/planned:

Sl. No.	Composting	Vermi-composting	Biogas	RDF/Pelletisation

Waste-to-Energy Plants: (Number/names of towns/capacity)

Sl. No.	Plant Location	Status of operation	Power generation (MW)	Remarks

Disposal of solid waste (number/names of towns/capacity):

Landfill sites identified

Landfill constructed

Landfill under construction

Landfill in operation

Landfill exhausted

Landfilled capped

Solid Waste Dumpsites (number/names of towns/capacity):

Total number of existing dumpsites

Dumpsites reclaimed/capped

Dumpsites converted to sanitary landfill

Monitoring at Waste processing/Landfills sites

Sl. No.	Name of facilities	Ambient air	Groundwater	Leachate quality	Compost quality	VOCs
1.						
2.						
3.						

Status of Action Plan prepared by Municipalities

Total number of municipalities:

Number of Action Plan submitted:

Form – VI

[see rule 25]

Accident Reporting

1.	Date and time of accident	:	
2.	Sequence of events leading to accident	:	
3.	The waste involved in accident	:	

4.	Assessment of the effects of the accidents on human health and the environment	:	
5.	Emergency measures taken	:	
6.	Steps taken to alleviate the effects of accidents	:	
7.	Steps taken to prevent the recurrence of such an accident	:	
Date: ……		Signature:……..……	
Place: ……		Designation: ……	

[F. No. 18-3/2004-HSMD]

BISHWANATH SINHA, Jt. Secy.

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भारत का राजपत्र
The Gazette of India

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पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय

अधिसूचना

नई दिल्ली, 28 मार्च, 2016

सा.का.नि. 343(अ).—भारत सरकार के तत्कालीन पर्यावरण और वन मंत्रालय की अधिसूचना संख्यांक का.आ. 630(अ), तारीख 20 जुलाई, 1998 की अधिसूचना द्वारा जैव चिकित्सा अपशिष्ट (प्रबंधन और हथालन) नियम, 1998 के माध्यम से देश में उत्पन्न जैव चिकित्सा अपशिष्ट के प्रबंधन के लिए एक विनियामक ढांचे का उपबंध किया गया था;

और इन नियमों को अधिक प्रभावी रूप से कार्यान्वित करने और पर्यावरण की दृष्टि से बेहतर प्रबंधन में संग्रहण, पृथक्करण, प्रसंस्करण, परिष्करण और निपटान में सुधार करने के लिए, जिससे जैव-चिकित्सा अपशिष्ट कम उत्पन्न हो और पर्यावरण पर कम प्रभाव पड़े, केन्द्रीय सरकार ने विद्यमान नियमों की समीक्षा की है;

और पर्यावरण (संरक्षण) अधिनियम, 1986 (1986 का 29) की धारा 6, 8 और 25 का प्रयोग करते हुए केन्द्र सरकार ने सा.का.नि.सं.450(अ), दिनांक 03 जून, 2015 के तहत राजपत्र में प्रारूप नियम प्रकाशित किए थे जिसमें जैव-चिकित्सा अपशिष्ट (प्रबंधन और हथालन), नियम, 1998 के अधिक्रमण में जैव-चिकित्सा (प्रबंधन और प्रहस्तन), नियम 2015 पर उक्त अधिसूचना के प्रकाशन की तारीख से साठ दिन के अंदर जनता से आपत्तियां अथवा सुझाव आमंत्रित किए गए थे;

उक्त प्रारूप नियम निहित राजपत्र की प्रतियां दिनांक 03 जून, 2015 को जनता को उपलब्ध करा दी गई थीं;

और उक्त प्रारूप नियम के संबंध में निर्धारित अवधि के अंदर जनता से प्राप्त आपत्तियों अथवा टिप्पणियां पर केन्द्रीय सरकार द्वारा विधिवत विचार किया गया है;

अब, इसलिए, पर्यावरण (संरक्षण) अधिनियम, 1986 (1986 का 29) की धारा 6, 8 और 25 द्वारा प्रदत्त शक्तियों का प्रयोग करते हुए और जैव-चिकित्सा अपशिष्ट (प्रबंधन और हथालन) नियम, 1998 का अधिक्रमण करते हुए केन्द्रीय सरकार एतद्वारा जैव-चिकित्सा अपशिष्ट के प्रबंधन के लिए निम्नलिखित नियम अधिसूचित करती है :-

1. **संक्षिप्त नाम और प्रारंभ.-** (1) इन नियमों का संक्षिप्त नाम जैव-चिकित्सा अपशिष्ट प्रबंधन नियम, 2016 है।

(2) ये राजपत्र में प्रकाशन की तारीख को प्रवृत्त होंगे।

2. **लागू होना.-**

(1) ये नियम अस्पतालों, नर्सिंग होम, क्लिनिकों, औषधालयों, पशु चिकित्सा संस्थाओं, पशु गृहों, पैथेलॉजिकल प्रयोगशालाओं, रक्त बैंकों, आयुष अस्पतालों, क्लिनिकल स्थापनाओं, अनुसंधान या शैक्षिक संस्थाओं, स्वास्थ्य शिविरों, चिकित्सा अथवा शल्यचिकित्सा कैंपों, टीकाकरण कैंपों, रक्तदान कैंपों, विद्यालयों के प्रथम चिकित्सा कक्षों, अदालती प्रयोगशालाओं और अनुसंधान प्रयोगशालाओं सहित उन सभी व्यक्तियों पर लागू होंगे, जो किसी भी रूप में जैव चिकित्सा अपशिष्ट का उत्पादन, संग्रहण, ग्रहण, भंडारण, परिवहन, शोधन, व्ययन या प्रहस्तन करते हैं।

(2) ये नियम निम्नलिखित पर लागू नहीं होंगे :

(क) रेडियोधर्मी अपशिष्ट जो परमाणु ऊर्जा अधिनियम, 1962 (1962 का 33) और उसके अधीन बनाए गए नियमों के उपबंधों के अधीन आते हैं;

(ख) अधिनियम के अंतर्गत बनाए गए परिसंकटमय रसायन विनिर्माण, भंडारण और आयात नियम, 1989 में शामिल परिसंकटमय रसायन;

(ग) अधिनियम के अधीन बनाए गए नगरीय ठोस अपशिष्ट (प्रबंधन और हथालन) नियम, 2000 के अधीन आने वाले ठोस अपशिष्ट;

(घ) अधिनियम के अधीन बनाए गए बैटरी (प्रबंधन और हथालन) नियम, 2001 के अधीन आने वाली लैड एसिड बैटरियां;

(ड.) अधिनियम के अधीन बनाए गए परिसंकटमय अपशिष्ट (प्रबंधन, हथालन और सीमापारीय संचालन) नियम, 2008 के अधीन आने वाले परिसंकटमय अपशिष्ट।

(च) अधिनियम के अधीन बनाए गए ई-अपशिष्ट (प्रबंधन और हथालन) नियम, 2011 के अधीन आने वाला अपशिष्ट; और

(छ) अधिनियम के अधीन बनाए गए परिसंकटमय सूक्ष्मजीवों का विनिर्माण, उपयोग, आयात, निर्यात और भंडारण, अनुवांशिक रूप से तैयार किए गए सूक्ष्मजीव या कोशिका नियम, 1989 के अधीन आने वाले परिसंकटमय सूक्ष्मजीव, अनुवांशिक रूप से तैयार किए गए सूक्ष्म जीव और कोशिकाएं।

3. **परिभाषाएं.-** इन नियमों में, जब तक कि संदर्भ में अन्यथा अपेक्षित न हो -

(क) "अधिनियम" से पर्यावरण (संरक्षण) अधिनियम 1986 (1986 का 29) अभिप्रेत है;

(ख) "पशु गृह" से ऐसा स्थान अभिप्रेत है जहां जीव जंतुओं को अनुसंधान या परीक्षण के प्रयोजनों के लिए पशुओं का पालन-पोषण किया जाता है/रखा जाता है;

(ग) "प्राधिकरण" से इन नियमों और यथास्थिति, भारत सरकार अथवा केन्द्रीय प्रदूषण नियंत्रण बोर्ड, द्वारा जारी मार्गदर्शन सिद्धांतों के अनुसार जैव चिकित्सा अपशिष्ट के उत्पादन, संग्रहण, ग्रहण, भंडारण, परिवहन, उपचार व्ययन और/या किसी भी अन्य प्रकार के हथालन के लिए विहित प्राधिकारी द्वारा प्रदान की गई अनुमति अभिप्रेत है;

(घ) "प्राधिकृत व्यक्ति" से इन नियमों और यथास्थिति, केन्द्रीय सरकार या केन्द्रीय प्रदूषण नियंत्रण बोर्ड द्वारा बनाए गए नियमों और जारी किए गए मार्गदर्शक सिद्धांतों के अनुसार जैव चिकित्सा अपशिष्ट के जनन, संग्रहण, ग्रहण, भंडारण, परिवहन, उपचार, व्ययन और/या किसी भी अन्य प्रकार के हथालन हेतु, के लिए विहित प्राधिकारी प्राधिकृत कोई अधिभोगी या प्रचालक अभिप्रेत है।

(ड.) "जैविक" से जीवों या सूक्ष्मजीवों का उपापच्छ या जैव रासायनिक प्रतिक्रियाओं के उत्पादों से बनाई गई विनिमितियां जो मानवों या पशुओं के निदान प्रतिरक्षण या शोधन में या उससे संबंधित अनुसंधान कार्यकलापों में उपयोग के लिए आशयित है;

(च) "जैव चिकित्सा अपशिष्ट" से कोई ऐसा अपशिष्ट अभिप्रेत है, जिसका जनन मानवों या पशुओं के निदान, शोधन या प्रतिरक्षण के दौरान या उससे संबंधित अनुसंधान कार्यकलापों या जैविकीय उत्पादन या परीक्षण में विभिन्न स्वास्थ्य कैंपों में जिसके अधीन इन नियमों की अनुसूची-I में उल्लिखित प्रवर्ग भी है, के दौरान हुआ है;

(छ) "जैव चिकित्सा अपशिष्ट शोधन और व्ययन सुविधा" से कोई ऐसी सुविधा अभिप्रेत है जिसमें जैव चिकित्सा अपशिष्ट का शोधन, व्ययन या ऐसे शोधन और व्ययन से आनुषंगिक प्रक्रियाएं की जाती हैं और इसमें सामान्य जैव-चिकित्सा शोधन सुविधाएं भी सम्मिलित हैं;

(ज) "प्ररूप" से इन नियमों में संलग्न प्ररूप अभिप्रेत हैं;

(झ) जैव-चिकित्सा अपशिष्ट के संबंध में "हथालन" से अभिप्रेत है ऐसे अपशिष्ट का जनन, छंटनी, पृथक्करण, संग्रहण, उपयोग, भंडारण, पैकेजिंग, लदान, परिवहन, उतराई, प्रसंस्करण, शोधन, नष्ट करना, रूपांतरण, बिक्री के लिए प्रस्तुत करना, स्थानान्तरण, निपटान और इसी प्रकार के कार्य;

(ञ) "स्वास्थ्य देखभाल सुविधा" एक ऐसा स्थान है जहां मानवों अथवा पशुओं का निदान, उपचार या प्रतिरक्षण किया जाता है, स्वास्थ्य उपचार प्रणाली का स्वरूप और आकार तथा उससे संबंधित अनुसंधान कार्यकलाप चाहे जो भी हो;

(ट) "भारी दुर्घटना" से अभिप्राय जैव-चिकित्सा अपशिष्ट का हथालन करते समय होने वाली ऐसे दुर्घटना से है जिसका बड़ी संख्या में आम जनता पर प्रभाव पड़ सकता है जैसे कि जैव-चिकित्सा अपशिष्ट ले जा रहे ट्रक का पलट जाना, जैव-चिकित्सा अपशिष्ट का दुर्घटनावश किसी जल निकाय में चले जाना आदि जिसमें सूई से लगने वाली जैसी चोट पारे का हुलकन दुर्घटनाएं शामिल नहीं हैं।

(ठ) "प्रबंधन" में वे सभी उपाय शामिल होते हैं जो यह सुनिश्चित करने के लिए अपेक्षित होते हैं कि जैव-चिकित्सा अपशिष्ट का प्रबंधन इस ढंग से किया जाए जिससे ऐसे अपशिष्ट के हथालन की वजह से होने वाले किसी प्रतिकूल प्रभाव से स्वास्थ्य और पर्यावरण की रक्षा हो सके;

(ड) "अधिभोगी" से ऐसा व्यक्ति अभिप्रेत है जिसका जैव चिकित्सीय अपशिष्ट को उत्पन्न करने वाली संस्था और परिसर पर प्रशासनिक नियंत्रण हो, जिनमें उनकी औषधि की प्रणाली तथा जिसे चाहे किसी भी नाम से पुकारा जाता हो अस्पताल, नर्सिंग होम, क्लीनिक, औषधालय, पशु चिकित्सा संस्थाएं, पशु गृह, पैथेलॉजिकल प्रयोगशालाएं, ब्लड बैंक, स्वास्थ्य देखभाल सुविधाएं तथा क्लीनिकल स्थापनाएं शामिल हैं;

(ढ) "किसी साझा जैव चिकित्सा अपशिष्ट शोधन सुविधा के प्रचालक" से ऐसा कोई व्यक्ति अभिप्रेत है जो जैव चिकित्सा अपशिष्ट के संग्रहण, ग्रहण, भंडारण, परिवहन, शोधन, व्ययन या किसी भी प्रकार के हथालन हेतु किसी साझा सुविधा का स्वामी है या उसे नियंत्रित करता है;

(ण) "विहित प्राधिकारी" से अभिप्रेत है राज्यों के मामले में राज्य प्रदूषण नियंत्रण बोर्ड और संघ राज्य क्षेत्रों के मामले में प्रदूषण नियंत्रण समितियां।

(त) "अनुसूची" से इन नियमों से उपाबद्ध अनुसूची अभिप्रेत है।

4. **अधिभोगी के कर्तव्य.-** प्रत्येक अधिभोगी का कर्तव्य होगा कि :

(क) यह सुनिश्चित करने के लिए सभी उपाय करे कि जैव चिकित्सा अपशिष्ट का हथालन मानव स्वास्थ्य और पर्यावरण पर कोई प्रतिकूल प्रभाव डाले बिना और इन नियमों के अनुसार हो;

(ख) अपने परिसर के अंदर अनूसूची-I के अनुसार रंग वाले बैगों या पात्रों में पृथक किए गए जैव-चिकित्सा अपशिष्ट के भंडारण के लिए सुरक्षित, संवातित और संरक्षित स्थान की व्यवस्था करना ताकि कोई गौण हथालन न हो, पुन:चक्रण योग्य सामग्री भूषण न हो या अनवथानता से छितराया न हो या पशुओं द्वारा बिखराया नहीं जाए और ऐसे स्थान या परिसर से जैव चिकित्सा अपशिष्ट को इन नियमों में विहित तरीके से सीधे साझा जैव चिकित्सा अपशिष्ट शोधन सुविधा के लिए या समुचित शोधन और निपटान के लिए अनूसूची-I में यथा विहित रीति, जैसा भी मामला भेजा जाना जाएगा।

(ग) विश्व स्वास्थ्य संगठन (डब्ल्यूएचओ) या राष्ट्रीय एड्स नियंत्रण संगठन (एनएसीओ) के मार्गदर्शक सिद्धांतों के अनुसार प्रयोगशाला अपशिष्ट, माइक्रोबायोलॉजिकल अपशिष्ट, रक्त के नमूनों और रक्त की थैलियों का विसंक्रमण अथवा जीवाणुनाशन के जरिए स्थल पर पूर्व-शोधन करेगा और उसके बाद अंतिम निपटान के लिए साझा जैव चिकित्सा अपशिष्ट शोधन सुविधा में भेजेगा;

(घ) अधिसूचना की तारीख से दो वर्ष के अंदर क्लोरीनेटेड प्लास्टिक की थैलियों, दस्तानों और रक्त की थैलियों का उपयोग बंद करना;

(ड.) जैव-चिकित्सा अपशिष्ट से भिन्न अन्य ठोस अपशिष्ट का निपटान सुसंगत और समय-समय पर यथा संशोधित विधियों में अधीन बनाये गये संबंधित अपशिष्ट प्रबंधन नियमों के उपबंधों अनुसार करना;

(च) उपचारित जैव चिकित्सा अपशिष्ट को नगरीय ठोस अपशिष्ट के साथ नहीं देना;

(छ) जैव चिकित्सा अपशिष्ट के हथालन में अन्तर्वलित कर्मकारों और अन्यों के स्वास्थ्य की देखभाल के लिए उन्हें भर्ती करने के समय और उसके बाद कम से कम वर्ष में एक बार प्रशिक्षण देना। आयोजित किए प्रशिक्षण कार्यक्रमों, प्रशिक्षित किए गए कार्मिकों की संख्या और कोई प्रशिक्षण न लेने वाले कार्मिकों की संख्या के ब्यौरे उपलब्ध कराना और उसे वार्षिक रिपोर्ट में शामिल करना;

(ज) प्रतिरक्षण नीति अथवा स्वास्थ्य और परिवार कल्याण मंत्रालय द्वारा समय-समय पर जारी मागदर्शक सिद्धांतों में यथा विहित रीति से हेपेटाइटिस बी और टिटेनस सहित उन रोगों से जैव चिकित्सा अपशिष्ट से हथालन में अन्तर्वलित स्वास्थ्य देखभाल कर्मकारों या अन्यों को बचाने के लिए जो जैव-चिकित्सा अपशिष्ट के हथालन के कारण संक्रमित हो सकते है;

(झ) इन नियमों के अधीन अधिसूचना की तारीख से एक वर्ष के अंदर किसी भी प्रयोजन के लिए परिसर या स्थान से बाहर भेजे जाने वाले जैव-चिकित्सा अपशिष्ट अन्तविष्ट वाले बैगों या आघानों के लिए बार-कोड प्रणाली की स्थापना करना;

(ञ) जनन बिन्दु पर द्रव रसायन अपशिष्ट का पृथक्करण सुनिश्चित करना और स्वास्थ्य देखभाल सुविधा से जनित अन्य बहि:स्राव के साथ मिश्रित होने से पहले पूर्व-शोधन या निष्प्रभावन सुनिश्चित करना;

(ट) जल (प्रदूषण निवारण और नियंत्रण) अधिनियम, 1974 (1974 का 6) के अनुसार द्रव अपशिष्ट का शोधन और निपटान सुनिश्चित करना;

(ठ) समुचित और पर्याप्त व्यक्तिगत संरक्षणकारी उपस्कर प्रदान करके जैव-चिकित्सा अपशिष्ट के हथालन में अन्तर्वलित अपने सभी स्वास्थ्य देखभाल कर्मकारों और अन्यों की वृतिक सुरक्षा सुनिश्चित करना।

(ड) जैव चिकित्सा अपशिष्ट के हथालन में अंतर्विलित अपने सभी स्वास्थ्य देखभाल कर्मकारों और अन्य की भर्ती करते समय और वर्ष में कम से कम एक बार स्वास्थ्य जांच आयोजित करना और उसका रिकॉर्ड रखना।

(ढ) जनित जैव चिकित्सा अपशिष्ट की श्रेणी, रंग कोड के अनुसार अनुसूची-I में यथा और अनुरक्षित विनिर्दिष्ट जैव चिकित्सा अपशिष्ट के प्रबंध का रजिस्टर रखना और इसे प्रतिदिन अद्यतन और अनुरक्षित करना तथा अपनी वेबसाइट पर मासिक रिकॉर्ड प्रदर्शित करना;

(ण) जैव चिकित्सा अपशिष्ट के हथालन के दौरान अग्नि संकट, विस्फोट जैसी दुर्घटनाओं सहित प्रमुख दुर्घटनाओं और की गई उपचारात्मक कार्रवाई की सूचना प्ररूप 1 में (शून्य सूचना सहित) विहित प्राधिकारी को और साथ ही वार्षिक रिपोर्ट के साथ भी दी जाएगी।

(त) वार्षिक रिपोर्ट अपनी वेबसाइट पर उपलब्ध कराएगा और सभी स्वास्थ्य देखभाल सुविधाएं इन नियमों की अधिसूचना की तारीख से दो वर्ष के अंदर अपनी वेबसाइट बनाएंगे।

(थ) यदि किसी सुविधा का प्रचालक अभिप्रेत समय के अंदर या सहमत समय के अनुसार जैव चिकित्सा अपशिष्ट का संग्रहण नहीं करता तो तत्काल विहित प्राधिकारी को सूचित करना।

(द) वर्तमान समिति के माध्यम से अथवा नई समिति बनाकर जैव-चिकित्सा अपशिष्ट प्रबंध से संबंधित कार्यकलापों की समीक्षा का पुनरावलोकन मॉनीटरिंग करने के लिए एक प्रणाली की स्थापना करना। यह समिति छह माह में एक बार बैठक करेगी। इस समिति की बैठकों के कार्यवृत्त का रिकॉर्ड वार्षिक रिपोर्ट के साथ विहित प्राधिकारी को प्रस्तुत किया जाएगा। तीस बिस्तरों से वाली स्वास्थ्य देखभाल स्थापनाएं अपनी स्थापना के अंदर जैव-चिकित्सा अपशिष्ट प्रबंध से संबंधित कार्यकलापों का पुनरावलोकन और मॉनीटरिंग करने के लिए एक सुयोग्य व्यक्ति पदानिहित करेंगी और वार्षिक रिपोर्ट प्रस्तुत करेंगी।

(ध) भस्मीकरण, हाइड्रो या ऑटोक्लेविंग आदि के प्रचालन का समस्त रिकॉर्ड पांच वर्ष तक रखना।

(न) इस अधिसूचना की तारीख से दो वर्ष के भीतर द्वितीय चैम्बर और डाईआक्सीजन तथा फुरान के बचाए रखने के समय के लिए अनुसूची 2 में यथा विहित जैव चिकित्सा अपशिष्टों के उपचार और निपटान के लिए मानकों को प्राप्त करने के लिए विद्यमान भस्मन यंत्र।

5. **साझा-जैव चिकित्सा अपशिष्ट उपचार और निपटान सुविधा प्रचालक के कर्तव्य.-** प्रत्येक प्रचालक का यह कर्तव्य होगा कि वह -

(क) यह सुनिश्चित करने के लिए सभी आवश्यक कदम उठाए कि अधिभोगी से संग्रहित जैव चिकित्सा अपशिष्ट का परिवहन हथालन, भंडारण, उपचार और व्ययन इन नियमों के अनुसार और केन्द्रीय सरकार या जैसा भी मामला हो केन्द्रीय प्रदूषण नियंत्रण बोर्ड द्वारा जारी मार्गदर्शक सिद्धांतों के अनुसार मानव स्वास्थ्य और पर्यावरण पर प्रतिकूल प्रभाव डाले बिना किया जा रहा है;

(ख) इन नियमों के अधीन यथा विहित अधिभोगी से समय से जैव चिकित्सा अपशिष्ट का एकत्रण को सुनिश्चित करना;

(ग) जैव-चिकित्सा अपशिष्ट के हथालन के लिए एक वर्ष के अंदर बार-कोडिंग और ग्लोबल प्रोजिशनिंग प्रणाली लगाना;

(घ) उन अधिभोगियों के संबंध में, जो इन नियमों के अनुसार पृथक किए गए जैव चिकित्सा अपशिष्ट को सौंप नहीं हो रहे हों, विहित प्राधिकारी को तत्काल सूचित करना।

(ड.) जैव चिकित्सा अपशिष्ट के हथालन में अन्तर्वलित अपने सभी कर्मकारों को उनको भर्ती और तत्पश्चात वर्ष में कम से कम एक बार प्रशिक्षण प्रदान करे।

(च) जैव चिकित्सा अपशिष्ट प्रबंधन के लिए उनके द्वारा आयोजित प्रशिक्षण में अधिभोगी की सहायता करना।

(छ) जैव चिकित्सा अपशिष्ट के हथालन में संक्रमण की आशंका वाले रोगों, जिनमें हैपेटाइटिस बी और टिटनेस शामिल हैं, के बचाव हेतु जैव चिकित्सा अपशिष्ट के हथालन में अन्तवर्लित अपने सभी कर्मकारों की समुचित ढंग से तैनाती पूर्व चिकित्सा जांच और कम से कम वर्ष में एक बार चिकित्सा जांच और प्रतिरक्षण करवाना जिनके जैव चिकित्सा अपशिष्ट के हथालन के दौरान फैलने की संभावना है तथा उसके अभिलेख का अनुरक्षण करना;

(ज) जैव चिकित्सा अपशिष्ट के हथालन में अंतवर्लित अपने सभी कर्मकारों को समुचित और पर्याप्त व्यक्तिगत संरक्षणकारी उपस्कर प्रदान करते हुए उनकी वृतिक सुरक्षा सुनिश्चित करना;

(झ) जैव चिकित्सा अपशिष्ट के हथालन के दौरान अग्नि संकट, विस्फोट जैसी दुर्घटनाओं सहित प्रमुख दुर्घटनाओं और की गई उपचारात्मक कार्रवाई की सूचना प्ररूप 1 में (शून्य सूचना सहित) विहित प्राधिकारी को और साथ ही वार्षिक रिपोर्ट भी दी जाएगी।

(ञ) अपने प्रत्येक उपचार उपस्कर के लिए बैच के भार, उपचारित अपशिष्ट की श्रेणियों, शोधन चक्र के समय, तारीख और अवधि तथा प्रचालन के कुल घंटों के अनुसार एक लाग बुक रखना।

(ट) जो अधिभोगी प्रचालक को शोधन के लिए अपशिष्ट दे रहे हैं, उन्हें यह देखने की अनुमति देना कि उपचार नियमों के अनुसार किया गया है;

(ठ) प्राधिकरण उपचार, वार्षिक रिपोर्ट आदि के ब्यौरे अपनी वेबसाइट पर प्रदर्शित करेगा।

(ड) विकृत कर दिए जाने या कतरन बना दिए जाने के बाद, जो भी लागू होता हो, ऑटोक्लेविंग या माइक्रोवेविंग द्वारा शोधन सुनिश्चित करने के बाद शोधित जैव-चिकित्सा अपशिष्टों में से पुन:चक्रण योग्य पदार्थों को, जैसे कि प्लास्टिक और शीशा आदि, ऐसे पुन: चक्रणकर्ताओं को दिया जाएगा जिनके पास संबंधित राज्य प्रदूषण नियंत्रण बोर्ड या प्रदूषण नियंत्रण समिति की विधिमान्य सहमति, प्राधिकार या रजिस्ट्रीकरण हो;

(ढ) यदि अपेक्षित हो तो अधिभोगी को प्रभार्य आधार पर गैर-क्लोरिनेटेड प्लास्टिक की रंगीन थैलियों की आपूर्ति करेगा।

(ण) साझा जैव चिकित्सा अपशिष्ट शोधन सुविधा छुट्टी के दिन भी जैव-चिकित्सा अपशिष्ट का संग्रहण सुनिश्चित करेगी।

(त) भस्मन यंत्र, हाइड्रूर ऑटोक्लेविंग के प्रचालन का समस्त रिकॉर्ड पांच वर्ष की अवधि तक रखेगा।

(थ) सेकेंड्री चैम्बर और डाइऑक्सिन और फुरान में बनाए रखने के मानक प्राप्त करने के लिए विद्यमान भस्मन यंत्रों का उन्नयन इस अधिसूचना की तारीख से दो वर्ष के अंदर करेगा।

6. **प्राधिकारियों के कर्तव्य.-** अनुसूची-III के स्तंभ (2) में विनिर्दिष्ट प्राधिकारी इन नियमों के उपबंधों के अनुसार उक्त अनुसूची के स्तंभ (3) में यथा-विनिर्दिष्ट कर्तव्यों का पालन करेगा।

7. **उपचार और व्ययन.-** (1) स्वास्थ्य अनुरक्षण सुविधा और साझा जैव चिकित्सा अपशिष्ट शोधन सुविधा द्वारा जैव चिकित्सा अपशिष्ट का शोधन और व्ययन अनुसूची-I के अनुसार और अनुसूची-2 में उपबंधित मानकों के अनुपालन में किया जाएगा।

(2) अधिभोगी अनुसूची-I के अनुसार पृथक किए गए अपशिष्ट को उपचारित, प्रसंस्करण और अंतिम निपटान के लिए साझा जैव चिकित्सा अपशिष्ट शोधन सुविधा को सौंपेगा :

परन्तु यह कि प्रयोगशाला और उत्पन्न होने वाले अत्यधिक संक्रमित जैव-चिकित्सा अपशिष्ट का ऑटोक्लेव या माइक्रोवेव जैसे उपस्कर द्वारा पूर्व-शोधन किया जाए।

(3) कोई भी अधिभोगी स्थल पर शोधन और निपटान सुविधा स्थापित नहीं करेगा, यदि साझा जैव चिकित्सा अपशिष्ट शोधन सुविधा पचहत्तर कि.मी. की दूरी पर उपलब्ध है।

(4) जिस मामले में साझा जैव चिकित्सा अपशिष्ट शोधन की सेवा उपलब्ध नहीं है उसमें अपना प्रचालन प्रारम्भ करने से पूर्व अधिभोगी विहित प्राधिकारी द्वारा दिए गए प्राधिकार के अनुसार भस्मन यंत्र, ऑटोक्लेव या माइक्रोवेव, श्रेडर जैसे अपेक्षित जैव-चिकित्सा अपशिष्ट शोधन उपकरण स्थापित करेगा।

(5) किसी साझा जैव-चिकित्सा अपशिष्ट शोधन सुविधा के अधिभोगी या प्रचालक सहित कोई भी व्यक्ति जिसका जैव-चिकित्सा अपशिष्ट के उपचार हेतु अनूसची-I में सूचीबद्ध से भिन्न उपचार की नई प्रौद्योगिकियों का उपयोग करने का आशय है, वह केन्द्रीय सरकार से मानकों या प्राचलित प्राचलों के निर्धारण हेतु अनुरोध करेगा।

(6) केन्द्रीय सरकार उप नियम (5) में निर्दिष्ट अनुरोध की प्राप्ति पर नई प्राद्योगिकी के मानकों और प्राचलित प्राचलों को अवधारित करेगी और राजपत्र में प्रकाशित करेगी।

(7) साझा जैव चिकित्सा अपशिष्ट शोधन सुविधा का प्रत्येक प्रचालक अपना प्रचालन आरंभ करने से पहले शोधन के एक भाग के रूप में भस्मन यंत्र, ऑटोक्लेव या माइक्रोवेव, श्रेडर और बहि:स्राव शोधन संयंत्र स्थापित करेगा।

(8) प्रत्येक अधिभोगी द्वारा इन नियमों के प्रकाशन की तारीख से दो वर्ष के अंदर गैर-क्लोरीनीकृत प्लास्टिक की थैलियों का उपयोग बंद कर दिया जाएगा। ऐसे नियमों के प्रकाशन की तारीख से दो वर्ष के बाद क्लोरीनीकृत प्लास्टिक की थैलियों का उपयोग जैव-चिकित्सा अपशिष्ट के भंडारण और परिवहन के लिए नहीं किया जाएगा तथा साझा जैव चिकित्सा अपशिष्ट शोधन सुविधा का अधिभोगी या प्रचालक भस्मन के द्वारा इस प्रकार की थैलियों का निपटान नहीं करेगा और जैव-चिकित्सा अपशिष्ट के भंडार एवं परिवहन के लिए उपयोग में लाई गई थैलियां भारतीय मानक ब्यूरो द्वारा प्रकाशित किए जाने वाले मानकों के अनुरूप होंगी। जब तक मानक प्रकाशित नहीं किए जाते तब तक कैरी बैग प्लास्टिक अपशिष्ट प्रबंधन नियम, 2011 के अनुसार होंगे।

(9) विकृत या कतरन कर दिए जाने के बाद, जो भी लागू हो, ऑटोक्लेविंग या माइक्रोवेविंग द्वारा शोधन सुनिश्चित करने के बाद शोधित जैव चिकित्सा अपशिष्ट से पुन:चक्रण योग्य वस्तुएं जैसे कि प्लास्टिक और शीशा आदि ऐसे पुन:चक्रकों को दी जाएंगी जिनके पास संबंधित विहित प्राधिकारी से विधि मान्य प्राधिकार या रजिस्ट्रीकरण होगा।

(10) साझा जैव चिकित्सा अपशिष्ट शोधन सुविधा का अधिभोगी या प्रचालक उप-नियम (9) में निर्दिष्ट ऐसे पुन:चक्रण योग्य अपशिष्ट का रिकॉर्ड रखेगा जिसकी नीलामी या बिक्री की गई है और उसे वार्षिक रिपोर्ट के भाग के रूप में विहित प्राधिकारी को प्रस्तुत किया जाएगा। यह रिकॉर्ड विहित प्राधिकारी द्वारा निरीक्षण के लिए खुला रखा जाएगा।

(11) समस्त पारे के अपशिष्ट और सीसा के अपशिष्ट का निपटान संबंधित नियमों और विनियमों के अनुसार किया जाएगा।

8. **पृथक्ककरण, पैकेजिंग, परिवहन और भंडारण**.- (1) अनुपचारित जैव चिकित्सा अपशिष्ट को अन्य अपशिष्टों के साथ नहीं मिलाया जाएगा।

(2) जैव चिकित्सा अपिशष्ट को उसके भंडारण, परिवहन, उपचार और व्ययन से पहले अनुसूची-I के अनुसार सृजन के स्थान पर आधान या थैलों में पृथक किया जाएगा।

(3) उप नियम (2) में निर्दिष्ट आधान या बैग पर अनुसूची-IV में यथा-विनिर्दिष्ट लेबल लगाया जाएगा।

(4) अधिभोगी और साझा जैव चिकित्सा अपशिष्ट शोधन सुविधा द्वारा एक वर्ष अंदर बार कोड और ग्लोबल पोजीशनिंग प्रणाली जोड़ी जाएगी।

(5) साझा जैव चिकित्सा अपशिष्ट शोधन सुविधा का प्रचालक किसी ऑफ साइट जैव चिकित्सा अपशिष्ट शोधन सुविधा के लिए किसी अधिभोगी के परिसर से जैव-चिकित्सा अपशिष्ट का परिवहन केवल ऐसे वाहनों में करेगा जिन पर अनुसूची-IV के भाग 'ख' में यथा विनिर्दिष्ट आवश्यक सूचना के साथ अनुसूची-IV के भाग 'क' में यथा-उपबंधित लेवल लगे हों ।

(6) जैव चिकित्सा अपशिष्ट के परिवहन के लिए उपयोग में लाए गए वाहन इस प्रकार के संक्रमित अपशिष्ट के परिवहन के लिए मोटर वाहन अधिनियम 1988 (1988 का 59) में अंतर्विष्ट अपेक्षाओं, यदि कोई हो, के अतिरिक्त राज्य प्रदूषण नियंत्रण बोर्ड या प्रदूषण नियंत्रण समिति अधीन या इसके तहत बनाए गए नियमों द्वारा निर्धारित शर्तों, यदि कोई हो, का पालन करेंगे।

(7) गैर-शोधित मानव शरीर अपशिष्ट, पशु शरीर अपशिष्ट, ठोस अपशिष्ट या जैव प्रौद्योगिकी अपशिष्ट का भंडारण अड़तालीस घंटे से अधिक अवधि के लिए नहीं किया जाएगा।

परंतु शर्त यह है कि यदि किसी कारण से इस प्रकार का अपशिष्ट इस अवधि से अधिक भंडारण करना आवश्यक हो जाता है तो अधिभोगी यह सुनिश्चित करने के लिए समुचित उपाय करेगा कि यह अपशिष्ट मानव स्वास्थ्य और पर्यावरण पर विपरीत प्रभाव न डाले और ऐसा करने के कारणों की सूचना विहित प्राधिकरण को देगा।

(8) पैकिंग करने और साझा जैव चिकित्सा अपशिष्ट शोधन सुविधा को भेजने से पहले सूक्ष्म जीव विज्ञान अपशिष्ट और समस्त अन्य क्लिनिकल प्रयोगशाला अपशिष्ट को स्टेरिलाइजेशन टु लॉग 6 अथवा डिसइनफेक्शन टु लॉग 4 के द्वारा पूर्व उपचारित किया जाएगा।

9. **विहित प्राधिकरण.-** (1) इन नियमों के उपबंधों के कार्यान्वयन के लिए विहत प्राधिकरण राज्यों के संबंध में राज्य प्रदूषण नियंत्रण बोर्ड और संघ राज्य क्षेत्रों में प्रदूषण नियंत्रण समितियां होंगी।

(2) सभी स्वास्थ्य देखभाल प्रतिष्ठानों के संबंध में, जिसके अंतर्गत रक्षा मंत्रालय के अधीन सशस्त्र सेना के अस्पतालों, नर्सिंग होम, क्लीनिकों, औषधालयों, पशु-चिकित्सा संस्थानों, पशु-गृह, विकृति विज्ञान प्रयोगशालाओं और रक्त बैंक भी हैं इन नियमों के उपबंधों के प्रवर्तन हेतु विहित प्राधिकारी महानिदेशक, सहस्त्र सेना चिकित्सा सेवाएं को रक्षा मंत्रालय के पर्यवेक्षण और नियंत्रण के अधीन कार्य करेगा।

(3) विहित प्राधिकरण इन नियमों की अनुसूची-III में यथा-अनुबद्ध उत्तरदायित्वों का अनुपालन करेगा।

10. **प्राधिकार के लिए प्रक्रिया.-** जैव चिकित्सा का अपशिष्ट का हथालन करने वाला प्रत्येक अधिभोगी या प्रचालक, मात्रा चाहे जो भी हो, प्राधिकार की मंजूरी के लिए विहित प्राधिकरण अर्थात राज्य प्रदूषण नियंत्रण बोर्ड या प्रदूषण नियंत्रण समिति को प्ररूप-2 में आवेदन करेगा और विहित प्राधिकरण प्ररूप 3 में अनंतिम प्राधिकार मंजूर करेगा और बिस्तर वाली स्वास्थ्य देखभाल सुविधा और साझा सुविधा के प्रचालक के लिए उक्त प्राधिकार की विधिमान्यता, सहमतियों की विधिमान्यता की समकालिक (एक समय) होगी।

(1) बिना बिस्तर वाले अधिभोगियों को एक बार का प्राधिकार दिया जाएगा और इस प्रकार के मामलों में प्राधिकार को अनुदत्त मान लिया जाएगा यदि विहित प्राधिकारी से सम्यक रूप से संपूर्ण आवेदन के साथ आवश्यक दस्तावेजों के प्राप्त होने के नब्बे दिन की अवधि के अंदर उस पर कोई आपत्ति प्राप्त नहीं होती है।

(2) विहित प्राधिकारी द्वारा प्राधिकार के नवीकरण के लिए मना करने, रद्द करने या निलंबित करने के मामले में कारणों को लिखित रूप में लेखबद्ध किया जाएगा।

बशर्ते कि प्राधिकार के लिए मना करने से पूर्व विहित प्राधिकारी आवेदक को सुनवाई के लिए एक अवसर देगा।

(3) प्राधिकार के लिए प्रत्येक आवेदन का निपटान विहित प्राधिकारी द्वारा आवश्यक दस्तावेजों के साथ सम्यक रूप से पूर्ण आवेदन प्राप्त होने की तारीख से नब्बे दिन के अंदर किया जाएगा, जिसके न होने पर यह मान लिया जाएगा कि इन नियमों के अधीन प्राधिकार मंजूर कर दिया गया है।

(4) जैव चिकित्सा अपशिष्ट के उत्पादन, हथालन, उपचार और निपटान में कोई परिवर्तन हो जाने के मामले में, जिसके लिए पूर्व में प्राधिकार मंजूर किया गया था, अधिभोगी या प्रचालक कार्यकलाप में बदलाव या अंतर के बारे में विहित प्राधिकारी को सूचित करेगा और प्राधिकार की शर्तों में संशोधन के लिए प्ररूप 2 में नए सिरे से आवेदन प्रस्तुत करेगा।

11. **सलाहकार समिति.-** (1) संबंधित राज्य में इन नियमों के कार्यान्वयन का निरीक्षण करने और किसी सुधार की सलाह देने के लिए प्रत्येक राज्य सरकार या संघ राज्य क्षेत्र का प्रशासन संबंधित स्वास्थ्य सचिव की अध्यक्षता में संबंधित राज्य या संघ राज्य क्षेत्र के लिए एक सलाहकार समिति का गठन करेगा। इस समिति में उस राज्य या संघ राज्य क्षेत्र प्रशासन के स्वास्थ्य, पर्यावरण, शहरी विकास, पशुपालन और पशुचिकित्सा विज्ञान के विभागों या राज्य प्रदूषण नियंत्रण बोर्ड या प्रदूषण नियंत्रण समिति, शहरी स्थानीय निकायों या स्थानीय निकायों या नगर निगमों के प्रतिनिधि, भारतीय चिकित्सा संघ, साझा जैव चिकित्सा अपशिष्ट शोधन सुविधा और गैर-सरकारी संगठन के प्रतिनिधि शामिल होंगे।

(2) उप-नियम (1) में अन्तर्विष्ट किसी बात के होते हुए भी रक्षा मंत्रालय द्वारा महानिदेशक, सशस्त्र सेना स्वास्थ्य सेवा की अध्यक्षता में उक्त समिति गठित की जाएगी जिसमें रक्षा मंत्रालय, पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय, केन्द्रीय प्रदूषण नियंत्रण बोर्ड, स्वास्थ्य एवं परिवार कल्याण मंत्रालय, सशस्त्र सेना चिकित्सा कॉलेज या कमान अस्पताल के प्रतिनिधि शामिल होंगे।

(3) उप-नियम (1) और (2) के अधीन गठित यह समिति कम से कम छ: महीने में एक बार बैठक करेगी और यथा-स्थिति राज्य और सशस्त्र सेना स्वास्थ्य देखभाल सुविधाओं में इन नियमों के उपबंध के लागू होने संबंधी सभी मामलों की समीक्षा करेगी।

(4) स्वास्थ्य मंत्रालय और रक्षा मंत्रालय जैव चिकित्सा अपशिष्ट प्रबंध के क्षेत्र में विशेषज्ञता रखने वाले अन्य सरकारी और गैर-सरकारी संगठनों के प्रतिनिधियों को सहयोजित कर सकते हैं।

12. **स्वास्थ्य देखभाल सुविधाओं में नियमों के लागू होने की मॉनीटरिंग.-** (1) राज्य स्वास्थ्य सचिवों और राज्य प्रदूषण नियंत्रण बोर्डों और केन्द्रीय प्रदूषण नियंत्रण बोर्ड के अध्यक्षों या सदस्य-सचिवों के माध्यम से पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय वर्ष में एक बार देश में इन नियमों के कार्यान्वयन की समीक्षा करेगा और मंत्रालय, यदि अपेक्षित हो, तो जैव चिकित्सा अपशिष्ट प्रबंध के क्षेत्र के विशेषज्ञों को आमंत्रित कर सकता है।

(2) केन्द्रीय प्रदूषण नियंत्रण बोर्ड रक्षा मंत्रालय के अधीन समस्त सशस्त्र सेना स्वास्थ्य देखभाल स्थापनाओं के संबंध में इन नियमों के लागू होने की मॉनीटरिंग करेगा।

(3) महानिदेशक, सशस्त्र सेना चिकित्सा सेवा को पूर्व सूचना देने के बाद केन्द्रीय प्रदूषण नियंत्रण बोर्ड नियम 11 के उप-नियम (2) के अधीन गठित सलाहकार समिति के एक या अधिक प्रतिनिधियों के साथ किसी भी सशस्त्र सेना स्वास्थ्य देखभाल स्थापना का निरीक्षण कर सकता है।

(4) जैव चिकित्सा अपशिष्ट पैदा करने वाली स्वास्थ्य देखभाल सुविधाओं और साझा जैव चिकित्सा अपशिष्ट शोधन और निपटान सुविधाओं में, जिनमें जैव-चिकित्सा अपशिष्ट का शोधन और निपटान किया जाता है, इन नियमों के उपबंधों के अनुपालन की मॉनीटरिंग करने के लिए प्रत्येक राज्य सरकार या संघ राज्य क्षेत्र का प्रशासन जिला नियंत्रक या जिला मजिस्ट्रेट या उपायुक्त या अपर जिला मजिस्ट्रेट की अध्यक्षता में जिलों में जिला स्तरीय मॉनीटरिंग समिति गठित की जाएगी।

(5) उप-नियम (4) के अधीन गठित जिला स्तरीय मॉनीटरिंग समिति अपनी रिपोर्ट छह महीने में एक बार राज्य सलाहकार समिति को प्रस्तुत करेगी और उसकी एक प्रति आगे आवश्यक कार्रवाई के लिए संबंधित राज्य प्रदूषण नियंत्रण बोर्ड या प्रदूषण नियंत्रण समिति को भी भेजेगी।

(6) जिला स्तरीय मॉनीटरिंग समिति में जिला चिकित्सा अधिकारी या जिला स्वास्थ्य अधिकारी, राज्य प्रदूषण नियंत्रण बोर्ड या प्रदूषण नियंत्रण समिति, लोक स्वास्थ्य इंजीनियरी विभाग, स्थानीय निकायों, नगर निगम, भारतीय चिकित्सा संघ, साझा जीवचिकित्सा अपशिष्ट शोधन सुविधा और जैव-चिकित्सा अपशिष्ट प्रबंध के क्षेत्र में कार्यरत रजिस्ट्रीकृत गैर-सरकारी संगठनों के प्रतिनिधि शामिल होंगे और यह समिति, यदि आवश्यक हो, तो अन्य सदस्यों और विशेषज्ञों के सहयोजित कर सकती है और जिला चिकित्सा अधिकारी इस समिति के सदस्य-सचिव होंगे।

13. **वार्षिक रिपोर्ट.-** (1) साझा जैव-चिकितसा अपशिष्ट शोधन सुविधा का प्रत्येक अधिभोगी या प्रचालक प्रत्येक वर्ष 30 जून तक प्ररूप 4 में विहित प्राधिकारी वार्षिक रिपोर्ट प्रस्तुत करेगा।

(2) विहित प्राधिकारी प्राप्त सूचना का समेकन, समीक्षा और विश्लेषण करेगा और इस सूचना को प्रत्येक वर्ष 31 जुलाई को या उससे पूर्व केन्द्रीय प्रदूषण नियंत्रण बोर्ड को भेजेगा।

(3) केन्द्रीय प्रदूषण नियंत्रक बोर्ड प्राप्त सूचना का समेकन, समीक्षा और विश्लेषण करेगा और अपनी टिप्पणियों या सुझावों या पर्यवेक्षणों के साथ इन सूचनाओं को प्रत्येक वर्ष 31 अगस्त को या उससे पूर्व पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय को भेजेगा।

(4) अधिभोगियों, राज्य प्रदूषण नियंत्रण बोर्डों और केन्द्रीय प्रदूषण नियंत्रण बोर्ड की वेबसाइटों पर सभी की वार्षिक रिपोर्टें भी ऑनलाइन उपलब्ध रहेंगी।

14. **अभिलेखों को रखना.-** (1) प्रत्येक प्राधिकृत व्यक्ति इन नियमों के अनुसार और केन्द्रीय सरकार या केन्द्रीय प्रदूषण नियंत्रण बोर्ड, जैसी भी स्थिति हो, द्वारा जारी मार्गदर्शक सिद्धांतों के अनुसार पांच वर्ष की अवधि के लिए जैव-चिकित्सा अपशिष्ट के उत्पादन, संग्रहण, प्राप्ति, भंडारण, परिवहन, उपचार, निपटान या हथालन के किसी अन्य प्रकार से संबंधित रिकॉर्ड रखेगा।

(2) समस्त रिकॉर्ड किसी भी समय विहित प्राधिकारी और पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय के निरीक्षण और सत्यापन के अध्यधीन होंगे।

15. **दुर्घटना की सूचना देना.-** (1) जैव-चिकित्सा अपशिष्ट का हथालन करते समय किसी संस्था या सुविधा या किसी स्थल पर कोई भारी दुर्घटना हो जाने के मामले में प्राधिकृत व्यक्ति ऐसी दुर्घटना के बारे में विहित प्राधिकारी को तत्काल सूचित करेगा और चौबीस घंटे के अंदर प्ररूप 1 में लिखित रूप में किए गए उपचारात्मक उपायों के बारे में सूचित करेगा।

(2) सभी अन्य दुर्घटनाओं और किए गए उपचारात्मक उपायों के बारे में सूचना अधिभोगी द्वारा नियम 13 के अनुसार विहित प्राधिकारी को वार्षिक रिपोर्ट में उपलब्ध कराई जाएगी।

16. **अपील.-** (1) इन नियमों के अधीन विहित प्राधिकारी द्वारा किए गए आदेश से कोई भी व्यक्ति उस तारीख से जिसको उसे आदेश की संसूचना दी जाती है, तीस दिन के अवधि के भीतर राज्य सरकार या संघ राज्य क्षेत्र प्रशासन के सचिव (पर्यावरण) को प्ररूप 5 में अपील कर सकेगा।

(2) इन नियमों के अधीन सशस्त्र सेना चिकित्सा सेवा के महानिदेशक के आदेश से व्यथित कोई भी व्यक्ति, उस तारीख से, जिसको उसे आदेश संसूचित किया जाता है, तीस दिन के भीतर सचिव, पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय को प्ररूप 5 में अपील प्रस्तुत कर सकता है।

(3) यथा स्थिति उप पैरा (1) और (2) में निर्दिष्ट प्राधिकारी तीस दिनों की उक्त अवधि के समाप्त होने के पश्चात अपील पर ग्रहण कर सकेगा, यदि वह उसका यह समाधान हो जाता है कि अपीलार्थी को समय पर अपील फाइल न कर पाने के पर्याप्त कारण से रोका गया था।

(4) अपील का निपटान उसे फाइल करने के तारीख से नब्बे दिन के भीतर किया जाएगा।

17. **साझा जैव चिकित्सा अपशिष्ट शोधन और निपटान सुविधा के लिए स्थल.-** (1) इन नियमों के नियम 5 पर प्रतिकूल प्रभाव डाले बिना जिस विभाग को भूमि समनुदेशित करने का कार्य आवंटित किया गया है वह राज्य सरकार या संघ राज्य क्षेत्र प्रशासन में साझा जैव-चिकित्सा अपशिष्ट शोधन और निपटान सुविधा स्थापित करने हेतु उपयुक्त स्थल उपलब्ध कराने के लिए जिम्मेदार होगा।

(2) ऐसी सुविधा की स्थापना हेतु स्थल का चयन विहित प्राधिकारी, अन्य पण धारकों के परामर्श से और पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय अथवा केन्द्रीय प्रदूषण नियंत्रण बोर्ड द्वारा प्रकाशित मार्गदर्शक सिद्धान्तों के अनुसरण किया जाएगा।

18. **सुविधा के अधिभोगी, प्रचालक का दायित्व.-** (1) साझा जैव चिकित्सा अपशिष्ट शोधन सुविधा का अधिभोगी अथवा प्रचालक जैव अचिकित्सा अपशिष्टों के अनुचित हथालन के कारण पर्यावरण अथवा जनता को होने वाली नुकसानियों के लिए उत्तरदायी होगा।

(2) साझा जैव चिकित्सा अपशिष्ट शोधन सुविधा का अधिभोगी या प्रचालक किसी भी अतिक्रमण के मामले में अधिनियम की धारा 5 और धारा 15 के अधीन कार्रवाई के लिए दायी होगा।

अनुसूची-I

[नियम 3 (ङ), 4(ख), 7(1), 7(2), 7(5), 7(6) और 8(2) देखें]

भाग-1

जैव-चिकित्सीय अपशिष्टों की श्रेणियां तथा उनके पृथक्करण, संग्रहण, उपचार, प्रसंस्करण के विकल्प

श्रेणी	अपशिष्ट का प्रकार	प्रयोग की जाने वाली थैली/आधान का प्रकार	उपचार और निपटान विकल्प
(1)	(2)	(3)	(4)
पीला	**(क) मानवीय शारीरिक अपशिष्ट:** मानवीय ऊतक, अंग, शरीर के अवयव जीवनक्षम अवधि से कम के भ्रूण (समय-समय पर संशोधित गर्भ या चिकित्सा समापन अधिनियम, 1971 के अनुसार)	पीले रंग की गैर क्लोरीनीकृत प्लास्टिक की थैलियां	भस्मन या प्लाज्मा पाइरोलाइसिस या गहरा दबाना*
	(ख) पशु शारीरिक अपशिष्ट : पशु चिकित्सालयों या महाविद्यालयों अथवा पशु गृहों से उत्पन्न अपशिष्ट सहित प्रयोगात्मक पशु मृत शरीर, शरीर के		

	अवयव, अंग, ऊतक।		
	(ग) ठोस अपशिष्ट : रक्त शारीरिक स्राव से युक्त मदें जैसे, पट्टी, प्लास्टर, कास्ट, कपड़े की झाड़ने और अवशेष या निष्प्रयोजन रक्त और रक्त के घटकों से भरी थैलियां।		भस्मन या प्लाज्मा पाइरोलाइसिस या गहरा दबाना* उपर्युक्त सुविधाओं की अनुपस्थिति में; ऑटोक्लेविंग अथवा माइक्रो-वेविंग/ हाइड्रोक्लेविंग के बाद श्रेडिंग अथवा म्युटिलेशन अथवा स्टेराइलिजेशन और श्रेडिंग। शोधित अपशिष्ट को ऊर्जा पुन: प्राप्ति हेतु भेजा जाएगा।
	(घ) अवसित या व्यक्त दवाइयां : औषधीय अपशिष्ट जैसे कि एंटिबायोटिक्स, साइटोटॉक्सिक औषधियां जिसमें शीशे के साथ साइटोटॉक्सिक औषधियों से संदूषित सभी मदें, प्लास्टिक एम्पूल, गोलियां आदि शामिल हैं।	गैर-क्लोरीनीकृत पीले रंग की प्लास्टिक की थैलियां अथवा आधान	अवसित साइटोटॉक्सिक दवाइयां और साइटोटॉक्सिक दवाइयों से संदूषित दवाइयां >1200 डिग्री से. तापमान पर भस्म करने के लिए विनिर्माता या आपूर्तिकर्ता को वापस कर दी जाएं या >1200 डिग्री से. तापमान पर भस्म करने के लिए साझा जैव चिकित्सा अपशिष्ट शोधन सुविधा या परिसंकटमय अपशिष्ट उपचार, भंडारण और निपटान सुविधा को भेज दी जाएं या >1200 डिग्री से. तापमान एनकेप्सुलेशन या प्लाज्मा पाइरोलाइसिस किया जाए। अन्य सभी अवसित दवाइयां या तो विनिर्माता को वापस भेज दी जाएं या भस्म करके निपटान कर दिया जाए।
	(ड.) रासायनिक अपशिष्ट : जैव-विज्ञान संबंधी मदों के उत्पादन में उपयोग में लाए गए या व्यक्त विसंक्रामकों के लिए उपयोग में लाए गए रसायन।	गैर-क्लोरीनीकृत पीले रंग की प्लास्टिक की थैलियां या आधान	परिसंकटमय अपशिष्ट उपचार, भंडारण और निपटान सुविधा में भस्मीकरण या प्लाज्मा पाइरोलासिस या एनकेप्सुलेशन द्वारा निपटान किया जाए।
	(च) रासायनिक द्रव अपशिष्ट : जीव विज्ञान संबंधी मदों के उत्पादन या अतिक्रांत विसंक्रामकों के लिए, उपयोग में लाए जाने के कारण द्रव अपशिष्ट सिल्वर एक्स-रे फिल्म विकसित करने वाला द्रव, निष्प्रयोजन फोरमेलिन,	बहि:स्राव शोधन प्रणाली में जाने वाली अलग संग्रहण प्रणाली	रिकवरी के बाद, रासायनिक द्रव अपशिष्ट को अन्य जल में मिश्रित होने से पहले पूर्व-उपचारित किया जाएगा। संयुक्त निस्सरण अनुसूची-III में दिए गए निस्सरण सन्नियमों के अनुरूप होगा।

	संक्रमित स्राव, एस्पाइरेटेड शरीर द्रव, प्रयोगशालाओं, फर्श की सफाई, धुलाई, हाउस कीपिंग और विसंक्रमण कार्यकलापों से निकलने वाले द्रव।		
	(छ) रक्त अथवा शरीरिक द्रव से संदूषित फेंके गए लीनेन, बिस्तर	गैर-क्लोरीनीकृत पीली प्लास्टिक की थैलियां या उपयुक्त पैकिंग सामग्री	गैर-क्लोरीनीकृत रासायनिक विसंक्रमण के बाद भस्मन या प्लाज्मा पाइरोलाइसिस या एनर्जी रिकवरी द्वारा। उपर्युक्त सुविधाओं की अनुपस्थिति में, श्रेडिंग अथवा म्युटिलेशन अथवा स्टेराइलिजेशन तथा श्रेडिंग का मिश्रण/उपचारित अपशिष्ट को ऊर्जा प्राप्ति अथवा भस्मन अथवा प्लाज्मा पाइरोलाइसिस के लिए भेजा जाए।
	(ज) सूक्ष्मजैविकी, जैव प्रौद्योगिकी और अन्य क्लीनिकल प्रयोगशाला अपशिष्ट : प्रयोगशाला संवर्धों, सूक्ष्म जीवों के संग्रह या नमूने, सजीव या अनुकूल टीके, अनुसंधान और औद्योगिक प्रयोगशालाओं में प्रयुक्त मानवीय और पशु कोशिका संवर्धों, जैविकों, अवशेष जीवविषों, संबंधों हेतु प्रयुक्त पात्रों और यंत्रों का उत्पादन।	ऑटोक्लेव सुरक्षित प्लास्टिक की थैलियां या आधान	इसके बाद भस्मन के लिए राष्ट्रीय एड्स नियंत्रण संगठन अथवा विश्व स्वास्थ्य संगठन के मार्गदर्शक सिद्धान्तों के अनुसार स्थल पर गैर क्लोरीनीकृत रसायनों से पूर्व उपचारित अथवा स्टेरेलाइज ।
लाल	**संदूषित अपशिष्ट (पुनर्चक्रण योग्य) :** (क) ट्यूबिंग्स, बोतलों, इंट्रावीनस ट्यूबों और सेटों, कैथेटरों, मूत्र की थैलियों, सिरिंजों (बिना सूई वाला और सूई लगी सिरिंज तथा वैक्युटेनरों, जिनकी सूई कटी हो और दस्तानों) जैसी निपटान	लाल रंग की गैर-क्लोरीनीकृत प्लास्टिक थैलियां या आधान	ऑटोक्लेविंग या माइक्रोवेविंग/ हाइड्रोक्लेविंग के पश्चात श्रेडिंग या म्युटिलेशन या श्रेडिंग और विसंक्रमण का संयोजन। उपचारित अपशिष्ट रजिस्ट्रीकृत या प्राधिकृत पुनर्चक्रकों को या एनर्जी रिकवरी के लिए या प्लास्टिक डीजल या ईंधन तेल या सड़क बनाने के लिए जो भी संभव हो, भेजा जाए। प्लास्टिक अपशिष्ट भू-भरण स्थलों पर नहीं भेजना चाहिए।

	योग्य मदों से उत्पन्न अपशिष्ट।		
सफेद (पारभासी)	**धातुओं सहित नोंकदार अपशिष्ट :** सूइयां, सूइयां लगी सिरिंजें, सूई की नोक के कटर या बर्नर से निकली सूइयां, स्कालपेल्स, ब्लेड या कोई अन्य संदूषित नोकदार वस्तु जो वेधन और कर्तन का कारण बन करती है। इसमें प्रयुक्त, निष्प्रयोजन और संदूषित नोकदार धातु की वस्तुएं शामिल हैं।	पंक्चर प्रूफ, लीक प्रूफ, टेंपर प्रूफ आधान	ऑटोक्लेविंग या शुष्क ऊष्मा विसंक्रमण उसके पश्चात धातु के कंटेनर या सीमेंट कंक्रीट में श्रेडिंग या म्युटिलेशन या एनकेप्सुलेशन; श्रेडिंग कम ऑटोक्लेविंग का संयोजन, और अंतिम निपटान के लिए लोहे की संधानशालाओं (जिनके पास राज्य प्रदूषण नियंत्रण बोर्ड या प्रदूषण नियंत्रण समितियों के प्रचालन की सहमति है) या स्वच्छता भू-भरण स्थलों या नामोदिष्ट कंक्रीट अपशिष्ट शार्प पिट के लिए भेज दिया जाए।
नीला	**(क) कांच के बर्तन :** टूटा हुआ त्यक्त या संदूषित कांच, जिसमें दवाई की शीशियां और सम्पूल्स शामिल है परन्तु इसमें साइटोटॉक्सिक अपशिष्ट से संदूषित वस्तुएं शामिल नहीं हैं।	नीले रंग की मार्किंग वाले गत्ते के बक्से	विसंक्रमण (डिटर्जेंट और सोडियम हाइपोक्लोराइट शोधन के साथ साफ करने के बाद डुबा कर धुलाई किया गया कांच का अपशिष्ट) या ऑटोक्लेविंग या माइक्रोवेविंग या हाइड्रोक्लेविंग के जरिए और उसके पुन:चक्रण के लिए भेजें।
	(ख) धातु की बॉडी वाले इम्प्लांट	नीले रंग की मार्किंग वाले गत्ते के बक्से	

*गहरा दबाकर निपटान करने की अनुमति केवल ग्रामीण और सुदूरवर्ती क्षेत्रों में है जहां साझा जैव-चिकित्सा अपशिष्ट उपचार की सुविधा सुलभ नहीं है। ऐसा विहित प्राधिकारी से पूर्व अनुमोदन प्राप्त करके और अनुसूची-3 में विनिर्दिष्ट मानकों के अनुसार किया जाएगा। गहरा दबाने की सुविधा समय-समय पर केन्द्रीय प्रदूषण नियंत्रण बोर्ड जारी उपबंधों और मार्गदर्शक सिद्धान्तों के अनुसार अवस्थित की जाएंगी।

भाग - 2

(1) सभी प्लास्टिक की थैलियां बीआईएस मानकों, जब भी प्रकाशित किए जाएंगे, के अनुसार होंगी तब तक वर्तमान प्लास्टिक अपशिष्ट प्रबंध नियम लागू होंगे।

(2) कम से कम 10% सोडियम हाइपोक्लोराइट का उपयोग करने वाले रासायनिक उपचार को जिसमें बीस मिनट के लिए 30% अवशिष्ट क्लोराइन या कोई अन्य समतुल्य रासायनिक रीजेंट होता है, सूक्ष्म जीव के लिए $Log_{10}4$ ह्रास इफिशिएंसी दर्शानी चाहिए, जैसा कि अनुसूची-III में दिया गया है।

(3) म्युटिलेशन या श्रेडिंग उस सीमा तक करना आवश्यक है जिससे अप्राधिकृत पुन: उपयोग को रोका जा सके।

(4) माइक्रोबायोलॉजिकल, प्रयोगशाला और अत्यधिक संक्रामक अपशिष्ट को छोड़कर भस्मन से पहले कोई रासायनिक पूर्व-उपचार नहीं किया जाएगा।

(5) भस्मन की राख (किसी जैव-चिकित्सा अपशिष्ट के भस्मन से निकलने वाली राख) का निपटान परिसंकटमय अपशिष्ट उपचार, भंडारण और निपटान सुविधा के माध्यम से किया जाएगा यदि उसमें विषाक्त या खतरनाक संघटक खतरनाक अपशिष्ट (प्रबंधन, हथालन और सीमापारीय संचलन) नियम, 2008 दी गई या समय-समय यथा संशोधित विहित सीमा से अधिक पाए जाते हैं।

(6) विधिमान्य अवधि के बाद के मृत भ्रूणों को (समय-समय पर यथा संशोधित एमटीपी अधिसूचना, 1971 के अनुसार) मानव शरीर-रचना का अपशिष्ट माना जा सकता है। ऐसे अपशिष्ट को अस्पताल या चिकित्सा देखभाल स्थापना के प्रसूति-विशेषज्ञ या चिकित्सा अधीक्षक के आधिकारिक गर्भ का चिकित्सीय समापन प्रमाणपत्र के साथ पीली थैली में साझा जैव चिकित्सा अपशिष्ट उपचार और निपटान सुविधा के प्रचालक को सौंपा जाना चाहिए।

(7) साइटोटॉक्सिक औषधि की शीशियां किसी भी परिस्थिति में अप्राधिकृत व्यक्ति को नहीं सौंपनी चाहिए। किसी एक स्थान पर आवश्यक निपटान के लिए इन्हें वापस निर्माता के पास वापस भेजना चाहिए। दूसरे विकल्प के रूप में इन्हें >1200 डिग्री से. तापमान पर साझा जैव चिकित्सा अपशिष्ट शोधन और निपटान सुविधा या परिसंकटमय अपशिष्ट उपचार, भंडारण और निपटान सुविधा या प्लाज्मा पाइरोलिस में भस्मन के लिए भेज दिया जाए।

(8) अवशिष्ट या व्यक्त रासायनिक अपशिष्टों, प्रयुक्त या व्यक्त विसंक्रामकों और रासायनिक गाद का निपटान परिसंकटमय अपशिष्ट उपचार, भंडारण और निपटान सुविधा में किया जा सकता है। इस प्रकार के मामले में, अपशिष्ट को परिसंकटमय अपशिष्ट शोधन, भंडारण और निपटान सुविधा के पास केवल साझा जैव चिकित्सा अपशिष्ट शोधन और निपटान सुविधा के प्रचालक के माध्यम से भेजना चाहिए।

(9) प्रयोगशाला अपशिष्ट, सूक्ष्मजीव अपशिष्ट, रक्त के नमूनों, रक्त की थैलियों को स्थल पर पूर्व उपचारित करके विश्व स्वास्थ्य संगठन या राष्ट्रीय एड्स नियंत्रण संगठन के मार्गदर्शक सिद्धान्तों के अनुसार विसंक्रमित या जीवाणुरहित किया जाना चाहिए और उसके बाद साझा जैव चिकित्सा अपशिष्ट उपचार और निपटान सुविधा को दिया जाना चाहिए।

(10) इन हाउस भस्मक स्थापित करने की अनुमति नहीं है। तथापि, यदि समीप में कोई साझा जैव-चिकित्सा अपशिष्ट निपटान सुविधा नहीं है तो राज्य प्रदूषण नियंत्रण बोर्ड से प्राधिकार प्राप्त करने के बाद अधिभोगी द्वारा इसे स्थापित किया जा सकता है।

(11) सिरिंजो को या तो म्युटिलेम्युटिलेट कर देना चाहिए या सूइयों को काट देना चाहिए तथा अथवा नुकीली वस्तुओं के भंडारण के टेम्पर प्रूफ, लीक प्रूफ और पंचर प्रूफ आधानों में इनका भंडारण करना चाहिए। जहां कहीं अधिभोगी किसी निपटान सुविधा संबद्ध नहीं है विहित रीति के अनुसार विसंक्रमण और निपटान करने की जिम्मेदारी अधिभोगी की होगी।

(12) स्वास्थ्य देखभाल के कार्यकलापों के दौरान घरों में जनित जैव-चिकित्सा अपशिष्ट को इन नियमों के अनुसार पृथक किया जाएगा और अलग थैलियों या आधानों में नगरपालिका के अपशिष्ट संग्रहकर्ता को सौंपा जाएगा। अनूसूची में यथा निहित रीति में अंतिम निपटान के लिए शहरी स्थानीय निकाय, साझा जैव चिकित्सा अपशिष्ट शोधन और निपटान सुविधा के बीच व्यवस्था के अनुसार सामग्री प्रतिप्राप्ति सुविधा (एमआरएफ) से या सीधा घर से इस अपशिष्ट को उठवाने की व्यवस्था करेगा।

अनुसूची-II

[नियम 4(ण), 7(1) और 7(6) देखें]

जैव-चिकित्सा अपशिष्ट के उपचार और निपटान हेतु मानक

1. भस्मक के लिए मानक.-

सभी भस्मक निम्नलिखित प्रचालन और उत्सर्जन मानक पूरे करेंगे.-

क. प्रचालन मानक

(1) दहन दक्षता (CE) कम से कम 99.00%

(2) दहन दक्षता की गणना इस प्रकार की जाती है :

$$CE = \frac{\%CO_2}{\%CO_2 + \%CO} \times 100$$

(3) प्राइमरी चैम्बर का तापमान न्यूनतम 800^0 सेल्सियस और सेकेण्डरी चैम्बर का न्यूनतम तापमान 1050^0 सेल्सियस + या -50^0 सेल्सियस होगा।

(4) सेकेण्डरी चैम्बर में गैस रहने का समय कम से कम दो सेकेंड होगा।

ख. उत्सर्जन मानक

क्र.सं.	पैरामीटर	मानक	
1.	2.	3.	4.
		जब तक सूचित न किया गया हो mg/NM^3 में सांद्रता सीमांत	जब तक सूचित न किया गया हो, मिनट वार सैपलिंग अवधि
1.	महीन कण	50	30 अथवा सैम्पल वॉल्यूम का $1NM^3$ जो भी अधिक हो
2.	नाइट्रोजन ऑक्साइड NO और NO_2	400	ऑनलाइन सैम्पलिंग या ग्रैब सैम्पल के लिए 30
3.	एचसीएल	50	30 या सैम्पल वॉल्यूम का $1NM^3$ का जो भी अधिक हो
4.	कुल डायोक्सिन और फुरान**	0.1 ngTEQ/NM^3 (11% O2 पर)	8 घंटे या सैम्पल वॉल्यूम का 5 NM^3 का जो भी अधिक हो

5.	एचजी और इसके यौगिक	0.05	2 घंटे या सैम्पल वॉल्यूम का 1NM^3 जो भी अधिक हो

(ग). स्टैक ऊंचाई : न्यूनतम स्टैक ऊंचाई भूमि से 30 मीटर ऊपर होगी तथा पर्यावरण (संरक्षण) अधिनियम, 1986 के अधीन यथा अधिसूचित और उत्सर्जन विनियम भाग-3 के केन्द्रीय प्रदूषण नियंत्रण बोर्ड के मार्गदर्शक सिद्धांतों के अनुसार "साधारण प्रांचल पैरामीटरों" की मॉनीटरिंग करने की यथा अपेक्षित आवश्यक मॉनीटरिंग सुविधाओं से जुड़ा होगा।

टिप्पण :

(क) विद्यमान भस्मक अधिसूचना की तारीख से दो वर्ष की अवधि के अंदर उपर्युक्त का अनुपालन करेंगे।

(ख) विद्यमान भस्मक इन नियमों के लागू होने की तारीख से दो वर्ष के भीतर नीचे दिए गए अनुसार डायक्सिनों और फुरान के 0.1 ngTEQ/Nm^3 मानकों का अनुपालन करेंगे।

(ग) भस्मक की सुविधा वाली या कैप्टिव भस्मक वाली आगामी सभी साझा जैव चिकित्सा अपशिष्ट उपचार और निपटान सुविधाएं डायक्सिनों और फुरान के मानकों का अनुपालन करेंगी।

(घ) यदि आवश्यक, हो तो उपर्युक्त उत्सर्जन सीमाओं की प्राप्ति हेतु विद्यमान द्वितीयक भस्मक चेम्बर में उपयुक्त रूप से तैयार किए गए प्रदूषण नियंत्रक यंत्र लगे होने चाहिए या बाद में लगा देने चाहिए।

(ड.) भस्म किए जाने वाले अपशिष्टों को किसी भी प्रकार के क्लोरीनीकृत जीवाणुनाशकों से रासायनिक रूप से शोधित नहीं किया जाएगा।

(च) जैव-चिकित्सा अपशिष्ट के भस्मीकरण से प्राप्त राख का निपटान साझा खतरनाक अपशिष्ट उपचार और निपटान सुविधा के माध्यम से किया जाएगा। तथापि यदि भस्मीकरण राख में विषैली धातुएं समय-समय पर यथा संशोधित परिसंकटमय खतरनाक अपशिष्ट (प्रबंधन और हथालन तथा सीमा-पारीय संचलन) नियम, 2008 के अधीन यथा परिभाषित विनियामक मात्राओं के भीतर हैं तो इनका निपटान नगरीय भूमि भरण स्थल में किया जाएगा।

(छ) भस्मक में ईंधन के रूप में केवल हल्के डीजल ऑयल या न्यून सल्फर भारी स्टॉक या डीजल, संपीड़ित प्राकृतिक गैस, द्रवीभूत प्राकृतिक गैस अथवा द्रवीभूत पेट्रोलियम गैस जैसे केवल न्यून सल्फर ईंधन का प्रयोग किया जाएगा।

(ज) किसी साझा जैव चिकित्सा अपशिष्ट शोधन सुविधा का अधिभोगी या प्रचालक, पर्यावरण (संरक्षण) अधिनियम, 1986 के अधीन अनुमोदित किसी प्रयोगशाला के माध्यम से तीन माह में एक बार स्टैक गैसीय उत्सर्जन (भस्मक की इष्टतम क्षमता के अधीन) की मॉनीटरिंग करेगा और उक्त विश्लेषण परिणामों का अभिलेख रखा जाएगा तथा विहित प्राधिकारी को प्रस्तुत किया जाएगा। डायोक्सिनों और फुरान के मामले में वर्ष में एक बार मॉनीटरिंग की जाएगी।

(झ) साझा जैव चिकित्सा अपशिष्ट प्रबंधन सुविधा का अधिभोगी या प्रचालक प्राधिकार में राज्य प्रदूषण नियंत्रण बोर्ड या प्रदूषण नियंत्रण समितियों द्वारा नियत प्रांचलों के लिए सतत उत्सर्जन मॉनीटरिंग प्रणाली स्थापित करेगा और राज्य प्रदूषण नियंत्रण बोर्ड या प्रदूषण नियंत्रण समितियों और केन्द्रीय प्रदूषण नियंत्रण बोर्ड के सर्वरों के लिए वास्तविक समय के आंकड़े प्रेषित करेगा।

(ञ) सभी मॉनीटरी किए गए मान शुष्क आधार पर 11% ऑक्सीजन तक शुद्ध किए जाएंगे।

(ट) भस्मक (दहन चैम्बर) ऐसे तापमान, धारण समय और विक्षोभ के साथ प्रचालित किए जाएंगे जिससे धातुमल और तली की राख में कुल जैविक कार्बन की मात्रा 3% से कम प्राप्त की जा सके या ज्वलन पर उनकी क्षति शुष्क भार की 5% से कम हो।

(ठ) साझा जैव-चिकित्सीय अपशिष्ट भस्मक का अधिभोगी या प्रचालक CO_2, CO और O_2 को मापने के लिए दहन गैस एनालाइजर का प्रयोग करेगा।

2. प्लाज्मा पाइरोलाइसिस या गैसीफिकेशन द्वारा निपटान के लिए प्रचालन और उत्सर्जन मानक:

क. प्रचालन मानक :

प्लाज्मा पाइरोलाइसिस और गैसीफिकेशन के सभी प्रचालक निम्नलिखित प्रचालन और उत्सर्जन मानकों को पूरा करेंगे :

(1) दहन दक्षता (सीई) कम से कम 99.99% होगी।

(2) दहन दक्षता की गणना नीचे दिए अनुसार की जाती है :

$$\text{सीई} = \frac{\%CO_2}{\%CO_2 + \%CO} \times 100$$

(3) प्लाज्मा गैसीफिकेशन के पश्चात दहन चैम्बर का तापमान 1050 ± 50^0 सेल्सियस होगा जिसके साथ गैस रहने का समय कम से 2 (दो) सेकेंड होगा और स्टैक गैस में कम से कम 3% ऑक्सीजन होगी।

(4) स्टैक की ऊंचाई भूमि से कम से 30 मीटर होगी तथा पर्यावरण (संरक्षण) अधिनियम, 1986 के अधीन यथा अधिसूचित और उत्सर्जन विनियम भाग-3 के केन्द्रीय प्रदूषण नियंत्रण बोर्ड के मार्गदर्शक सिद्धान्तों के अनुसार "साधारण प्राचलों" की मॉनीटरिंग करने की यथा अपेक्षित सुविधाओं से जुड़ा होगा।

ख. वायु उत्सर्जन मानक और वायु प्रदूषण नियंत्रण के उपाय

(i) भस्मक के उत्सर्जन मानक, इस अनुसूची में ऊपर क्रम सं.1 पर अधिसूचित और समय-समय पर संशोधित, प्लाज्मा पाइरोलीसिस या गैसीफिकेशन के लिए भी लागू होंगे।

(ii) यदि आवश्यक हो तो उपर्युक्त उत्सर्जन सीमाओं को पूरा करने के लिए प्लाज्मा पाइरोलीसिस या गैसीफिकेशन के साथ या बाद में उपयुक्त डिजाइन वाले वायु प्रदूषण नियंत्रण उपकरण स्थापित किए जाएंगे।

(iii) प्लाज्मा पाइरोलीसिस या गैसीफिकेशन का उपयोग करके उपचारित किए जाने वाले अपशिष्टों को किसी क्लोरीनीकृत विसंक्रामक से रासायनिक रूप से शोधित नहीं किया जाएगा तथा क्लोरीनीकृत प्लास्टिक इस प्रणाली में शोधित नहीं किया जाएगा।

ग. राख या काचित सामग्री का निपटान : प्लाज्मा पाइरोलीसिस या गैसीफिकेशन से उत्पन्न राख या काचित सामग्री का निपटान यदि संघटक उक्त नियमों की अनुसूची-II के अधीन विहित सीमाओं से अधिक है तो खतरनाक अपशिष्ट (प्रबंधन, हथालन और सीमापारीय संचलन) नियम, 2008 और इसके बाद किए गए संशोधनों के अनुसार अन्यथा पर्यावरण (संरक्षण) नियम, 1986 के अनुसार किया जाएगा।

3. जैव चिकित्सा अपशिष्ट के ऑटोक्लेविंग हेतु मानक.-

ऑटोक्लेव को जैव चिकित्सा अपशिष्ट को रोगाणुमुक्त और उपचारित करने के प्रयोजनार्थ ही उपयोग में लाया जाना चाहिए।

(1) ग्रेविटी फ्लो ऑटोक्लेव का प्रचालन करते समय, चिकित्सा अपशिष्ट निम्नलिखित के अध्यधीन होगा:

(i) कम से कम 60 मिनट के किसी ऑटोक्लेव रेजिडेन्स समय हेतु कम से कम 121^0 से. का तापमान और 15 पाउंडस प्रति वर्ग इंच (पीएसआई) का दबाव; या

(ii) कम से कम 45 मिनट के किसी ऑटोक्लेव रेजिडेन्स समय हेतु कम से कम 135^0 से. का मापमान और 31 पाउंडस प्रति वर्ग इंच (पीएसआई) का दबाव; या

(iv) कम से कम 30 मिनट के किसी ऑटोक्लेव रेजिडेन्स समय हेतु कम से कम 149^0 से. का तापमान और 52 पाउंडस प्रति वर्ग इंच (पीएसआई) का दबाव;

(2) किसी वैक्यूम ऑटोक्लेव को प्रचालित करते समय चिकित्सीय अपशिष्ट ऑटोक्लेव से संपूर्ण वायु को निष्कासित करने के लिए न्यूनतम तीन वैक्यूम-पूर्व पल्स के अध्यधीन होगा। वैक्यूम पूर्व चक्र के दौरान निष्कासित वायु को एचईपीए और एक्टिवेटिड कार्बन फिल्टरेशन, वाष्प शोधन या किसी अन्य प्रकार से संदूषण मुक्त किया जाए। अपशिष्ट निम्नलिखित के अधीन होगा :

(i) कम से कम 45 मिनट के किसी ऑटोक्लेव रेजिडेन्स समय हेतु कम से कम 121^0 से. का मापमान और 15 पाउंडस प्रति वर्ग इंच (पीएसआई) का दबाव; या

(ii) कम से कम 30 मिनट के किसी ऑटोक्लेव रेजिडेन्स समय हेतु कम से कम 135^0 से. का तापमान और 31 पाउंडस प्रति वर्ग इंच (पीएसआई) का दबाव; या

(3) जैव चिकित्सीय अपशिष्ट को तब तक समुचित रूप से उपचारित नहीं माना जाएगा जब तक कि समय, तापमान और दबाव सूचक यह न दर्शाए कि ऑटोक्लेव प्रक्रिया के दौरान अपेक्षित समय, तापमान और दबाव की प्राप्ति की गई। यदि किसी भी कारण से समय, तापमान या दबाव सूचक यह दर्शाता है कि अपेक्षित तापमान, दबाव या रेजिडेन्स समय की प्राप्ति नहीं हुई थी तो चिकित्सीय अपशिष्ट का संपूर्ण भार पुन: ऑटोक्लेव किया जाना चाहिए जब तक कि उचित तापमान, दबाव और रेजिडेन्स समय की प्राप्ति न हो जाए।

(4) प्रचालन पैरामीटरों की रिकार्डिंग : प्रत्येक ऑटोक्लेव में ग्राफिक या कम्प्यूअर रिकॉर्डिंग यंत्र होंगे जो ऑटोक्लेव चक्र की संपूर्ण अवधि में तारीखें, दिन का समय, भार पहचान संख्या और प्रचालन पैरामीटर को स्वत: और लगातार मॉनीटर तथा रिकॉर्ड करेगा।

(5) ऑटोक्लेव की विधिमान्यता जांच : वैधता जांच में चार जीवाणु सूचक स्ट्रिप्स का प्रयोग होगा; एक का प्रयोग नियंत्रण के रूप में होगा और इसे कमरे के तापमान पर रखा जाएगा और तीन को अपशिष्ट युक्त तीन आधानों के समीपवर्ती केन्द्र में रखा जाएगा। जैविक संकेतकों को रखने के प्रयोजन से कंटेनर खोलते समय वैयक्तिक सुरक्षा उपस्कर (दस्ताने, फेस मास्क और कवरआल) का प्रयोग किया जाएगा। वाष्प भरने के लिए जैविक संकेतक सहित कम से कम एक आधान सर्वाधिक कठिन स्थान सामान्यत: अपशिष्ट के ढेर की तली के बीच रखा जाना चाहिए। अधिभोगी या प्रचालक न्यूनतम प्रचालन शर्तें निश्चित करने के लिए लगातार तीन बार यह जांच करेंगे। तापमान, दबाव और ठहराव समय जब लगातार तीन जांचों के सभी जीवाणु संकेतक वायल्स या स्ट्रिप्स जीवाणुओं की पूर्ण रूपेण निष्क्रियता दर्शाएं तो ऑटोक्लेव के लिए न्यूनतम प्रचालन शर्तें निर्धारित की जाएंगी। न्यूनतम तापमान, दबाव और ठहराव समय अवधारित करने के पश्चात साझा जैव चिकित्सा अपशिष्ट शोधन सुविधा का अधिभोगी या प्रचालक तीन महीने में एक बार यह जांच करेगा और इससे संबंधित रिकॉर्ड रखा जाएगा।

(6) नेमी जांच : किसी कतिपय तापमान की प्राप्ति का सत्यापन करने के लिए उस रसायन सूचक स्ट्रिप या टेप का प्रयोग किया जा सकता है जिसका रंग विनिर्दिष्ट तापमान पर पहुंचने पर परिवर्तित हो सकता है। यह आवश्यक होगा कि भिन्न-भिन्न स्थानों पर अपशिष्ट पैकेज के ऊपर एक से अधिक स्ट्रिप का उपयोग किया जाए ताकि यह सुनिश्चित हो सके कि पैकेज की आंतरिक सामग्री को पर्याप्त रूप से ऑटोक्लेव कर दिया गया है। साझा जैव चिकित्सा अपशिष्ट उपचार सुविधा का अधिभोगी या प्रचालक प्रत्येक बैच की ऑटोक्लेविंग के दौरान यह जांच करेगा और इससे संबंधित रिकॉर्ड रखे जाएंगे।

(7) जीवाणु जांच : ऑटोक्लेव को प्रत्येक ऑटोक्लेव इकाई की अधिकतम डिजाइन क्षमता पर अनुमोदित जैविक सूचक को पूर्णत: और लगातार मार देना चाहिए। ऑटोक्लेव के लिए जैविक सूचक कम से कम 1×10^6 जीवाणु प्रति मिली लीटर सहित वायल्स या जीवाणु स्ट्रिप्स का प्रयोग करते हुए बेसिल्लस स्टीएरोथर्मोफिलस स्पोर्स होगा किसी भी स्थिति में किसी ऑटोक्लेव के न्यूनतम प्रचालन प्रांचल 30 मिनट के रेजिडेन्स समय, 121^0 से. तापमान या 15 पीएसआई से दबाव से कम नहीं होंगे। साझा जैव चिकित्सा अपशिष्ट शोधन उपचार का अधिभोगी या प्रचालक सप्ताह में कम से कम एक बार जांच करेगा और इससे संबंधित रिकॉर्ड रखे जाएंगे।

4. माइक्रोवेविंग के मानक.-

(1) माइक्रोवेव उपचार को साइटोटॉक्सिक, खतरनाक या रेडियोधर्मी अपशिष्टों, संक्रमित पशु कंकालों, शरीर के अंगों और धातु की बड़ी वस्तुओं के लिए प्रयुक्त नहीं किया जाएगा।

(2) माइक्रोवेव प्रणाली, प्रभावकारिता परीक्षण या नेमी परीक्षणों के अनुरूप होगी और आपूर्तिकर्ता द्वारा निर्धारित सीमा का प्रचालन शुरू करने से पूर्व एक कार्य-पालन गारंटी प्रदान की जाएगी।

(3) माइक्रोवेव को प्रत्येक माइक्रोवेव इकाई की अधिकतम डिजाइन क्षमता पर अनुमोदित जैविक सूचक द्वारा सुनिश्चित किए जाने वाले जीवाणु और अन्य रोगजनक जीवों को पूर्णत: और निरंतर रूप से मार देना चाहिए। माइक्रोवेव के लिए जैविक सूचक कम से कम 1×10^4 वियोज्य पट्टी के साथ कूपक या बीजाणु पट्टी का प्रयोग करते हुए दण्डाणु अपक्षयक बीजाणु होगा। जैविक सूचक अपशिष्ट के साथ निर्धारित किए जाएंगे और उन्हीं परिस्थितियों में उजागर किए जाएंगे जैसा-सामान्य शोधन चक्र के दौरान अपशिष्ट के लिए होता है।

5. गहराई में दबाने हेतु मानक.- (1) लगभग दो मीटर गहरा गड्ढा या खाई खोदी जानी चाहिए। इसे अपशिष्ट से आधा भर देना चाहिए और आकी गड्ढे को मिट्टी से भरने से पहले सतह से 50 सेमी अंदर चूना भर देना चाहिए।

(2) यह सुनिश्चित किया जाना चाहिए कि दबाने वाले स्थल तक जानवरों की कोई पहुंच न हो। जस्तेदार लोहे या तारों के जाल के कवर का उपयोग किया जा सकता है।

(3) प्रत्येक बार, जब गड्ढे में अपशिष्ट डाला जाता है, तो अपशिष्टों को ढंकने के लिए मिट्टी की 10 से.मी. की परत डाली जाएगी।

(4) दबाने का कार्य गहन और समर्पित पर्यवेक्षण में किया जाना चाहिए।

(5) गहराई में दबाने वाला स्थल अपेक्षाकृत अपारगम्य होना चाहिए और स्थल के पास छिछला कुआं नहीं होना चाहिए।

(6) गड्ढे आवास-स्थल से दूर होने चाहिए और ऐसे अवस्थित होने चाहिए ताकि यह सुनिश्चित हो सके कि सतही जल या भूमि जल में कोई संदूषण न हो। यह क्षेत्र बाढ़ या अपरदन के प्रति प्रवृत्त नहीं होना चाहिए।

(7) गहराई से दबाने का स्थान, विहित प्राधिकारी द्वारा प्राधिकृत होगा।

(8) संस्था, गहराई से दबाने के लिए प्रयुक्त सभी गड्ढों का रिकॉर्ड रखेगा।

(9) भूजल स्तर, गहराई से दबाने वाले गड्ढे के निचले स्तर से कम से कम छ: मीटर नीचे होगा।

6. रासायनिक विसंक्रमण की क्षमता के लिए मानक :

माइक्रोबियल विसंक्रमण की क्षमता "लॉग 10 किल" के बराबर मानी जाती है जिसे रासायनिक उपचार से पूर्व और बाद में सूक्ष्मजीवों की जांच की संख्या के लघुगणकों की अंतर के रूप में पारिभाषित किया गया है। रासायनिक विसंक्रमण पद्धतियां रासायनिक उपचार प्रणालियों में बेसिल्स सबटिलिस (एटीसीसी 19659) के लिए 4 लॉग 10 कमी या अधिक का प्रदर्शन करेंगी।

7. शुष्क ऊष्मा द्वारा जीवाणुनाशन के लिए मानक :

नुकीले अपशिष्ट को कम से कम 185^0 सेल्सियस तापमान पर शुष्क ऊष्मा जीवाणुनाशन के द्वारा उपचारित किया जा सकता है, इसमें प्रत्येक चक्र में रहने की अवधि न्यूनतम 150 मिनट होगी जिसमें जीवाणुनाशन की अवधि 90 मिनट होगी। प्रचालन प्रांचलों की मॉनीटरिंग करने के लिए स्वचालित रिकॉर्डिंग प्रणाली होनी चाहिए।

(i) नुकीले अपशिष्ट की जीवाणुनाशन यूनिट की विधिमान्यता जांच

कम से कम लॉग_{10} 6 बीजाणु प्रति मि.ली. वाली शीशियों का उपयोग करके नुकीले अपशिष्ट की जीवाणुनाशन यूनिट को जैविक सूचक जीओबेसिलस स्टीरोथर्मोफिलस या बेसिलस एट्रोफीयसपोरस को पूर्णत: और सतत रूप से मार देना चाहिए। यह जांच तीन माह में एक बार की जाएगी।

(ii) नेमी जांच

इस बात की जांच करने के लिए कि एक कतिपय तापमान प्राप्त कर लिया गया है, एक ऐसी रासायनिक सूचक पट्टी या टेप का उपयोग किया जा सकता है जो एक विनिर्दिष्ट तापमान पहुंचने पर रंग बदल देती है। यह आवश्यक है कि अपशिष्ट पर एक से अधिक पट्टियों का उपयोग किया जाए ताकि यह सुनिश्चित किया जा सके कि नुकीले अपशिष्टों भीतरी भाग पर्याप्त रूप से विसंक्रमित हो गया है। यह जांच सप्ताह में एक बार की जाएगी और इससे संबंधित रिकॉर्ड रखा जाएगा।

8. द्रव अपशिष्ट के लिए मानक.-

(1) किसी साझा जैव चिकित्सा अपशिष्ट उपचार सुविधा के अधिभोगी या प्रचालक के भवन से उत्सर्जित या उपचारित बहि:स्राव को छोड़े जाने से पहले निम्नलिखित सीमाओं का अनुपालन किया जाना चाहिए -

प्रांचल	अनुमेय सीमाएं
पीएच (pH)	6.5-9.0
निलंबित ठोस	100 मिग्रा/लीटर
तेल और ग्रीस	10 मिग्रा/लीटर
बीओडी	30 मिग्रा/लीटर
सीओडी	250 मिग्रा/लीटर
जैव-परिमाप परीक्षण	100% बहि:स्राव में 96 घंटों के बाद मछली की 90% उत्तर जीविता

(2) बहिस्राव शोधन संयंत्र अवमल को भस्म करने के लिए साझा जैव चिकित्सा अपशिष्ट उपचार सुविधा को या निपटान के लिए परिसंकटमय अपशिष्ट उपचार, भंडारण और निपटान सुविधा को दिया जाएगा।

अनुसूची-III

[नियम 6 और 9(3) देखें]

विहित प्राधिकरणों और तदनुरूपी कर्तव्यों की सूची

क्र.सं.	प्राधिकरण	तदनुरूपी कर्तव्य	
1.	पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय, भारत सरकार	(i)	नियमों की अधिसूचना और जब कभी अपेक्षित हो इन नियमों में संशोधनों सहित देश में जैव-चिकित्सा अपशिष्ट प्रबंधन संबंधी नीतियां बनाना।
		(ii)	राज्य प्रदूषण नियंत्रण बोर्डों या प्रदूषण नियंत्रण समितियों के लिए जैव-चिकित्सा अपशिष्ट प्रबंधन संबंधी कार्यकलापों के संबंध में प्रशिक्षण और जागरूकता कार्यक्रमों के लिए वित्तीय सहायता प्रदान करना।
		(iii)	साझा जैव-चिकित्सा अपशिष्ट शोधन और निपटान सुविधाओं की स्थापना या उन्नयन के लिए वित्तीय सहायता प्रदान करना।
		(iv)	जैव-चिकित्सा अपशिष्ट और विगत में अज्ञात निपटान योग्य तथा नए प्रकार के उपस्करों के अपशिष्ट के कारण पर्यावरण और स्वास्थ्य को जोखिमों के संदर्भ में

			अनुसंधान और निर्धारण कार्य शुरू करना और उनमें सहायता करना।
		(v)	नियमों को लागू करने के लिए मॉनीटरिंग समिति गठित करना।
		(vi)	विहित प्राधिकारियों द्वारा दिए गए आदेश के विरुद्ध प्ररूप-V में की गई अपील सुनना और उन पर निर्णय देना।
		(vii)	प्रशिक्षकों के प्रशिक्षण के लिए मानक मैनुअल तैयार करना।
		(viii)	जैव-चिकित्सा अपशिष्ट, अनुसूची-I में सूचीबद्ध को छोड़कर, के शोधन की नई प्रौद्योगिकियों के लिए प्रचालन प्रांचलों के मानक अधिसूचित करना।
2.	केन्द्रीय या राज्य स्वास्थ्य और परिवार कल्याण मंत्रालय, केन्द्रीय पशुपालन और पशु चिकित्सा मंत्रालय या राज्य पशुपालन और पशु चिकित्सा विभाग	(i)	जैव-चिकित्सा अपशिष्ट प्रबंध के लिए विहित प्राधिकारी से प्राधिकार प्राप्त करने के अध्यधीन स्वास्थ्य देखभाल सुविधाओं या नर्सिंग होम या पशु चिकित्सा प्रतिष्ठानों हेतु अनुज्ञप्ति प्रदान करना।
		(ii)	इन नियमों के अधीन उपबंधों के उल्लंघन के लिए स्वास्थ्य देखभाल सुविधाओं या नर्सिंग होम या पशु चिकित्सा प्रतिष्ठानों हेतु अनुज्ञप्ति की मॉनीटरिंग, अस्वीकृति या रद्द करना।
		(iii)	जैव-चिकित्सा अपशिष्ट जनन, उपचार और निपटान से संबंधित रजिस्ट्रीकृत स्वास्थ्य देखभाल सुविधाओं की सूची प्रकाशित करना।
		(iv)	जैव-चिकित्सा अपशिष्ट और विगत में अज्ञात निपटान योग्य तथा नए प्रकार के उपस्करों के अपशिष्ट के कारण पर्यावरण और स्वास्थ्य को जोखिमों के संदर्भ में अनुसंधान और निर्धारण कार्य शुरू करना और उनमें सहायता करना।
		(v)	स्वास्थ्य देखभाल सुविधा के कर्मचारिवृन्दों और जैव-चिकित्सा अपशिष्ट से संबंधित म्युनिसिपल कर्मकारों के लिए प्रशिक्षण कार्यक्रमों को आयोजित करने के लिए राज्य प्रदूषण नियंत्रण बोर्डों के साथ समन्वय करना।
		(vi)	जैव-चिकित्सा अपशिष्ट प्रबंधन के लिए स्वच्छ प्रौद्योगिकियों की समग्र समीक्षा और संवर्धन हेतु राष्ट्रीय या राज्य स्तर पर विशेषज्ञ समितियों का गठन करना।

		(vii)	जैव-चिकित्सा अपशिष्ट प्रबंधन संबंधी कार्यकलापों के संबंध में विनियामक प्राधिकारियों के लिए प्रशिक्षणों को आयोजित या प्रायोजित करना।
		(viii)	इलेक्ट्रॉनिक मीडिया और प्रिंट मीडिया में जन जागरुकता अभियानों को प्रयोजित करना।
3.	रक्षा मंत्रालय	(i)	सशस्त्र बल स्वास्थ्य देखभाल सुविधाओं या साझा जैव-चिकित्सा अपशिष्ट उपचार सुविधाओं को प्राधिकार की मंजूरी और नवीकरण (नियम-9)
		(ii)	राज्य प्रदूषण नियंत्रण बोर्डों या प्रदूषण नियंत्रण समितियों या केन्द्रीय प्रदूषण नियंत्रण बोर्ड या पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय के सहयोग से सशस्त्र बल स्वास्थ्य देखभाल सुविधाओं या शोधन सुविधाओं में जैव-चिकित्सा अपशिष्टों के प्रबंधन का कार्य करने वाले प्राधिकारियों के लिए प्रशिक्षण पाठ्यक्रमों का आयोजन करना।
		(iii)	अधिभोगियों और सशस्त्र बल स्वास्थ्य देखभाल सुविधाओं या अधिभोगियों से जैव-चिकित्सीय अपशिष्ट के उत्पादन की सूची प्रकाशित करना।
		(iv)	नियमों को लागू करने के लिए सलाहकार समिति गठित करना।
		(v)	अपनी सलाहकार समिति के माध्यम से सशस्त्र बल स्वास्थ्य देखभाल सुविधाओं में जैव-चिकित्सा अपशिष्ट उत्सर्जन के प्रबंधन की समीक्षा (नियम-11)
		(vi)	निर्धारित समयावधि के अंदर केन्द्रीय प्रदूषण बोर्ड को वार्षिक रिपोर्ट को प्रस्तुत करना (नियम 13)
4.	केन्द्रीय प्रदूषण नियंत्रण बोर्ड	(i)	जैव-चिकित्सा प्रबंधन के संबंध में मार्गदर्शक सिद्धान्त तैयार करना और पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय को प्रस्तुत करना।
		(ii)	राज्य प्रदूषण नियंत्रण बोर्डों या प्रदूषण नियंत्रण समितियों के कार्यकलापों का समन्वयन।
		(iii)	जैव-चिकित्सीय अपशिष्ट के प्रबंधन का कार्य करने वाले प्राधिकरणों हेतु प्रशिक्षण पाठ्यक्रमों का आयोजन।

		(iv)	जैव-चिकित्सा अपशिष्ट के उपचार और निपटान हेतु नई प्रौद्योगिकियों के लिए मानकों का निर्धारण करना (नियम-7) तथा जैव-चिकित्सीय अपशिष्टों के उपचार और निपटान हेतु विहित विनिर्देशों का निर्धारण करना (नियम-7)
		(v)	देश में साझा जैव-चिकित्सीय अपशिष्ट उपचार और निपटान सुविधाओं की स्थापना के लिए मानदंड निर्धारित करना।
		(vi)	स्वास्थ्य देखभाल सुविधाओं तथा साझा जैव-चिकित्सीय अपशिष्ट उपचार सुविधाओं का यादृच्छिक निरीक्षण या मॉनीटरिंग करना।
		(vii)	जैव-चिकित्सीय अपशिष्ट के संबंध में राज्य प्रदूषण नियंत्रण बोर्डों द्वारा प्रस्तुत आंकड़ों की समीक्षा और विश्लेषण करना तथा अपनी टिप्पणी के साथ वार्षिक रिपोर्ट के रूप में समेकित सूचना पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय को प्रस्तुत करना।
		(viii)	महानिदेशक, सशस्त्र बल चिकित्सा सेवा द्वारा प्रचालित स्वास्थ्य देखभाल सुविधाओं का निरीक्षण और मॉनीटरिंग करना (नियम-9)
		(ix)	जैव-चिकित्सीय अपशिष्ट के बारे में अनुसंधान या प्रचालनात्मक अनुसंधान करना या इसमें सहायता करना।
5.	राज्य सरकार स्वास्थ्य विभाग या संघ राज्य क्षेत्र सरकार प्रशासन	(i)	सभी स्वास्थ्य देखभाल सुविधाओं या अधिभोगियों में इन नियमों का लागू होना सुनिश्चित करना।
		(ii)	जैव-चिकित्सीय अपशिष्ट प्रबंधन हेतु सरकारी स्वास्थ्य देखभाल सुविधाओं को पर्याप्त निधियों का आबंटन।
		(iii)	सरकारी स्वास्थ्य देखभाल सुविधाओं में जैव-चिकित्सीय अपशिष्ट प्रबंधन के लिए शोधन उपस्करों का प्रापण और आबंटन करना, उपभोज्य वस्तु का उपबंध करना।
		(iv)	जिलों में जैव-चिकित्सीय अपशिष्ट प्रबंधन का पर्यवेक्षण करने के लिए जिला मजिस्ट्रेट या सहायक जिला मजिस्ट्रेट के अधीन राज्य या जिला स्तरीय सलाहकार समितियों का गठन करना।

		(v)	इन नियमों के क्रियान्वयन के संबंध में राज्य प्रदूषण नियंत्रण बोर्डों या प्रदूषण नियंत्रण समितियों को सलाह देना।
		(vi)	सलाहकार समितियों की सिफारिशों का सभी स्वास्थ्य देखभाल सुविधाओं में क्रियान्वयन करना।
6.	राज्य प्रदूषण नियंत्रण बोर्ड या प्रदूषण नियंत्रण समितियां	(i)	अधिभोगियों और जैव-चिकित्सीय अपशिष्ट के जनन, उपचार और निपटान संबंधी आंकड़ों की सूची बनाना।
		(ii)	आंकड़ों को समेकित करना और निर्धारित समयावधि के अंदर वार्षिक रिपोर्ट में केन्द्रीय प्रदूषण नियंत्रण बोर्ड को प्रस्तुत करना।
		(iii)	इन नियमों के अधीन प्राधिकार की मंजूरी और नवीकरण, निलंबन या अस्वीकृति या रद्दकरण (नियम 7, 8 और 10)
		(iv)	प्राधिकार के विभिन्न उपबंधों और शर्तों के अनुपालन की मॉनीटरिंग।
		(v)	इन नियमों के उल्लंघन के लिए स्वास्थ्य देखभाल सुविधाओं या साझा जैव-चिकित्सीय अपशिष्ट उपचार सुविधाओं के विरुद्ध कार्रवाई (नियम-18)।
		(vi)	जैव-चिकित्सीय अपशिष्टों के पृथक्करण, एकत्रण, भंडारण, परिवहन, उपचार और निपटान के संबंध में स्वास्थ्य देखभाल सुविधाओं या साझा जैव-चिकित्सीय अपशिष्ट उपचार सुविधाओं तथा राज्य प्रदूषण नियंत्रण बोर्डों या प्रदूषण नियंत्रण समितियों के कर्मचारिवृन्दों के लिए प्रशिक्षण कार्यक्रमों का आयोजन।
		(vii)	जैव-चिकित्सीय अपशिष्ट प्रबंधन के संबंध में अनुसंधान या प्रचालनात्मक अनुसंधान करना या उसमें सहायता करना।
		(viii)	इन नियमों के अंतर्गत पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय या केन्द्रीय प्रदूषण नियंत्रण बोर्ड द्वारा समय-समय पर सौंपा गया कोई अन्य कार्य।
		(ix)	सलाहकार समिति की सिफारिशों का क्रियान्वयन।

		(x)	पंजीकृत या प्राधिकृत (या जिन्हें सहमति दी गई है) पुन: चक्रकों की सूची प्रकाशित करना।
		(xi)	अपने राज्य में साझा जैव चिकित्सीय अपशिष्ट उपचार सुविधाओं की तृतीय पक्ष द्वारा लेखापरीक्षा कराना और इसमें सहायता करना।
7.	नगरपालिकाएं या निगम, शहरी स्थानीय निकाय और ग्राम पंचायतें	(i)	अपने संबंधित अधिकार क्षेत्र में केन्द्रीय प्रदूषण नियंत्रण बोर्ड के मार्गदर्शक सिद्धान्तों के अनुसार साझा जैव-चिकित्सीय अपशिष्ट उपचार सुविधा के विकास के लिए उपयुक्त भूमि उपलब्ध या आबंटित करना।
		(ii)	नगरीय ठोस अपशिष्ट (प्रबंधन एवं हथालन) नियम, 2000 या समय-समय पर इनमें किए गए संशोधन के अनुसार स्वास्थ्य देखभाल सुविधाओं से अन्य ठोस अपशिष्ट (जैव-चिकित्सीय अपशिष्ट के अलावा) का संग्रहण करना।
		(iii)	इन नियमों के अंतर्गत विनिर्दिष्ट कोई अन्य कार्य।

अनुसूची-IV

[नियम 8(3) और (5) देखें]

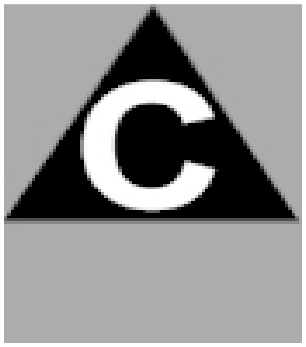
भाग क

क. जैव-चिकित्सीय अपशिष्ट आधानों/थैलियों के लिए लेबल

बायोहेजार्ड

सावधानीपूर्वक हथालन

साइटोटॉक्सिक हेजार्ड चिह्न



सावधानीपूर्वक हथालन

भाग ख

जैव-चिकित्सीय अपशिष्ट आधानों या थैलियों या आधानों के परिवहन हेतु लेबल

तारीख ..... माह .....
वर्ष .....
सृजन की तारीख .....

अपशिष्ट श्रेणी सं. .....
अपशिष्ट मात्रा .....

प्रेषक का नाम और पता
दूरभाष सं. .....
फैक्स सं. .....
संपर्क सूत्र .....

प्राप्तकर्ता का नाम और पता
दूरभाष सं. .....
फैक्स सं. .....
संपर्की व्यक्ति .....

आपात स्थिति में कृपया निम्नलिखित से संपर्क करें
नाम और पता :
दूरभाष सं. :

टिप्पणी : लेबल धुल जाने योग्य नहीं होंगे और प्रमुखता से दिखाई देने वाले होंगे।

प्ररूप 1

[नियम 4(ण), 5(झ) और 15(2) देखें]

दुर्घटना की रिपोर्ट

1. दुर्घटना की तारीख और समय :
2. दुर्घटना का स्वरूप :
3. दुर्घटना होने का घटनाक्रम :
4. क्या प्राधिकरण को तत्काल सूचित किया गया है :
5. दुर्घटना में अंतर्विलित अपशिष्ट का स्वरूप :
6. मानव स्वास्थ्य और पर्यावरण पर दुर्घटनाओं के प्रभावों का निर्धारण :
7. किए गए आपात उपाय :
8. दुर्घटनाओं के प्रभावों का उपशमन करने के लिए उठाए गए कदम :
9. इस प्रकार की दुर्घटना की पुनरावृत्ति को रोकने के लिए उठाए गए कदम :
10. क्या आपकी सुविधा की कोई आपात नियंत्रण नीति है?

    यदि हां, तो ब्यौरा दें :

तारीख :..... हस्ताक्षर.....

स्थान : ..... पदनाम .....

प्ररूप 2

(नियम 10 देखें)

प्राधिकार या प्राधिकार के नवीकरण हेतु आवेदन

(स्वास्थ्य देखभाल सुविधा या साझा जैव चिकित्सा अपशिष्ट उपचार सुविधा के अधिभोगी द्वारा प्रस्तुत किया जाए)

सेवा में

विहित प्राधिकारी,

(राज्य या संघ राज्य क्षेत्र प्रशासन का नाम)

पता

1. आवेदक का विवरण

(i) आवेदक का नाम :
(पूरा नाम स्पष्ट अक्षरों में)

(ii) स्वास्थ्य देखभाल सुविधा (एचसीएफ) या साझा जैव-चिकित्सा अपशिष्ट शोधन सुविधा (सीबीडब्ल्यूटीएफ) का नाम :

(iii) पत्राचार के लिए पता :

(iv) टेलीफोन नं., फैक्स नं. :

(v) ई-मेल :

(vi) वेबसाइट का पता :

2. कार्यकलाप जिसके लिए प्राधिकार मांगा गया है :

कार्यकलाप	कृपया (√) निशान लगाएं
जनन, पृथक्करण	
संग्रहण	
भंडारण	
पैकेजिंग	
प्राप्ति	
परिवहन	
उपचार या प्रसंस्करण या रूपान्तरण	
पुन:चक्रण	
निपटान या नष्ट करना	
उपयोग	
बिक्री, स्थानान्तरण के लिए प्रस्तुत करना	
हथालन का कोई और स्वरूप	

3. आवेदन पत्र □ नए या □ प्राधिकार के नवीकरण के लिए है (कृपया जो लागू हो उसे (√) करें):

(i) नवीकरण के मामले में पिछले प्राधिकार का नम्बर और तारीख

(ii) सहमतियों की स्थिति :

(क) जल (प्रदूषण निवारण एवं नियंत्रण) अधिनियम, 1974 के अधीन

(ख) वायु (प्रदूषण निवारण एवं नियंत्रण) अधिनियम, 1981 के अधीन

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4. (i) स्वास्थ्य देखभाल सुविधा (एचसीएफ) अथवा साझा जैव चिकित्सा अपशिष्ट उपचार सुविधा (सीबीएमडब्ल्यूटीएफ) का पता :

(ii) स्वास्थ्य देखभाल सुविधा (एचसीएफ) अथवा साझा जैव चिकित्सा अपशिष्ट उपचार सुविधा (सीबीएमडब्ल्यूटीएफ) के जीपीएस निर्देशांक :

5. स्वास्थ्य देखभाल सुविधा (एचसीएफ) या साझा जैव चिकित्सा उपचार सुविधा (सीबीएमडब्ल्यूटीएफ) के ब्यौरे :

(i) एचसीएफ के बिस्तरों की संख्या :

(ii) एचसीएफ द्वारा प्रति माह उपचारित रोगियों की संख्या :

(iii) सीबीएमडब्ल्यूटीएफ के अधीन स्वास्थ्य देखभाल सुविधाओं की संख्या : _____

(iv) सीबीएमडब्ल्यूटीएफ के अधीन बिस्तरों की संख्या : _____

(v) सीबीएमडब्ल्यूटीएफ की प्रतिष्ठापित उपचार एवं निपटान क्षमता : ___किलोग्राम प्रतिदिन

(vi) सीबीएमडब्ल्यूटीएफ द्वारा उपचारित या निपटाए गए जैव-चिकित्सा अपशिष्ट की मात्रा : _____
कि.ग्रा. प्रतिदिन

(vii) सीबीएमडब्ल्यूटीएफ के अधीन क्षेत्रफल और दूरी : _____

(सीबीएमडब्ल्यूटीएफ के स्थान और अधीन आने वाले क्षेत्रफल को दर्शाने वाला नक्शा संलग्न करें)

(viii) हथालन, उपचार या निपटान किए गए जैव-चिकित्सा अपशिष्ट की मात्रा :

श्रेणी	अपशिष्ट का स्वरूप	उत्पादित या संग्रहीत मात्रा (कि.ग्रा. प्रतिदिन)	उपचार और निपटान की पद्धति (**अनुसूची-I**)
(1)	(2)	(3)	(4)
पीला	(क) मानव शरीरिक रचना अपशिष्ट		
	(ख) पशु शारीरिक रचना अपशिष्ट		

	(ग) ठोस अपशिष्ट		
	(घ) समाप्त या त्यक्त गई दवाएं		
	(ड.) रासायनिक ठोस अपशिष्ट		
	(च) रासायनिक द्रव अपशिष्ट		
	(छ) फेंकी गई लिनिन, चादरें, बिस्तरें (रक्त या शरीर के द्रव से संदूषित)		
	(ज) सूक्ष्म जीवविज्ञान, जैव-प्रौद्योगिकी और अन्य क्लीनिकल प्रयोगशाला अपशिष्ट		
लाल	संदूषित अपशिष्ट (पुन: चक्रण योग्य)		
सफेद (पारभासी)	धातुओं सहित अपशिष्ट शार्प		
नीला	शीशे के बर्तन		
	मेटालिक बॉडी इम्प्लांट		

6. जैव-चिकित्सा अपशिष्ट के हथालन की व्यवस्थाओं का संक्षिप्त विवरण (ब्यौरा संलगन करें):

(i) जैव-चिकित्सा अपशिष्ट के परिवहन की पद्धति (यदि कोई हो) :

(ii) शोधन उपस्कर के ब्यौरे :

(कृपया ब्यौरा दें जैसे कि प्रत्येक इकाई की संख्या, प्रकार और क्षमता)

	इकाइयों की संख्या	प्रत्येक इकाई की क्षमता
भस्मन यंत्र		
प्लाज्मा पाइरोलाइसिस		
ऑटोक्लेव		
माइक्रोवेव		
हाइड्रोक्लेव		
श्रेडर		

सूई की नोक काटने वाला नष्ट करने वाला		
शार्प एनकेप्सुलेशन या कंक्रीट पिट:		
डीप बरियल पिट		
रासायनिक विसंक्रमण		
कोई अन्य उपचार उपस्कर		

7. साझा जैव चिकित्सा अपशिष्ट उपचार सुविधा (सीबीएमडब्ल्यूटीएफ) की आपात योजना :

8. पूर्ववर्ती प्राधिकार की अवधि के दौरान निर्देशों या सूचनाओं या विधिक कार्रवाइयों के ब्यौरे, यदि कोई हो :

9. घोषणा :

मैं घोषणा करता हूं कि ऊपर दिए गए विवरण और दी गई सूचना मेरे संपूर्ण ज्ञान और विश्वास के अनुसार सही है तथा मैंने कोई भी सूचना छुपाई नहीं है।

मैं इन नियमों के संबंध में विहित प्राधिकरण द्वारा मांगी गई कोई और सूचना उपलब्ध कराने और विहित प्राधिकरण द्वारा विहित कोई भी शर्त को पूरा करने का भी वचन देता हूं।

तारीख : आवेदक के हस्ताक्षर

स्थान : आवेदक का पदनाम

प्ररूप 3
(नियम 10 देखें)
प्राधिकार

(जैव-चिकित्सा अपशिष्टों के जनन, संग्रहण, प्राप्ति, उपचार, भंडारण, परिवहन और निपटान के लिए प्राधिकार)

1. प्राधिकार की फाइल संख्या और जारी करने की तारीख .....

2. मैसर्स _____ को, जो _____ पर स्थित सुविधा का अधिभोगी या प्रचालक है, निम्नलिखित के लिए प्राधिकार प्रदान किया जाता है;

कार्यकलाप	कृपया (√) का निशान लगाएं
जनन, पृथक्करण	
संग्रहण	
भंडारण	
पैकेजिंग	
प्राप्त करना	
परिवहन	
उपचार या प्रसंस्करण या रूपान्तरण	
पुन:चक्रण	
निपटान या नष्ट करना	
उपयोग करना	
बिक्री, स्थानान्तरण के लिए प्रस्तुत करना	
हथालन का कोई अन्य स्वरूप	

3. मैसर्स _____को नीचे दी गई क्षमता के अनुसार जैव-चिकित्सा अपशिष्ट का हथालन करने के लिए प्राधिकृत किया जाता है :-

(i) एचसीएफ के बिस्तरों की संख्या :

(ii) सीबीएमडब्ल्यूटीएफ के अधीन आने वाली
स्वास्थ्य देखभाल सुविधाओं की संख्या : _____

(iii) प्रतिष्ठापित उपचार और निपटान क्षमता _____ कि.ग्रा. प्रति दिन

(iv) सीबीएमडब्ल्यूटीएफ के अधीन आने वाला क्षेत्र या दूरी : _____

_____

(v) हथालन, उपचार या निपटान किए गए जैव चिकित्सा अपशिष्ट की मात्रा :

अपशिष्ट के स्वरूप की श्रेणी	हथालन के लिए अनुमति दी गई मात्रा
पीला	
लाल	
सफेद (पारभासी)	
नीला	

4. यह प्राधिकार जारी किए जाने की तारीख से _____ वर्ष की अवधि के लिए लागू रहेगा।

5. यह प्राधिकार नीचे दी गई शर्तों और पर्यावरण (संरक्षण), अधिनियम, 1986 के तहत वर्तमान में लागू नियमों में यथा विनिर्दिष्ट अन्य शर्तों के अधीन होगा।

तारीख :..... हस्ताक्षर.....

स्थान : ..... पदनाम .....

प्राधिकार के निबंधन और शर्तें*

1. यह प्राधिकार पर्यावरण (संरक्षण) अधिनियम, 1986 और उसके अधीन बनाए गए नियमों के उपबंधों के अनुपालन में होगा।
2. यह प्राधिकार या इसका नवीकरण, विहित प्राधिकारी द्वारा प्राधिकृत किसी अधिकारी के अनुरोध पर निरीक्षण हेतु प्रस्तुत किया जाएगा।
3. विहित प्राधिकारी की पूर्वानुमति प्राप्त किए बिना प्राधिकृत व्यक्ति द्वारा जैव चिकित्सा अपशिष्टों को किराए पर नहीं दिया जाएगा, उधार नहीं दिया जाएगा; विक्रय नहीं किया जाएगा या अन्तरित या अन्यथा परिवहन नहीं किया जाएगा।
4. प्राधिकृत व्यक्ति द्वारा आवेदन में यथा उल्लिखित कार्मिक, उपस्कर या कार्य स्थितियों में किसी भी अनधिकृत परिवर्तन किए जाने से उसका प्राधिकार भंग हो जाएगा।
5. प्राधिकृत व्यक्ति का कर्तव्य होगा कि वह सुविधा को बंद करने से पहले विहित प्राधिकारी पूर्वानुमति प्राप्त करे और विहित प्राधिकारी द्वारा निर्धारित निबंधन एवं शर्तों का अनुपालन करें।

प्ररुप 4
(देखें नियम-13)
वार्षिक रिपोर्ट

स्वास्थ्य देखभाल सुविधा (एचसीएफ) या साझा जैव चिकित्सा अपशिष्ट उपचार सुविधा (सीबीएमडब्ल्यूटीएफ) के अधिभोगी द्वारा पूर्ववर्ती वर्ष के जनवरी से दिसम्बर माह तक की अवधि के लिए प्रत्येक वर्ष 30 जून को या उससे पहले विहित प्राधिकारी को प्रस्तुत किया जाए

क्र.सं.	विवरण		
1.	अधिभोगी का विवरण		
	(i) प्राधिकृत व्यक्ति का नाम (सुविधा का अधिभोगी या प्रचालक)	:	
	(ii) एचसीएफ या सीबीएमडब्ल्यूटीएफ का नाम	:	
	(iii) पत्राचार के लिए पता	:	
	(iv) सुविधा का पता	:	
	(v) टेलीफोन नं. और फैक्स नं.	:	
	(vi) ई-मेल आईडी	:	
	(vii) वेबसाइट का यूआरएल	:	
	(viii) एचसीएफ या सीबीएमडब्ल्यूटीएफ के जीपीएस कोऑर्डिनेट्स	:	
	(ix) एचसीएफ या सीबीएमडब्ल्यूटीएफ का स्वामित्व	:	(राज्य सरकार या प्राइवेट या अर्द्धसरकारी या कोई अन्य)
	(x) जैव-चिकित्सा अपशिष्ट (प्रबंधन एवं हथालन) नियमों के तहत प्राधिकार की स्थिति	:	प्राधिकार सं. ..... तारीख ..... तक विधिमान्य
	(xi) जल अधिनियम और वायु अधिनियम के तहत सहमतियों की स्थिति	:	दिनांक ..... तक विधिमान्य
2.	स्वास्थ्य देखभाल सुविधा का स्वरूप	:	

	(i) बिस्तर वाला अस्पताल	:	बिस्तरों की संख्या .....
	(ii) बिना-बिस्तर वाला अस्पताल (क्लीनिक या रक्त बैंक या क्लिनिकल प्रयोगशाला या अनुसंधान संस्थान या पशु अस्पताल या कोई अन्य)	:	
	(iii) अनुज्ञप्ति संख्यांक और इसकी समाप्ति की तारीख	:	
3.	सीबीएमडब्ल्यूटीएफ के ब्यौरे	:	
	(i) सीबीएमडब्ल्यूटीएफ के अधीन आने वाली स्वास्थ्य देखभाल सुविधाओं की संख्या	:	
	(ii) सीबीएमडब्ल्यूटीएफ के अधीन आने वाले बिस्तरों की संख्या	:	
	(iii) सीबीएमडब्ल्यूटीएफ की प्रतिष्ठापित उपचार एवं निपटान क्षमता	:	___ किलोग्राम प्रतिदिन
	(iv) सीबीएमडब्ल्यूटीएफ द्वारा उपचारित या निपटान किए गए जैव-चिकित्सा अपशिष्ट की मात्रा	:	___ किलोग्राम प्रतिदिन
4.	प्रति वर्ष किलोग्राम में जनित या निपटान किए गए अपशिष्ट की मात्रा (मासिक औसत के आधार पर)	:	पीली श्रेणी :
			लाल श्रेणी :
			सफेद श्रेणी :
			नीली श्रेणी :
			सामान्य ठोस अपशिष्ट:
5.	भंडारण, उपचार, परिवहन, प्रसंस्करण और निपटान सुविधा के ब्यौरे		
	(i) स्थल पर भंडारण सुविधा के ब्यौरे	:	आकार :
			क्षमता :
			स्थल पर भंडारण के उपबंध : (कोल्ड स्टोरेज या कोई अन्य व्यवस्था)

(ii) शोधन या निपटान सुविधाओं के ब्यौरे :

शोधन उपस्कर का स्वरूप	इकाइयों की संख्या	क्षमता किलोग्राम प्रतिदिन	प्रतिवर्ष किलोग्राम में उपचार या निपटान की गई मात्रा
भस्मक			
प्लाजमा पाइरोलाइसिस			
ऑटोक्लेव			
माइक्रोवेव			
हाइड्रोक्लेव			
श्रेडर			
सूई की नोक तोड़ने वाला या नष्ट करने वाला यंत्र		-	
शार्पस् एनकेप्सुलेशन या कंक्रीट पिट		-	
डीप बरियल पिट			
रासायनिक विसंक्रमण		-	
कोई अन्य			
उपचार उपस्कर			

(iii) उपचार के बाद प्राधिकृत पुन: चक्रकों को बेचे गए पुन:चक्रण योग्य अपशिष्ट की मात्रा, प्रतिवर्ष किलोग्राम में : लाल श्रेणी (जैसे कि प्लास्टिक, शीशा आदि)

<table>
<tr><td></td><td>(iv) जैव चिकित्सा अपशिष्ट के संग्रहण एवं परिवहन के लिए उपयोग में लाए गए वाहनों की संख्या</td><td>:</td><td></td></tr>
<tr><td></td><td>(v) अपशिष्टों के शोधन के दौरान जनित और निपटान की गई भस्मक की राख और ईटीपी कीचड़ के ब्यौरे, प्रतिवर्ष किलोग्राम में</td><td>:</td><td><table><tr><td></td><td>जनित मात्रा</td><td>कहां निपटान किया गया</td></tr><tr><td>भस्मक की राख</td><td></td><td></td></tr><tr><td>ईटीपी कीचड़</td><td></td><td></td></tr></table></td></tr>
<tr><td></td><td>(vi) साझा जैव चिकित्सा शोधन सुविधा के प्रचालक का नाम जिसके माध्यम से अपशिष्टों का निपटान किया जाता है</td><td>:</td><td></td></tr>
<tr><td></td><td>(vii) ऐसे सदस्य एचसीएफ की सूची जिन्होंने जैव-चिकित्सा अपशिष्ट नहीं सौंपा</td><td>:</td><td></td></tr>
<tr><td>6.</td><td>क्या आपकी जैव-चिकित्सा अपशिष्ट प्रबंध समिति है? यदि हां, तो रिपोर्ट की अवधि के दौरान आयोजित बैठकों के कार्यवृत्त संलग्न करें।</td><td>:</td><td></td></tr>
<tr><td>7.</td><td>बीएमडब्ल्यू के संबंध में आयोजित प्रशिक्षणों के ब्यौरे</td><td>:</td><td></td></tr>
<tr><td></td><td>(i) बीएमडब्ल्यू प्रबंधन के संबंध में आयोजित प्रशिक्षणों की संख्या</td><td>:</td><td></td></tr>
<tr><td></td><td>(ii) प्रशिक्षित कार्मिकों की संख्या</td><td>:</td><td></td></tr>
<tr><td></td><td>(iii) भर्ती के समय प्रशिक्षित कार्मिकों की संख्या</td><td>:</td><td></td></tr>
<tr><td></td><td>(iv) ऐसे कार्मिकों की संख्या जिन्होंने अभी कोई प्रशिक्षण नहीं लिया है</td><td>:</td><td></td></tr>
<tr><td></td><td>(v) क्या प्रशिक्षण के लिए मानक मैनुअल उपलब्ध है?</td><td>:</td><td></td></tr>
<tr><td></td><td>(vi) अन्य कोई सूचना</td><td></td><td></td></tr>
</table>

8.	वर्ष के दौरान हुई दुर्घटनाओं के ब्यौरे	:	
	(i) घटित हुई दुर्घटनाओं की संख्या	:	
	(ii) प्रभावित हुए व्यक्तियों की संख्या	:	
	(iii) की गई सुधारात्मक कार्रवाई (कृपया ब्यौरे, यदि कोई हो तो संलग्न करें)	:	
	(iv) क्या कोई मौत भी हुई है? ब्यौरे दें।	:	
9.	क्या आप भस्मक से होने वाले वायु प्रदूषण के मानकों को पूरा करते हैं? विगत वर्ष में कितनी बार आप मानकों को पूरा नहीं कर सके?	:	
	प्रतिष्ठापित की गई सतत् ऑनलाइन उत्सर्जन मॉनीटरिंग प्रणालियों का विवरण	:	
10.	संचित द्रव अपशिष्ट और स्थापित उपचार पद्धतियां। एक वर्ष में आपने कितनी बार मानकों को पूरा नहीं किया है?	:	
11.	क्या विसंक्रमण या जीवाणुनाशन की पद्धति लॉग 4 के मानकों को पूरा करती है? एक वर्ष में आपने कितनी बार मानकों को पूरा नहीं किया है?	:	
12.	अन्य कोई सुसंगत सूचना	:	(भस्मक के साथ संलग्न की गई वायु प्रदूषण नियंत्रण पद्धतियां)

प्रमाणित किया जाता है कि उपर्युक्त रिपोर्ट _____ से _____ तक की अवधि की है।

.....

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.....

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संस्था के प्रमुख का नाम और हस्ताक्षर

तारीख :

स्थान :

प्ररूप 5

(नियम 16 देखें)

विहित प्राधिकारी द्वारा जारी आदेश के विरुद्ध अपील दायर करने के लिए आवेदन

1. अपील हेतु आवेदन करने वाले व्यक्ति का नाम और पता :
2. आदेश की संख्या, तारीख और आदेश पारित करने वाले प्राधिकारी का पता जिसके विरुद्ध अपील की जा रही है (आदेश की प्रमाणित प्रति संलग्न करें)
3. अपील किए जाने का आधार
4. पैरा 2 में निर्दिष्ट ऐसे आदेश से भिन्न, जिसके विरुद्ध अपील की गई है, संलग्नकों की सूची।

तारीख

हस्ताक्षर .....
नाम और पता .....
.....

[फा. सं.3-1/2000-एचएसएमडी]

विश्वनाथ सिन्हा, संयुक्त सचिव

MINISTRY OF ENVIRONMENT, FOREST AND CLIMATE CHANGE

NOTIFICATION

New Delhi, the 28th March, 2016

G.S.R. 343(E).—Whereas the Bio-Medical Waste (Management and Handling) Rules, 1998 was published *vide* notification number S.O. 630 (E) dated the 20th July, 1998, by the Government of India in the erstwhile Ministry of Environment and Forests, provided a regulatory frame work for management of bio-medical waste generated in the country;

And whereas, to implement these rules more effectively and to improve the collection, segregation, processing, treatment and disposal of these bio-medical wastes in an environmentally sound management thereby, reducing the bio-medical waste generation and its impact on the environment, the Central Government reviewed the existing rules;

And whereas, in exercise of the powers conferred by sections 6, 8 and 25 of the Environment (Protection) Act, 1986 (29 of 1986), the Central Government published the draft rules in the Gazette vide number G.S.R. 450 (E), dated the 3rd June, 2015 inviting objections or suggestions from the public within sixty days from the date on which copies of the Gazette containing the said notification were made available to the public;

And whereas, the copies of the Gazette containing the said draft rules were made available to the public on the 3rd June, 2015;

And whereas, the objections or comments received within the specified period from the public in respect of the said draft rules have been duly considered by the Central Government;

Now, therefore, in exercise of the powers conferred by section 6, 8 and 25 of the Environment (Protection) Act, 1986 (29 of 1986), and in supersession of the Bio-Medical Waste (Management and Handling) Rules, 1998, except as respects things done or omitted to be done before such suppression, the Central Government hereby makes the following rules, namely:-

1. Short title and commencement.- (1) these rules may be called the Bio-Medical Waste Management Rules, 2016.

(2) They shall come into force on the date of their publication in the Official Gazette.

2. **Application.-**

(1) These rules shall apply to all persons who generate, collect, receive, store, transport, treat, dispose, or handle bio medical waste in any form including hospitals, nursing homes, clinics, dispensaries, veterinary institutions, animal houses, pathological laboratories, blood banks, ayush hospitals, clinical establishments, research or educational institutions, health camps, medical or surgical camps, vaccination camps, blood donation camps, first aid rooms of schools, forensic laboratories and research labs.

(2). These rules shall not apply to,-

(a) radioactive wastes as covered under the provisions of the Atomic Energy Act, 1962(33 of 1962) and the rules made there under;

(b) hazardous chemicals covered under the Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989 made under the Act;

(c) solid wastes covered under the Municipal Solid Waste (Management and Handling) Rules, 2000 made under the Act;

(d) the lead acid batteries covered under the Batteries (Management and Handling) Rules, 2001 made under the Act;

(e) hazardous wastes covered under the Hazardous Wastes (Management, Handling and Transboundary Movement) Rules, 2008 made under the Act;

(f) waste covered under the e-Waste (Management and Handling) Rules, 2011 made under the Act; and

(g) hazardous micro organisms, genetically engineered micro organisms and cells covered under the Manufacture, Use, Import, Export and Storage of Hazardous Microorganisms, Genetically Engineered Micro organisms or Cells Rules, 1989 made under the Act.

3. Definitions.- In these rules, unless the context otherwise requires, -

(a) "Act" means the Environment (Protection) Act, 1986 (29 of 1986);

(b) "animal house" means a place where animals are reared or kept for the purpose of experiments or testing;

(c) "authorisation" means permission granted by the prescribed authority for the generation, collection, reception, storage, transportation, treatment, processing, disposal or any other form of handling of bio-medical waste in accordance with these rules and guidelines issued by the Central Government or Central Pollution Control Board as the case may be;

(d) "authorised person" means an occupier or operator authorised by the prescribed authority to generate, collect, receive, store, transport, treat, process, dispose or handle bio-medical waste in accordance with these rules and the guidelines issued by the Central Government or the Central Pollution Control Board, as the case may be;

(e) "biological" means any preparation made from organisms or micro-organisms or product of metabolism and biochemical reactions intended for use in the diagnosis, immunisation or the treatment of human beings or animals or in research activities pertaining thereto;

(f) "bio-medical waste" means any waste, which is generated during the diagnosis, treatment or immunisation of human beings or animals or research activities pertaining thereto or in the production or testing of biological or in health camps, including the categories mentioned in Schedule I appended to these rules;

(g) "bio-medical waste treatment and disposal facility" means any facility wherein treatment, disposal of bio-medical waste or processes incidental to such treatment and disposal is carried out, and includes common bio-medical waste treatment facilities;

(h) "Form" means the Form appended to these rules;

(i) "handling" in relation to bio-medical waste includes the generation, sorting, segregation, collection, use, storage, packaging, loading, transportation, unloading, processing, treatment, destruction, conversion, or offering for sale, transfer, disposal of such waste;

(j) "health care facility" means a place where diagnosis, treatment or immunisation of human beings or animals is provided irrespective of type and size of health treatment system, and research activity pertaining thereto;

(k) "major accident" means accident occurring while handling of bio-medical waste having potential to affect large masses of public and includes toppling of the truck carrying bio-medical waste, accidental release of bio-medical waste in any water body but exclude accidents like needle prick injuries, mercury spills;

(l) "management" includes all steps required to ensure that bio- medical waste is managed in such a manner as to protect health and environment against any adverse effects due to handling of such waste;

(m) "occupier" means a person having administrative control over the institution and the premises generating bio-medical waste, which includes a hospital, nursing home, clinic, dispensary, veterinary institution, animal house, pathological laboratory, blood bank, health care facility and clinical establishment, irrespective of their system of medicine and by whatever name they are called;

(n) "operator of a common bio-medical waste treatment facility" means a person who owns or controls a Common Bio-medical Waste Treatment Facility (CBMWTF) for the collection, reception, storage, transport, treatment, disposal or any other form of handling of bio-medical waste;

(o) "prescribed authority" means the State Pollution Control Board in respect of a State and Pollution Control Committees in respect of an Union territory;

(p) "Schedule" means the Schedule appended to these rules.

4. Duties of the Occupier.- It shall be the duty of every occupier to-

(a) take all necessary steps to ensure that bio-medical waste is handled without any adverse effect to human health and the environment and in accordance with these rules;

(b) make a provision within the premises for a safe, ventilated and secured location for storage of segregated biomedical waste in colored bags or containers in the manner as specified in Schedule I, to ensure that there shall be no secondary handling, pilferage of recyclables or inadvertent scattering or spillage by animals and the bio-medical waste from such place or premises shall be directly transported in the manner as prescribed in these rules to the common bio-medical waste treatment facility or for the appropriate treatment and disposal, as the case may be, in the manner as prescribed in Schedule I;

(c) pre-treat the laboratory waste, microbiological waste, blood samples and blood bags through disinfection or sterilisation on-site in the manner as prescribed by the World Health Organisation (WHO) or National AIDs Control Organisation (NACO) guidelines and then sent to the common bio-medical waste treatment facility for final disposal;

(d) phase out use of chlorinated plastic bags, gloves and blood bags within two years from the date of notification of these rules;

(e) dispose of solid waste other than bio-medical waste in accordance with the provisions of respective waste management rules made under the relevant laws and amended from time to time;

(f) not to give treated bio-medical waste with municipal solid waste;

(g) provide training to all its health care workers and others, involved in handling of bio medical waste at the time of induction and thereafter at least once every year and the details of training programmes conducted, number of personnel trained and number of personnel not undergone any training shall be provided in the Annual Report;

(h) immunise all its health care workers and others, involved in handling of bio-medical waste for protection against diseases including Hepatitis B and Tetanus that are likely to be transmitted by handling of bio-medical waste, in the manner as prescribed in the National Immunisation Policy or the guidelines of the Ministry of Health and Family Welfare issued from time to time;

(i) establish a Bar- Code System for bags or containers containing bio-medical waste to be sent out of the premises or place for any purpose within one year from the date of the notification of these rules;

(j) ensure segregation of liquid chemical waste at source and ensure pre-treatment or neutralisation prior to mixing with other effluent generated from health care facilities;

(k) ensure treatment and disposal of liquid waste in accordance with the Water (Prevention and Control of Pollution) Act, 1974 (6 of 1974);

(l) ensure occupational safety of all its health care workers and others involved in handling of bio-medical waste by providing appropriate and adequate personal protective equipments;

(m) conduct health check up at the time of induction and at least once in a year for all its health care workers and others involved in handling of bio- medical waste and maintain the records for the same;

(n) maintain and update on day to day basis the bio-medical waste management register and display the monthly record on its website according to the bio-medical waste generated in terms of category and colour coding as specified in Schedule I;

(o) report major accidents including accidents caused by fire hazards, blasts during handling of bio-medical waste and the remedial action taken and the records relevant thereto, (including nil report) in Form I to the prescribed authority **and also** along with the annual report;

(p) make available the annual report on its web-site and all the health care facilities shall make own website within two years from the date of notification of these rules;

(q) inform the prescribed authority immediately in case the operator of a facility does not collect the bio-medical waste within the intended time or as per the agreed time;

(r) establish a system to review and monitor the activities related to bio-medical waste management, either through an existing committee or by forming a new committee and the Committee shall meet once in every six months and the record of the minutes of the meetings of this committee shall be submitted along with the annual report to the prescribed authority and the healthcare establishments having less than thirty beds shall

designate a qualified person to review and monitor the activities relating to bio-medical waste management within that establishment and submit the annual report;

(s) maintain all record for operation of incineration, hydro or autoclaving etc., for a period of five years;

(t) existing incinerators to achieve the standards for treatment and disposal of bio-medical waste as specified in Schedule II for retention time in secondary chamber and Dioxin and Furans within two years from the date of this notification.

5. Duties of the operator of a common bio-medical waste treatment and disposal facility.-It shall be the duty of every operator to -

(a) take all necessary steps to ensure that the bio-medical waste collected from the occupier is transported, handled, stored, treated and disposed of, without any adverse effect to the human health and the environment, in accordance with these rules and guidelines issued by the Central Government or, as the case may be, the central pollution control board from time to time;

(b) ensure timely collection of bio-medical waste from the occupier as prescribed under these rules;

(c) establish bar coding and global positioning system for handling of bio- medical waste within one year;

(d) inform the prescribed authority immediately regarding the occupiers which are not handing over the segregated bio-medical waste in accordance with these rules;

(e) provide training for all its workers involved in handling of bio-medical waste at the time of induction and at least once a year thereafter;

(f) assist the occupier in training conducted by them for bio-medical waste management;

(g) undertake appropriate medical examination at the time of induction and at least once in a year and immunise all its workers involved in handling of bio-medical waste for protection against diseases, including Hepatitis B and Tetanus, that are likely to be transmitted while handling bio-medical waste and maintain the records for the same;

(h) ensure occupational safety of all its workers involved in handling of bio-medical waste by providing appropriate and adequate personal protective equipment;

(i) report major accidents including accidents caused by fire hazards, blasts during handling of bio-medical waste and the remedial action taken and the records relevant thereto, (including nil report) in Form I to the prescribed authority **and also** along with the annual report;

(j) maintain a log book for each of its treatment equipment according to weight of batch; categories of waste treated; time, date and duration of treatment cycle and total hours of operation;

(k) allow occupier , who are giving waste for treatment to the operator, to see whether the treatment is carried out as per the rules;

(l) shall display details of authorisation, treatment, annual report etc on its web-site;

(m) after ensuring treatment by autoclaving or microwaving followed by mutilation or shredding, whichever is applicable, the recyclables from the treated bio-medical wastes such as plastics and glass, shall be given to recyclers having valid consent or authorisation or registration from the respective State Pollution Control Board or Pollution Control Committee;

(n) supply non-chlorinated plastic coloured bags to the occupier on chargeable basis, if required;

(o) common bio-medical waste treatment facility shall ensure collection of biomedical waste on holidays also;

(p) maintain all record for operation of incineration, hydroor autoclaving for a period of five years; and

(q) upgrade existing incinerators to achieve the standards for retention time in secondary chamber and Dioxin and Furans within two years from the date of this notification.

6. Duties of authorities.-The Authority specified in column (2) of Schedule-III shall perform the duties as specified in column (3) thereof in accordance with the provisions of these rules.

7. Treatment and disposal.- (1) Bio-medical waste shall be treated and disposed of in accordance with Schedule I, and in compliance with the standards provided in Schedule-II by the health care facilities and common bio-medical waste treatment facility.

(2) Occupier shall hand over segregated waste as per the Schedule-I to common bio-medical waste treatment facility for treatment, processing and final disposal:

Provided that the lab and highly infectious bio-medical waste generated shall be pre-treated by equipment like autoclave or microwave.

(3) No occupier shall establish on-site treatment and disposal facility, if a service of common bio-medical waste treatment facility is available at a distance of seventy-five kilometer.

(4) In cases where service of the common bio-medical waste treatment facility is not available, the Occupiers shall set up requisite biomedical waste treatment equipment like incinerator, autoclave or microwave, shredder prior to commencement of its operation, as per the authorisation given by the prescribed authority.

(5) Any person including an occupier or operator of a common bio medical waste treatment facility, intending to use new technologies for treatment of bio medical waste other than those listed in Schedule I shall request the Central Government for laying down the standards or operating parameters.

(6) On receipt of a request referred to in sub-rule (5), the Central Government may determine the standards and operating parameters for new technology which may be published in Gazette by the Central Government.

(7) Every operator of common bio-medical waste treatment facility shall set up requisite biomedical waste treatment equipments like incinerator, autoclave or microwave, shredder and effluent treatment plant as a part of treatment, prior to commencement of its operation.

(8) Every occupier shall phase out use of non-chlorinated plastic bags within two years from the date of publication of these rules and after two years from such publication of these rules, the chlorinated plastic bags shall not be used for storing and transporting of bio-medical waste and the occupier or operator of a common bio-medical waste treatment facility shall not dispose of such plastics by incineration and the bags used for storing and transporting biomedical waste shall be in compliance with the Bureau of Indian Standards. Till the Standards are published, the carry bags shall be as per the Plastic Waste Management Rules, 2011.

(9) After ensuring treatment by autoclaving or microwaving followed by mutilation or shredding, whichever is applicable, the recyclables from the treated bio-medical wastes such as plastics and glass shall be given to such recyclers having valid authorisation or registration from the respective prescribed authority.

(10) The Occupier or Operator of a common bio-medical waste treatment facility shall maintain a record of recyclable wastes referred to in sub-rule (9) which are auctioned or sold and the same shall be submitted to the prescribed authority as part of its annual report. The record shall be open for inspection by the prescribed authorities.

(11) The handling and disposal of all the mercury waste and lead waste shall be in accordance with the respective rules and regulations.

8. Segregation, packaging, transportation and storage.-(1) No untreated bio-medical waste shall be mixed with other wastes.

(2) The bio-medical waste shall be segregated into containers or bags at the point of generation in accordance with Schedule I prior to its storage, transportation, treatment and disposal.

(3) The containers or bags referred to in sub-rule (2) shall be labeled as specified in Schedule IV.

(4) Bar code and global positioning system shall be added by the Occupier and common bio-medical waste treatment facility in one year time.

(5) The operator of common bio-medical waste treatment facility shall transport the bio-medical waste from the premises of an occupier to any off-site bio-medical waste treatment facility only in the vehicles having label as provided in part 'A' of the Schedule IV along with necessary information as specified in part 'B' of the Schedule IV.

(6) The vehicles used for transportation of bio-medical waste shall comply with the conditions if any stipulated by the State Pollution Control Board or Pollution Control Committee in addition to the requirement contained in the Motor Vehicles Act, 1988 (59 of 1988), if any or the rules made there under for transportation of such infectious waste.

(7) Untreated human anatomical waste, animal anatomical waste, soiled waste and, biotechnology waste shall not be stored beyond a period of forty –eight hours:

Provided that in case for any reason it becomes necessary to store such waste beyond such a period, the occupier shall take appropriate measures to ensure that the waste does not adversely affect human health and the environment and inform the prescribed authority along with the reasons for doing so.

(8) Microbiology waste and all other clinical laboratory waste shall be pre-treated by sterilisation to Log 6 or disinfection to Log 4, as per the World Health Organisation guidelines before packing and sending to the common bio-medical waste treatment facility.

9. Prescribed authority.-(1) The prescribed authority for implementation of the provisions of these rules shall be the State Pollution Control Boards in respect of States and Pollution Control Committees in respect of Union territories.

(2) The prescribed authority for enforcement of the provisions of these rules in respect of all health care establishments including hospitals, nursing homes, clinics, dispensaries, veterinary institutions, animal houses, pathological laboratories and blood banks of the Armed Forces under the Ministry of Defence shall be the Director General, Armed Forces Medical Services, who shall function under the supervision and control of the Ministry of Defence.

(3) The prescribed authorities shall comply with the responsibilities as stipulated in Schedule III of these rules.

10. Procedure for authorisation.-Every occupier or operator handling bio-medical waste, irrespective of the quantity shall make an application in Form II to the prescribed authority i.e. State Pollution Control Board and Pollution Control Committee, as the case may be, for grant of authorisation and the prescribed authority shall grant the provisional authorisation in Form III and the validity of such authorisation for bedded health care facility and operator of a common facility shall be synchronised with the validity of the consents.

(1) The authorisation shall be one time for non-bedded occupiers and the authorisation in such cases shall be deemed to have been granted, if not objected by the prescribed authority within a period of ninety days from the date of receipt of duly completed application along with such necessary documents.

(2) In case of refusal of renewal, cancellation or suspension of the authorisation by the prescribed authority, the reasons shall be recorded in writing:

Provided that the prescribed authority shall give an opportunity of being heard to the applicant before such refusal of the authorisation.

(3) Every application for authorisation shall be disposed of by the prescribed authority within a period of ninety days from the date of receipt of duly completed application along with such necessary documents, failing which it shall be deemed that the authorisation is granted under these rules.

(4) In case of any change in the bio-medical waste generation, handling, treatment and disposal for which authorisation was earlier granted, the occupier or operator shall intimate to the prescribed authority about the change or variation in the activity and shall submit a fresh application in Form II for modification of the conditions of authorisation.

11. **Advisory Committee**.-(1) Every State Government or Union territory Administration shall constitute an Advisory Committee for the respective State or Union territory under the chairmanship of the respective health secretary to oversee the implementation of the rules in the respective state and to advice any improvements and the Advisory Committee shall include representatives from the Departments of Health, Environment, Urban Development, Animal Husbandry and Veterinary Sciences of that State Government or Union territory Administration, State Pollution Control Board or Pollution Control Committee, urban local bodies or local bodies or Municipal Corporation, representatives from Indian Medical Association, common bio-medical waste treatment facility and non-governmental organisation.

(2) Notwithstanding anything contained in sub-rule (1), the Ministry of Defence shall constitute the Advisory Committee (Defence) under the chairmanship of Director General of Health Services of Armed Forces consisting of representatives from the Ministry of Defence, Ministry of Environment, Forest and Climate Change, Central Pollution Control Board, Ministry of Health and Family Welfare, Armed Forces Medical College or Command Hospital.

(3) The Advisory Committee constituted under sub-rule (1) and (2) shall meet at least once in six months and review all matters related to implementation of the provisions of these rules in the State and Armed Forces Health Care Facilities, as the case may be.

(4) The Ministry of Health and Defence may co-opt representatives from the other Governmental and non-governmental organisations having expertise in the field of bio-medical waste management.

12. **Monitoring of implementation of the rules in health care facilities.-** (1) The Ministry of Environment, Forest and Climate Change shall review the implementation of the rules in the country once in a year through the State Health Secretaries and Chairmen or Member Secretary of State Pollution Control Boards and Central Pollution Control Board and the Ministry may also invite experts in the field of bio-medical waste management, if required.

(2) The Central Pollution Control Board shall monitor the implementation of these rules in respect of all the Armed Forces health care establishments under the Ministry of Defence.

(3) The Central Pollution Control Board along with one or more representatives of the Advisory Committee constituted under sub-rule (2) of rule 11, may inspect any Armed Forces health care establishments after prior intimation to the Director General Armed Forces Medical Services.

(4) Every State Government or Union territory Administration shall constitute District Level Monitoring Committee in the districts under the chairmanship of District Collector or District Magistrate or Deputy Commissioner or Additional District Magistrate to monitor the compliance of the provisions of these rules in the health care facilities generating bio-medical waste and in the common bio-medical waste treatment and disposal facilities, where the bio-medical waste is treated and disposed of.

(5) The District Level Monitoring Committee constituted under sub-rule (4) shall submit its report once in six months to the State Advisory Committee and a copy thereof shall also be forwarded to State Pollution Control Board or Pollution Control Committee concerned for taking further necessary action.

(6) The District Level Monitoring Committee shall comprise of District Medical Officer or District Health Officer, representatives from State Pollution Control Board or Pollution Control Committee, Public Health Engineering Department, local bodies or municipal corporation, Indian Medical Association, common bio-medical waste treatment facility and registered non-governmental organisations working in the field of bio-medical waste management and the Committee may co-opt other members and experts, if necessary and the District Medical Officer shall be the Member Secretary of this Committee.

13. **Annual report.-**(1) Every occupier or operator of common bio-medical waste treatment facility shall submit an annual report to the prescribed authority in Form-IV, on or before the 30th June of every year.

(2) The prescribed authority shall compile, review and analyse the information received and send this information to the Central Pollution Control Board on or before the 31st July of every year.

(3) The Central Pollution Control Board shall compile, review and analyse the information received and send this information, along with its comments or suggestions or observations to the Ministry of Environment, Forest and Climate Change on or before 31st August every year.

(4) The Annual Reports shall also be available online on the websites of Occupiers, State Pollution Control Boards and Central Pollution Control Board.

14. Maintenance of records.- (1) Every authorised person shall maintain records related to the generation, collection, reception, storage, transportation, treatment, disposal or any other form of handling of bio-medical waste, for a period of five years, in accordance with these rules and guidelines issued by the Central Government or the Central Pollution Control Board or the prescribed authority as the case may be.

(2) All records shall be subject to inspection and verification by the prescribed authority or the Ministry of Environment, Forest and Climate Change at any time.

15. **Accident reporting.-** (1) In case of any major accident at any institution or facility or any other site while handling bio-medical waste, the authorised person shall intimate immediately to the prescribed authority about such accident and forward a report within twenty-four hours in writing regarding the remedial steps taken in Form I.

(2) Information regarding all other accidents and remedial steps taken shall be provided in the annual report in accordance with rule 13 by the occupier.

16. Appeal.-(1) Any person aggrieved by an order made by the prescribed authority under these rules may, within a period of thirty days from the date on which the order is communicated to him, prefer an appeal in Form V to the Secretary (Environment) of the State Government or Union territory administration .

(2) Any person aggrieved by an order of the Director General Armed Forces Medical Services under these rules may, within thirty days from the date on which the order is communicated to him, prefer an appeal in Form V to the Secretary, Ministry of Environment, Forest and Climate Change.

(3) The authority referred to in sub-para (1) and (2) as the case may be, may entertain the appeal after the expiry of the said period of thirty days, if it is satisfied that the appellant was prevented by sufficient cause from filing the appeal in time.

(4) The appeal shall be disposed of within a period of ninety days from the date of its filing.

17. **Site for common bio-medical waste treatment and disposal facility**.-(1) Without prejudice to rule 5 of these rules, the department in the business allocation of land assignment shall be responsible for providing suitable site for setting up of common biomedical waste treatment and disposal facility in the State Government or Union territory Administration.

(2) The selection of site for setting up of such facility shall be made in consultation with the prescribed authority, other stakeholders and in accordance with guidelines published by the Ministry of Environment, Forest and Climate Change or Central Pollution Control Board.

18. **Liability of the occupier, operator of a facility**.- (1) The occupier or an operator of a common bio-medical waste treatment facility shall be liable for all the damages caused to the environment or the public due to improper handling of bio- medical wastes.

(2) The occupier or operator of common bio-medical waste treatment facility shall be liable for action under section 5 and section 15 of the Act, in case of any violation.

SCHEDULE I

[See rules 3 (e), 4(b), 7(1), 7(2), 7(5), 7 (6) and 8(2)]

Part-1

Biomedical wastes categories and their segregation, collection, treatment, processing and disposal options

Category	Type of Waste	Type of Bag or Container to be used	Treatment and Disposal options
(1)	(2)	(3)	(4)
Yellow	**(a) Human Anatomical Waste:** Human tissues, organs, body parts and fetus below the viability period (as per the Medical Termination of Pregnancy Act 1971, amended from time to time).	Yellow coloured non-chlorinated plastic bags	Incineration or Plasma Pyrolysis or deep burial*
	(b)Animal Anatomical Waste : Experimental animal carcasses, body parts, organs, tissues, including the waste generated from animals used in experiments or testing in veterinary hospitals or colleges or animal houses.		
	(c) Soiled Waste: Items contaminated with blood, body fluids like dressings, plaster casts, cotton swabs and bags containing residual or discarded blood and blood components.		Incineration or Plasma Pyrolysis or deep burial* In absence of above facilities, autoclaving or micro-waving/ hydroclaving followed by shredding or mutilation or combination of sterilization and shredding. Treated waste to be sent for energy recovery.

	(d) Expired or Discarded Medicines: Pharmaceutical waste like antibiotics, cytotoxic drugs including all items contaminated with cytotoxic drugs along with glass or plastic ampoules, vials etc.	Yellow coloured non-chlorinated plastic bags or containers	Expired `cytotoxic drugs and items contaminated with cytotoxic drugs to be returned back to the manufacturer or supplier for incineration at temperature >1200 ^{0}C or to common bio-medical waste treatment facility or hazardous waste treatment, storage and disposal facility for incineration at >1200^{0}C Or Encapsulation or Plasma Pyrolysis at >1200^{0}C. All other discarded medicines shall be either sent back to manufacturer or disposed by incineration.
	(e) Chemical Waste: Chemicals used in production of biological and used or discarded disinfectants.	Yellow coloured containers or non-chlorinated plastic bags	Disposed of by incineration or Plasma Pyrolysis or Encapsulation in hazardous waste treatment, storage and disposal facility.
	(f) Chemical Liquid Waste: Liquid waste generated due to use of chemicals in production of biological and used or discarded disinfectants, Silver X-ray film developing liquid, discarded Formalin, **infected secretions, aspirated body fluids,** liquid from **laboratories** and floor washings, cleaning, house-keeping and disinfecting activities etc.	Separate collection system leading to effluent treatment system	After resource recovery, the chemical liquid waste shall be pre-treated before mixing with other wastewater. The combined discharge shall conform to the discharge norms given in Schedule- III.
	(g) Discarded linen, mattresses, beddings contaminated with blood or body fluid.	Non-chlorinated yellow plastic bags or suitable packing material	Non- chlorinated chemical disinfection followed by incineration or Plazma Pyrolysis or for energy recovery. In absence of above facilities, shredding or mutilation or combination of sterilization and shredding. Treated waste to be sent for energy recovery or incineration or Plazma Pyrolysis.
	(h) Microbiology, Biotechnology and other clinical laboratory waste: Blood bags, Laboratory cultures, stocks or specimens of micro-organisms, live or attenuated vaccines, human and animal cell cultures used in research, industrial laboratories, production of	Autoclave safe plastic bags or containers	Pre-treat to sterilize with non-chlorinated chemicals on-site as per National AIDS Control Organisation or World Health Organisation guidelines thereafter for Incineration.

	biological, residual toxins, dishes and devices used for cultures.		
Red	**Contaminated Waste (Recyclable)** (a) Wastes generated from disposable items such as tubing, bottles, intravenous tubes and sets, catheters, urine bags, syringes (without needles and *fixed needle syringes*) and vaccutainers with their needles cut) and gloves.	Red coloured non-chlorinated plastic bags or containers	Autoclaving or micro-waving/ hydroclaving followed by shredding or mutilation or combination of sterilization and shredding. Treated waste to be sent to registered or authorized recyclers or for energy recovery or plastics to diesel or fuel oil or for road making, whichever is possible. Plastic waste should not be sent to landfill sites.
White (Translucent)	**Waste sharps including Metals:** Needles, syringes with fixed needles, needles from needle tip cutter or burner, scalpels, blades, or any other contaminated sharp object that may cause puncture and cuts. This includes both used, discarded and contaminated metal sharps	Puncture proof, Leak proof, tamper proof containers	Autoclaving or Dry Heat Sterilization followed by shredding or mutilation or encapsulation in metal container or cement concrete; combination of shredding cum autoclaving; and sent for final disposal to iron foundries (having consent to operate from the State Pollution Control Boards or Pollution Control Committees) or sanitary landfill or designated concrete waste sharp pit.
Blue	**(a) Glassware:** Broken or discarded and contaminated glass including medicine vials and ampoules except those contaminated with cytotoxic wastes.	Cardboard boxes with blue colored marking	Disinfection (by soaking the washed glass waste after cleaning with detergent and Sodium Hypochlorite treatment) or through autoclaving or microwaving or hydroclaving and then sent for recycling.
	(b) Metallic Body Implants	Cardboard boxes with blue colored marking	

[*] **Disposal by deep burial is permitted only in rural or remote areas where there is no access to common bio-medical waste treatment facility. This will be carried out with prior approval from the prescribed authority and as per the Standards specified in Schedule-III. The deep burial facility shall be located as per the provisions and guidelines issued by Central Pollution Control Board from time to time.**

Part -2

(1) All plastic bags shall be as per BIS standards as and when published, till then the prevailing Plastic Waste Management Rules shall be applicable.

(2) Chemical treatment using at least 10% Sodium Hypochlorite having 30% residual chlorine for twenty minutesor any other equivalent chemical reagent that should demonstrate $Log_{10}4$ reduction efficiency for microorganisms as given in Schedule- III.

(3) Mutilation or shredding must be to an extent to prevent unauthorized reuse.

(4) There will be no chemical pretreatment before incineration, except for microbiological, lab and highly infectious waste.

(5) Incineration ash (ash from incineration of any bio-medical waste) shall be disposed through hazardous waste treatment, storage and disposal facility, if toxic or hazardous constituents are present beyond the prescribed limits as given in the Hazardous Waste (Management, Handling and Transboundary Movement) Rules, 2008 or as revised from time to time.

(6) Dead Fetus below the viability period (as per the Medical Termination of Pregnancy Act 1971, amended from time to time) can be considered as human anatomical waste. Such waste should be handed over to the operator of common bio-medical waste treatment and disposal facility in yellow bag with a copy of the official Medical Termination of Pregnancy certificate from the Obstetrician or the Medical Superintendent of hospital or healthcare establishment.

(7) Cytotoxic drug vials shall not be handed over to unauthorised person under any circumstances. These shall be sent back to the manufactures for necessary disposal at a single point. As a second option, these may be sent for incineration at common bio-medical waste treatment and disposal facility or TSDFs or plasma pyrolys is at temperature >1200 ^{0}C.

(8) Residual or discarded chemical wastes, used or discarded disinfectants and chemical sludge can be disposed at hazardous waste treatment, storage and disposal facility. In such case, the waste should be sent to hazardous waste treatment, storage and disposal facility through operator of common bio-medical waste treatment and disposal facility only.

(9) On-site pre-treatment of laboratory waste, microbiological waste, blood samples, blood bags should be disinfected or sterilized as per the Guidelines of World Health Organisation or National AIDS Control Organisation and then given to the common bio-medical waste treatment and disposal facility.

(10) Installation of in-house incinerator is not allowed. However in case there is no common biomedical facility nearby, the same may be installed by the occupier after taking authorisation from the State Pollution Control Board.

(11) Syringes should be either mutilated or needles should be cut and or stored in tamper proof, leak proof and puncture proof containers for sharps storage. Wherever the occupier is not linked to a disposal facility it shall be the responsibility of the occupier to sterilize and dispose in the manner prescribed.

(12) Bio-medical waste generated in households during healthcare activities shall be segregated as per these rules and handed over in separate bags or containers to municipal waste collectors. Urban Local Bodies shall have tie up with the common bio-medical waste treatment and disposal facility to pickup this waste from the Material Recovery Facility (MRF) or from the house hold directly, for final disposal in the manner as prescribed in this Schedule.

SCHEDULE II

[See rule 4(t), 7(1) and 7(6)]

STANDARDS FOR TREATMENT AND DISPOSAL OF BIO-MEDICALWASTES

1. STANDARDS FOR INCINERATION.-

All incinerators shall meet the following operating and emission standards-

A. Operating Standards

1). Combustion efficiency (CE) shall be at least 99.00%.

2). The Combustion efficiency is computed as follows:

$$C.E. = \frac{\%CO_2}{\%CO_2 + \%\ CO} \times 100$$

3). The temperature of the primary chamber shall be a minimum of 800 ^{0}C and the secondary chamber shall be minimum of 1050^{0}C + or - 50^{0}C.

4). The secondary chamber gas residence time shall be at least two seconds.

B. Emission Standards

Sl. No.	Parameter	Standards	
(1)	(2)	(3)	(4)
		Limiting concentration in mg Nm^3 unless stated	**Sampling Duration in minutes, unless stated**
1.	Particulate matter	50	30 or $1NM^3$ of sample volume, whichever is more
2.	Nitrogen Oxides NO and NO_2 expressed asNO_2	400	30 for online sampling or grab sample
3.	HCl	50	30 or $1NM^3$ of sample volume, whichever is more
4.	Total Dioxins and Furans	0.1ngTEQ/Nm^3 (at 11% O2)	8 hours or $5NM^3$ of sample volume, whichever is more
5.	Hg and its compounds	0.05	2 hours or $1NM^3$ of sample volume, whichever is more

C. Stack Height: Minimum stack height shall be 30 meters above the ground and shall be attached with the necessary monitoring facilities as per requirement of monitoring of 'general parameters' as notified under the Environment (Protection) Act, 1986 and in accordance with the Central Pollution Control Board Guidelines of Emission Regulation Part-III.

Note:

(a) The existing incinerators shall comply with the above within a period of two years from the date of the notification.

(b) The existing incinerators shall comply with the standards for Dioxins and Furans of 0.1ngTEQ/Nm^3, as given below within two years from the date of commencement of these rules.

(c) All upcoming common bio-medical waste treatment facilities having incineration facility or captive incinerator shall comply with standards for Dioxins and Furans.

(d) The existing secondary combustion chambers of the incinerator and the pollution control devices shall be suitably retrofitted, if necessary, to achieve the emission limits.

(e) Wastes to be incinerated shall not be chemically treated with any chlorinated disinfectants.

(f) Ash from incineration of biomedical waste shall be disposed of at common hazardous waste treatment and disposal facility. However, it may be disposed of in municipal landfill, if the toxic metals in incineration ash are within the regulatory quantities as defined under the Hazardous Waste (Management and Handling and Transboundary Movement) Rules, 2008 as amended from time to time.

(g) Only low Sulphur fuel like Light Diesel Oil or Low Sulphur Heavy Stock or Diesel, Compressed Natural Gas, Liquefied Natural Gas or Liquefied Petroleum Gas shall be used as fuel in the incinerator.

(h) The occupier or operator of a common bio-medical waste treatment facility shall monitor the stack gaseous emissions (under optimum capacity of the incinerator) once in three months through a laboratory approved under the Environment (Protection) Act, 1986 and record of such analysis results shall be maintained and submitted to the prescribed authority. In case of dioxins and furans, monitoring should be done once in a year.

(i) The occupier or operator of the common bio-medical waste treatment facility shall install continuous emission monitoring system for the parameters as stipulated by State Pollution Control Board or Pollution Control Committees in authorisation and transmit the data real time to the servers at State Pollution Control Board or Pollution Control Committees and Central Pollution Control Board.

(j) All monitored values shall be corrected to 11% Oxygen on dry basis.

(k) Incinerators (combustion chambers) shall be operated with such temperature, retention time and turbulence, as to achieve Total Organic Carbon content in the slag and bottom ashes less than 3% or their loss on ignition shall be less than 5% of the dry weight.

(l) The occupier or operator of a common bio-medical waste incinerator shall use combustion gas analyzer to measure CO_2, CO and O_2.

2. **Operating and Emission Standards for Disposal by Plasma Pyrolysis or Gasification:**

A. Operating Standards:

All the operators of the Plasma Pyrolysis or Gasification **s**hall meet the following operating and emission standards:

1) Combustion Efficiency (CE) shall be at least 99.99%.

2) The Combustion Efficiency is computed as follows.

$$C.E = \frac{\%\ CO_2}{(\%\ CO_2 + \%\ CO)} \times 100$$

3) The temperature of the combustion chamber after plasma gasification shall be 1050 ± 50 ^{o} C with gas residence time of at least 2(two) second, with minimum 3 % Oxygen in the stack gas.

4) The Stack height should be minimum of 30 m above ground level and shall be attached with the necessary monitoring facilities as per requirement of monitoring of 'general parameters' as notified under the Environment (Protection) Act, 1986 and in accordance with the CPCB Guidelines of Emission Regulation Part-III.

B. Air Emission Standards and Air Pollution Control Measures

(i) Emission standards for incinerator, notified at Sl No.1 above in this Schedule, and revised from time to time, shall be applicable for the Plasma Pyrolysis or Gasification also.

(ii) Suitably designed air pollution control devices shall be installed or retrofitted with the 'Plasma Pyrolysis or Gasification to achieve the above emission limits, if necessary.

(iii) Wastes to be treated using Plasma Pyrolysis or Gasification shall not be chemically treated with any chlorinated disinfectants and chlorinated plastics shall not be treated in the system.

C. Disposal of Ash Vitrified Material: The ash or vitrified material generated from the 'Plasma Pyrolysis or Gasification shall be disposed off in accordance with the Hazardous Waste (Management, Handling and Transboundary Movement) Rules 2008 and revisions made thereafter in case the constituents exceed the limits prescribed under Schedule II of the said Rules or else in accordance with the provisions of the Environment (Protection) Act, 1986, whichever is applicable.

3. STANDARDS FOR AUTOCLAVING OF BIO-MEDICAL WASTE.-

The autoclave should be dedicated for the purposes of disinfecting and treating bio-medical waste.

(1) When operating a gravity flow autoclave, medical waste shall be subjected to:

(i) a temperature of not less than 121° C and pressure of 15 pounds per square inch (psi) for an autoclave residence time of not less than 60 minutes; or

(ii) a temperature of not less than 135° C and a pressure of 31 psi for an autoclave residence time of not less than 45 minutes; or

(iii) a temperature of not less than 149° C and a pressure of 52 psi for an autoclave residence time of not less than 30 minutes.

(2) When operating a vacuum autoclave, medical waste shall be subjected to a minimum of three pre-vacuum pulse to purge the autoclave of all air. The air removed during the pre-vacuum, cycle should be decontaminated by means of HEPA and activated carbon filtration, steam treatment, or any other method to prevent release of pathogen. The waste shall be subjected to the following:

(i) a temperature of not less than 121°C and pressure of 15 psi per an autoclave residence time of not less than 45 minutes; or

(ii) a temperature of not less than 135°C and a pressure of 31 psi for an autoclave residence time of not less than 30 minutes;

(3) Medical waste shall not be considered as properly treated unless the time, temperature and pressure indicators indicate that the required time, temperature and pressure were reached during the autoclave process. If for any reasons, time temperature or pressure indicator indicates that the required temperature, pressure or residence time was not

reached, the entire load of medical waste must be autoclaved again until the proper temperature, pressure and residence time were achieved.

(4) **Recording of operational parameters:** Each autoclave shall have graphic or computer recording devices which will automatically and continuously monitor and record dates, time of day, load identification number and operating parameters throughout the entire length of the autoclave cycle.

(5) **Validation test for autoclave:** The validation test shall use four biological indicator strips, one shall be used as a control and left at room temperature, and three shall be placed in the approximate center of three containers with the waste. Personal protective equipment (gloves, face mask and coveralls) shall be used when opening containers for the purpose of placing the biological indicators. At least one of the containers with a biological indicator should be placed in the most difficult location for steam to penetrate, generally the bottom center of the waste pile. The occupier or operator shall conduct this test three consecutive times to define the minimum operating conditions. The temperature, pressure and residence time at which all biological indicator vials or strips for three consecutive tests show complete inactivation of the spores shall define the minimum operating conditions for the autoclave. After determining the minimum temperature, pressure and residence time, the occupier or operator of a common biomedical waste treatment facility shall conduct this test once in three months and records in this regard shall be maintained.

(6) **Routine Test:** A chemical indicator strip or tape that changes colour when a certain temperature is reached can be used to verify that a specific temperature has been achieved. It may be necessary to use more than one strip over the waste package at different locations to ensure that the inner content of the package has been adequately autoclaved. The occupier or operator of a common bio medical waste treatment facility shall conduct this test during autoclaving of each batch and records in this regard shall be maintained.

(7) Spore testing: The autoclave should completely and consistently kill the approved biological indicator at the maximum design capacity of each autoclave unit. Biological indicator for autoclave shall be Geobacillusstearothermophilus spores using vials or spore Strips; with at least $1X10^6$ spores. Under no circumstances will an autoclave have minimum operating parameters less than a residence time of 30 minutes, a temperature less than 121^o C or a pressure less than 15 psi. The occupier or operator of a common bio medical waste treatment and disposal facility shall conduct this test at least once in every week and records in this regard shall be maintained.

4. **STANDARDS OF MICROWAVING.-**

(1) Microwave treatment shall not be used for cytotoxic, hazardous or radioactive wastes, contaminated animal carcasses, body parts and large metal items.

(2) The microwave system shall comply with the efficacy test or routine tests and a performance guarantee may be provided by the supplier before operation of the limit.

(3) The microwave should completely and consistently kill the bacteria and other pathogenic organisms that are ensured by approved biological indicator at the maximum design capacity of each microwave unit. Biological indicators for microwave shall be Bacillus atrophaeusspores using vials or spore strips with at least 1×10^4sporesper detachable strip. The biological indicator shall be placed with waste and exposed to same conditions as the waste during a normal treatment cycle.

5. **STANDARDS FOR DEEP BURIAL.-** (1) A pit or trench should be dug about two meters deep. It should be half filled with waste, then covered with lime within 50 cm of the surface, before filling the rest of the pit with soil.

(2) It must be ensured that animals do not have any access to burial sites. Covers of galvanised iron or wire meshes may be used.

(3) On each occasion, when wastes are added to the pit, a layer of 10 cm of soil shall be added to cover the wastes.

(4) Burial must be performed under close and dedicated supervision.

(5) The deep burial site should be relatively impermeable and no shallow well should be close to the site.

(6) The pits should be distant from habitation, and located so as to ensure that no contamination occurs to surface water or ground water. The area should not be prone to flooding or erosion.

(7) The location of the deep burial site shall be authorised by the prescribed authority.

(8) The institution shall maintain a record of all pits used for deep burial.

(9) The ground water table level should be a minimum of six meters below the lower level of deep burial pit.

6. STANDARDS FOR EFFICACY OF CHEMICAL DISINFECTION

Microbial inactivation efficacy is equated to "Log10 kill" which is defined as the difference between the logarithms of number of test microorganisms before and after chemical treatment. Chemical disinfection methods shall demonstrate a 4 Log10 reduction or greater for Bacillus Subtilis (ATCC 19659) in chemical treatment systems.

7. STANDARDS FOR DRY HEAT STERILIZATION

Waste sharps can be treated by dry heat sterilization at a temperature not less than 185^0C, at least for a residence period of 150 minutes in each cycle, which sterilization period of 90 minutes. There should be automatic recording system to monitor operating parameters.

(i) Validation test for Shaprs sterilization unit

Waste shaprs sterilization unit should completely and consistently kill the biological indicator GeobacillusStearothermophillus or Bacillus Atropheausspoers using vials with at least $\log_{10}$ 6 spores per ml. The test shall be carried out once in three months

(ii) Routine test

A chemical indicator strip or tape that changes colour when a certain temperature is reached can be used to verify that a specific temperature has been achieved. It may be necessary to use more than one strip over the waste to ensure that the inner content of the sharps has been adequately disinfected. This test shall be performed once in week and records in this regard shall be maintained.

8. **STANDARDS FOR LIQUID WASTE.-**

(1) The effluent generated or treated from the premises of occupier or operator of a common bio medical waste treatment and disposal facility, before discharge into the sewer should conform to the following limits-

PARAMETERS	PERMISSIBLE LIMITS
pH	6.5-9.0
Suspended solids	100 mg/l
Oil and grease	10 mg/l
BOD	30 mg/l
COD	250 mg/l
Bio-assay test	90% survival of fish after 96 hours in 100% effluent.

(2) Sludge from Effluent Treatment Plant shall be given to common bio-medical waste treatment facility for incineration or to hazardous waste treatment, storage and disposal facility for disposal.

Schedule III

[See rule 6 and 9(3)]

List of Prescribed Authorities and the Corresponding Duties

Sl. No. (1)	Authority (2)	Corresponding Duties (3)
1	Ministry of Environment, Forest and Climate Change, Government of India	(i) Making Policies concerning bio-medical waste Management in the Country including notification of Rules and amendments to the Rules as and when required. (ii) Providing financial assistance for training and awareness programmes on bio-medical waste management related activities to for the State Pollution Control Boards or Pollution Control Committees. (iii) Facilitating financial assistance for setting up or up-gradation of common bio-medical waste treatment facilities. (iv) Undertake or support operational research and assessment with reference to risks to environment and health due to bio-medical waste and previously unknown disposables and wastes from new types of equipment. (v) Constitution of Monitoring Committee for implementation of the rules. (vi) Hearing Appeals and give decision made in Form- V against order passed by the prescribed authorities. (vii) Develop Standard manual for Trainers and Training.

		(viii) Notify the standards or operating parameters for new technologies for treatment of bio medical waste other than those listed in Schedule- I.
2	Central or State Ministry of Health and Family Welfare, Central Ministry for Animal Husbandry and Veterinary or State Department of Animal Husbandry and Veterinary.	(i) Grant of license to health care facilities or nursing homes or veterinary establishments with a condition to obtain authorisation from the prescribed authority for bio-medical waste management. (ii) Monitoring, Refusal or Cancellation of license for health care facilities or nursing homes or veterinary establishments for violations of conditions of authorisation or provisions under these Rules. (iii) Publication of list of registered health care facilities with regard to bio-medical waste generation, treatment and disposal. (iv) Undertake or support operational research and assessment with reference to risks to environment and health due to bio-medical waste and previously unknown disposables and wastes from new types of equipment. (v) Coordinate with State Pollution Control Boards for organizing training programmes to staff of health care facilities and municipal workers on bio-medical waste. (vi) Constitution of Expert Committees at National or State level for overall review and promotion of clean or new technologies for bio-medical waste management. (vii) Organizing or Sponsoring of trainings for the regulatory authorities and health care facilities on bio-medical waste management related activities. (viii) Sponsoring of mass awareness campaigns in electronic media and print media.
3	Ministry of Defence	(i) Grant and renewal of authorisation to Armed Forces health care facilities or common bio-medical waste treatment facilities (Rule 9). (ii) Conduct training courses for authorities dealing with management of bio-medical wastes in Armed Forces health care facilities or treatment facilities in association with State Pollution Control Boards or Pollution Control Committees or Central Pollution Control Board or Ministry of Environment, Forest and Climate Change. (iii) Publication of inventory of occupiers and bio-medical waste generation from Armed Forces health care facilities or occupiers (iv) Constitution of Advisory Committee for implementation of the rules. (v) Review of management of bio-medical waste generation in the Armed Forces health care facilities through its Advisory Committee (Rule 11). (vi) Submission of annual report to Central Pollution Control Board within the stipulated time period (Rule 13).
4.	Central Pollution Control Board	(i) Prepare Guidelines on bio-medical waste Management and submit to the Ministry of Environment, Forest and Climate Change. (ii) Co-ordination of activities of State Pollution Control Boards or Pollution Control Committees on bio-medical waste.

		(iii) Conduct training courses for authorities dealing with management of bio-medical waste. (iv) Lay down standards for new technologies for treatment and disposal of bio-medical waste (Rule 7) and prescribe specifications for treatment and disposal of bio-medical wastes (Rule 7). (v) Lay down Criteria for establishing common bio-medical waste treatment facilities in the Country. (vi) Random inspection or monitoring of health care facilities and common bio-medical waste treatment facilities. (vii) Review and analysis of data submitted by the State Pollution Control Boards on bio-medical waste and submission of compiled information in the form of annual report along with its observations to Ministry of Environment, Forest and Climate Change . (viii) Inspection and monitoring of health care facilities operated by the Director General, Armed Forces Medical Services (Rule 9). (ix) Undertake or support research or operational research regarding bio-medical waste.
5.	State Government of Health or Union Territory Government or Administration	(i) To ensure implementation of the rule in all health care facilities or occupiers. (ii) Allocation of adequate funds to Government health care facilities for bio-medical waste management. (iii) Procurement and allocation of treatment equipments and make provision for consumables for bio-medical waste management in Government health care facilities. (iv) Constitute State or District Level Advisory Committees under the District Magistrate or Additional District Magistrate to oversee the bio-medical waste management in the Districts. (v) Advise State Pollution Control Boards or Pollution Control Committees on implementation of these Rules. (vi) Implementation of recommendations of the Advisory Committee in all the health care facilities.
6.	State Pollution Control Boards or Pollution Control Committees	(i) Inventorisation of Occupiers and data on bio-medical waste generation, treatment & disposal. (ii) Compilation of data and submission of the same in annual report to Central Pollution Control Board within the stipulated time period. (iii) Grant and renewal, suspension or refusal cancellation or of authorisation under these rules (Rule 7, 8 and 10). (iv) Monitoring of compliance of various provisions and conditions of authorisation. (v) Action against health care facilities or common bio-medical waste treatment facilities for violation of these rules (Rule 18). (vi) Organizing training programmes to staff of health care facilities and common bio-medical waste treatment facilities and State Pollution Control Boards or Pollution Control Committees Staff on segregation, collection, storage, transportation, treatment and disposal of bio-medical wastes.

		(vii) Undertake or support research or operational research regarding bio-medical waste management. (viii) Any other function under these rules assigned by Ministry of Environment, Forest and Climate Change or Central Pollution Control Board from time to time. (ix) Implementation of recommendations of the Advisory Committee. (x) Publish the list of Registered or Authorised (or give consent) Recyclers. (xi) Undertake and support third party audits of the common bio-medical waste treatment facilities in their State.
7	Municipalities or Corporations, Urban Local Bodies and Gram Panchayats	(i) Provide or allocate suitable land for development of common bio-medical waste treatment facilities in their respective jurisdictions as per the guidelines of Central Pollution Control Board. (ii) Collect other solid waste (other than the bio-medical waste) from the health care facilities as per the Municipal Solid Waste (Management and handling) Rules, 2000 or as amended time to time. (iii) Any other function stipulated under these Rules.

SCHEDULE IV

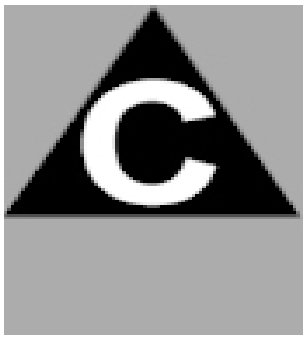
[See rule 8(3) and (5)]

Part A

LABEL FOR BIO-MEDICAL WASTE CONTAINERS or BAGS

HANDLE WITH CARE

CYTOTOXIC HAZARDSYMBOL



HANDLE WITH CARE

Part B

LABEL FOR TRANSPORTING BIO-MEDICAL WASTE BAGS OR CONTAINERS

Day .....Month .....

Year .....

Date of generation .....

Waste category Number .....

Waste quantity……

Sender's Name and Address

Phone Number .....

Receiver's Name and Address:

Phone Number .....

Fax Number..... Fax Number .....

Contact Person ..... Contact Person .....

In case of emergency please contact :

Name and Address :

Phone No.

Note :Label shall be non-washable and prominently visible.

FORM – I

[(See rule 4(o), 5(i) and 15 (2)]

ACCIDENT REPORTING

1. Date and time of accident :
2. Type of Accident :
3. Sequence of events leading to accident :
4. Has the Authority been informed immediately :
5. The type of waste involved in accident :
6. Assessment of the effects of the accidents on human health and the environment:
7. Emergency measures taken :
8. Steps taken to alleviate the effects of accidents :
9. Steps taken to prevent the recurrence of such an accident :
10. Does you facility has an Emergency Control policy? If yes give details:

Date : …… Signature …….

Place: …… Designation ……..

FORM - II

(See rule10)

APPLICATION FOR AUTHORISATION OR RENEWAL OF AUTHORISATION

(To be submitted by occupier of health care facility or common bio-medical waste treatment facility)

To

The Prescribed Authority
(Name of the State or UT Administration)
Address.

1. Particulars of Applicant:

(i) Name of the Applicant:
(In block letters & in full)

(ii) Name of the health care facility (HCF) or common bio-medical waste treatment facility (CBWTF) :

(iii) Address for correspondence:

(iv) Tele No., Fax No.:

(v) Email:

(vi) Website Address:

2. Activity for which authorisation is sought:

Activity	Please tick
Generation, segregation	
Collection,	
Storage	
packaging	
Reception	
Transportation	
Treatment or processing or conversion	
Recycling	
Disposal or destruction	
use	
offering for sale, transfer	
Any other form of handling	

3. Application for □ fresh or □ renewal of authorisation (please tick whatever is applicable):

(i) Applied for CTO/CTE Yes/No

(ii) In case of renewal previous authorisation number and date:

(iii) Status of Consents:

(a) under the Water (Prevention and Control of Pollution) Act, 1974

(b) under the Air (Prevention and Control of Pollution) Act, 1981:

---

4. (i) Address of the health care facility (HCF) or common bio-medical waste treatment facility (CBWTF):

(ii) GPS coordinates of health care facility (HCF) or common bio-medical waste treatment facility (CBWTF):

5. Details of health care facility (HCF) or common bio-medical waste treatment facility (CBWTF):

(i) Number of beds of HCF:

(ii) Number of patients treated per month by HCF:

(iii) Number healthcare facilities covered by CBMWTF: _____

(iv) No of beds covered by CBMWTF: _____

(v) Installed treatment and disposal capacity of CBMWTF:_____ Kg per day

(vi) Quantity of biomedical waste treated or disposed by CBMWTF:_____ Kg/ day

(vii) Area or distance covered by CBMWTF:_____

(pl. attach map a map with GPS locations of CBMWTF and area of coverage)

(viii) Quantity of Biomedical waste handled, treated or disposed:

Category	Type of Waste	Quantity Generated or Collected, kg/day	Method of Treatment and Disposal (Refer Schedule-I)
(1)	(2)	(3)	(4)
Yellow	(a) Human Anatomical Waste:		
	(b)Animal Anatomical Waste :		
	(c) Soiled Waste:		
	(d) Expired or Discarded Medicines:		
	(e) Chemical Solid Waste:		
	(f) Chemical Liquid Waste :		

	(g) Discarded linen, mattresses, beddings contaminated with blood or body fluid.		
	(h) Microbiology, Biotechnology and other clinical laboratory waste:		
Red	Contaminated Waste (Recyclable)		
White (Translucent)	Waste sharps including Metals:		
Blue	Glassware:		
	Metallic Body Implants		

6. Brief description of arrangements for handling of biomedical waste (attach details):
   (i) Mode of transportation (if any) of bio-medical waste:
   (ii) Details of treatment equipment (please give details such as the number, type & capacity of each unit)

	No of units	Capacity of each unit
Incinerators :		
Plasma Pyrolysis:		
Autoclaves:		
Microwave:		
Hydroclave:		
Shredder:		
Needle tip cutter or destroyer		
Sharps encapsulation or concrete pit:		
Deep burial pits:		
Chemical disinfection:		
Any other treatment equipment:		

7. Contingency plan of common bio-medical waste treatment facility (CBWTF)(attach documents):

8. Details of directions or notices or legal actions if any during the period of earlier authorisation

9. Declaration

I do hereby declare that the statements made and information given above are true to the best of my knowledge and belief and that I have not concealed any information.

I do also hereby undertake to provide any further information sought by the prescribed authority in relation to these rules and to fulfill any conditions stipulated by the prescribed authority.

Date : Signature of the Applicant

Place : Designation of the Applicant

FORM –III

(See rule 10)

AUTHORISATION

(Authorisation for operating a facility for generation, collection, reception, treatment, storage, transport and disposal of biomedical wastes)

1. File number of authorisation and date of issue…….

2. M/s _____ an occupier or operator of the facility located at _____ is hereby granted an authorisation for;

Activity	Please tick
Generation, segregation	
Collection, Storage packaging	

Reception
Transportation
Treatment or processing or conversion
Recycling
Disposal or destruction
use
offering for sale, transfer
Any other form of handling

3. M/s _____ is hereby authorized for handling of biomedical waste as per the capacity given below;

(i) Number of beds of HCF:

(ii) Number healthcare facilities covered by CBMWTF: _____

(iii) Installed treatment and disposal capacity:_____ Kg per day

(iv) Area or distance covered by CBMWTF:_____

_____

(v) Quantity of Biomedical waste handled, treated or disposed:

Type of Waste Category	Quantity permitted for Handling
Yellow	
Red	
White (Translucent)	
Blue	

4. This authorisation shall be in force for a period of ……. Years from the date of issue.

5. This authorisation is subject to the conditions stated below and to such other conditions as may be specified in the rules for the time being in force under the Environment (Protection) Act, 1986.

Date ……. Signature……..

Place: …… Designation ……..

*Terms and conditions of authorisation **

1. The authorisation shall comply with the provisions of the Environment (Protection) Act, 1986 and the rules made there under.

2. The authorisation or its renewal shall be produced for inspection at the request of an officer authorised by the prescribed authority.

3. The person authorized shall not rent, lend, sell, transfer or otherwise transport the biomedical wastes without obtaining prior permission of the prescribed authority.

4. Any unauthorised change in personnel, equipment or working conditions as mentioned in the application by the person authorised shall constitute a breach of his authorisation.

5. It is the duty of the authorised person to take prior permission of the prescribed authority to close down the facility and such other terms and conditions may be stipulated by the prescribed authority.

Form - IV

(See rule 13)

ANNUAL REPORT

[To be submitted to the prescribed authority on or before 30th June every year for the period from January to December of the preceding year, by the occupier of health care facility (HCF) or common bio-medical waste treatment facility (CBWTF)]

Sl. No.	Particulars		
1 .	Particulars of the Occupier	:	
	(i) Name of the authorised person (occupier or operator of facility)	:	
	(ii) Name of HCF or CBMWTF	:	
	(iii) Address for Correspondence	:	
	(iv) Address of Facility		
	(v)Tel. No, Fax. No	:	
	(vi) E-mail ID	:	
	(vii) URL of Website		
	(viii) GPS coordinates of HCF or CBMWTF		
	(ix) Ownership of HCF or CBMWTF	:	(State Government or Private or Semi Govt. or any other)
	(x). Status of Authorisation under the Bio-Medical Waste (Management and Handling) Rules	:	Authorisation No.: ……..valid up to ……..
	(xi). Status of Consents under Water Act and Air Act	:	Valid up to:
2.	Type of Health Care Facility	:	
	(i) Bedded Hospital	:	No. of Beds:…..
	(ii) Non-bedded hospital (Clinic or Blood Bank or Clinical Laboratory or Research Institute or Veterinary Hospital or any other)	:	
	(iii) License number and its date of expiry		
3.	Details of CBMWTF	:	
	(i) Number healthcare facilities covered by CBMWTF	:	
	(ii) No of beds covered by CBMWTF	:	
	(iii) Installed treatment and disposal capacity of CBMWTF:	:	_____ Kg per day
	(iv) Quantity of biomedical waste treated or disposed by CBMWTF	:	_____ Kg/day
4.	Quantity of waste generated or disposed in Kg per annum (on monthly average basis)	:	Yellow Category :
			Red Category :
			White:
			Blue Category :
			General Solid waste:
5	Details of the Storage, treatment, transportation, processing and Disposal Facility		
	(i) Details of the on-site storage facility	:	Size :
			Capacity :
			Provision of on-site storage : (cold storage or any other provision)

	disposal facilities		Type of treatment equipment / No of units / Capacity Kg/ day / Quantity treatedor disposed in kg per annum Incinerators Plasma Pyrolysis Autoclaves Microwave Hydroclave Shredder Needle tip cutter or destroyer - Sharps encapsulation or concrete pit - Deep burial pits: Chemical disinfection: - Any other treatment equipment:
	(iii) Quantity of recyclable wastes sold to authorized recyclers after treatment in kg per annum.	:	Red Category (like plastic, glass etc.)
	(iv) No of vehicles used for collection and transportation of biomedical waste	:	
	(v) Details of incineration ash and ETP sludge generated and disposed during the treatment of wastes in Kg per annum		Quantity generated / Where disposed Incineration Ash ETP Sludge
	(vi) Name of the Common Bio-Medical Waste Treatment Facility Operator through which wastes are disposed of	:	
	(vii) List of member HCF not handed over bio-medical waste.		
6	Do you have bio-medical waste management committee? If yes, attach minutes of the meetings held during the reporting period		
7	Details trainings conducted on BMW		
	(i) Number of trainings conducted on BMW Management.		
	(ii) number of personnel trained		
	(iii) number of personnel trained at the time of induction		
	(iv) number of personnel not undergone any training so far		
	(v) whether standard manual for training is available?		
	(vi) any other information)		
8	Details of the accident occurred during the year		

	(i) Number of Accidents occurred		
	(ii) Number of the persons affected		
	(iii) Remedial Action taken (Please attach details if any)		
	(iv) Any Fatality occurred, details.		
9.	Are you meeting the standards of air Pollution from the incinerator? How many times in last year could not met the standards?		
	Details of Continuous online emission monitoring systems installed		
10.	Liquid waste generated and treatment methods in place. How many times you have not met the standards in a year?		
11	Is the disinfection method or sterilization meeting the log 4 standards? How many times you have not met the standards in a year?		
12.	Any other relevant information	:	(Air Pollution Control Devices attached with the Incinerator)

Certified that the above report is for the period from

……..……
……
……
……

Name and Signature of the Head of the Institution

Date:

Place

FORM –V

(See rule 16)

Application for filing appeal against order passed by the prescribed authority

1. Name and address of the person applying for appeal :
2. Number, date of order and address of the authority which passed the order, against which appeal is being made (certified copy of order to be attached):
3. Ground on which the appeal is being made:
4. List of enclosures other than the order referred in para 2 against which appeal is being filed:

Signature ……..

Date : Name and Address……..

[F. No. 3-1/2000-HSMD]

BISHWANATH SINHA, Jt. Secy.

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Ministry of Environment, Forest and Climate Change

NOTIFICATION

New Delhi, the 29th March, 2016

G.S.R. 317(E).-Whereas the Municipal Solid Wastes (Management and Handling) Rules, 2000 published vide notification number S.O. 908(E), dated the 25th September, 2000 by the Government of India in the erstwhile Ministry of Environment and Forests, provided a regulatory frame work for management of Municipal Solid Waste generated in the urban area of the country;

And whereas, to make these rules more effective and to improve the collection, segregation, recycling, treatment and disposal of solid waste in an environmentally sound manner, the Central Government reviewed the existing rules and it was considered necessary to revise the existing rules with a emphasis on the roles and accountability of waste generators and various stakeholders, give thrust to segregation, recovery, reuse, recycle at source, address in detail the management of construction and demolition waste.

And whereas, the draft rules, namely, the Solid Waste Management Rules, 2015 with a separate chapter on construction and demolition waste were published by the Central Government in the Ministry of Environment, Forest and Climate Change vide G.S.R. 451 (E), datedthe 3rd June, 2015 inviting objections or suggestions from the public within sixty days from the date of publication of the said notification;

And Whereas, the objections or suggestions received within the stipulated period were duly considered by the Central Government;

Now, therefore, in exercise of the powers conferred by sections 6, 25 of the Environment (Protection) Act, 1986 (29 of 1986), and in supersession of the Municipal Solid Wastes (Management and Handling) Rules, 2000, except as respect things done or omitted to be done before such supersession, the Central Government hereby notifies the following rules for Management of Construction and Demolition Waste –

1. Short title and commencement.-(1) These rules shall be called the Construction and Demolition Waste Management Rules, 2016.

(2) They shall come into force on the date of their publication in the Official Gazette.

2. Application.-The rules shall apply to every waste resulting from construction, re-modeling, repair and demolition of any civil structure of individual or organisation or authority who generates construction and demolition waste such as building materials, debris, rubble.

3. Definitions –(1) In these rules, unless the context otherwise requires,-

(a) " ACT' means the Environment (Protection) Act, 1986 (29 of 1986);

(b) "**construction**" means the process of erecting of building or built facility or other structure, or

building of infrastructure including alteration in these entities,;

(c) "**construction and demolition waste**" means the waste comprising of building materials, debris and rubble resulting from construction, re-modeling, repair and demolition of any civil structure;

(d) **"de-construction"** means a planned selective demolition in which salvage, re-use and recycling of the demolished structure is maximized;

(e) "demolition" means breaking down or tearing down buildings and other structures either manually or using mechanical force (by various equipment) or by implosion using explosives.

(f) "form" means a Form annexed to these rules;

(g) "local authority" means an urban local authority with different nomenclature such as municipal corporation, municipality, nagarpalika, nagarnigam, nagarpanchayat, municipal council including notified area committee and not limited to or any other local authority constituted under the relevant statutes such as gram panchayat, where the management of construction and demolition waste is entrusted to such agency;

(h) " schedule" means a schedule annexed to these rules;

(i) "service provider' means authorities who provide services like water, sewerage, electricity, telephone, roads, drainage etc. often generate construction and demolition waste during their activities, which includes excavation, demolition and civil work;

(j) "waste generator" means any person or association of persons or institution, residential and commercial establishments including Indian Railways, Airport, Port and Harbour and Defence establishments who undertakes construction of or demolition of any civil structure which generate construction and demolition waste.

(2) Words and expressions used but not defined herein shall have the same meaning defined in the ACT.

(4) Duties of the waste generator -

(1) Every waste generator shall prima-facie be responsible for collection, segregation of concrete, soil and others and storage of construction and demolition waste generated, as directed or notified by the concerned local authority in consonance with these rules.

(2) The generator shall ensure that other waste (such as solid waste) does not get mixed with this waste and is stored and disposed separately.

(3) Waste generators who generate more than 20 tons or more in one day or 300 tons per project in a month shall segregate the waste into four streams such as concrete, soil, steel, wood and plastics, bricks and mortar and shall submit waste management plan and get appropriate approvals from the local authority before starting construction or demolition or remodeling work and keep the concerned

authorities informed regarding the relevant activities from the planning stage to the implementation stage and this should be on project to project basis.

(4) Every waste generator shall keep the construction and demolition waste within the premise or get the waste deposited at collection centre so made by the local body or handover it to the authorised processing facilities of construction and demolition waste; and ensure that there is no littering or deposition of construction and demolition waste so as to prevent obstruction to the traffic or the public or drains.

(5) Every waste generator shall pay relevant charges for collection, transportation, processing and disposal as notified by the concerned authorities; Waste generators who generate more than 20 tons or more in one day or 300 tons per project in a month shall have to pay for the processing and disposal of construction and demolition waste generated by them, apart from the payment for storage, collection and transportation. The rate shall be fixed by the concerned local authority or any other authority designated by the State Government.

(5) Duties of service provider and their contractors -

(1) The service providers shall prepare within six months from the date of notification of these rules, a comprehensive waste management plan covering segregation, storage, collection, reuse, recycling, transportation and disposal of construction and demolition waste generated within their jurisdiction.

(2) The service providers shall remove all construction and demolition waste and clean the area every day, if possible, or depending upon the duration of the work, the quantity and type of waste generated, appropriate storage and collection, a reasonable timeframe shall be worked out in consultation with the concerned local authority.

(3) In case of the service providers have no logistics support to carry out the work specified in sub-rules (1) and (2) , they shall tie up with the authorised agencies for removal of construction and demolition waste and pay the relevant charges as notified by the local authority.

(6) Duties of local authority-The local authority shall,-

(1) issue detailed directions with regard to proper management of construction and demolition waste within its jurisdiction in accordance with the provisions of these rules and the local authority shall seek detailed plan or undertaking as applicable, from generator of construction and demolition waste;

(2) chalk out stages, methodology and equipment, material involved in the overall activity and final clean up after completion of the construction and demolition ;

(3c) seek assistance from concerned authorities for safe disposal of construction and demolition waste contaminated with industrial hazardous or toxic material or nuclear waste if any;

(4) shall make arrangements and place appropriate containers for collection of waste and shall remove at regular intervals or when they are filled, either through own resources or by appointing private operators;

(5) shall get the collected waste transported to appropriate sites for processing and disposal either through own resources or by appointing private operators;

(6) shall give appropriate incentives to generator for salvaging, processing and or recycling preferably in-situ;

(7) shall examine and sanction the waste management plan of the generators within a period of one month or from the date of approval of building plan, whichever is earlier from the date of its submission;

(8) shall keep track of the generation of construction and demolition waste within its jurisdiction and establish a data base and update once in a year;

(9) shall device appropriate measures in consultation with expert institutions for management of construction and demolition waste generated including processing facility and for using the recycled products in the best possible manner;

(10) shall create a sustained system of information, education and communication for construction and demolition waste through collaboration with expert institutions and civil societies and also disseminate through their own website;

(11) shall make provision for giving incentives for use of material made out of construction and demolition waste in the construction activity including in non-structural concrete, paving blocks, lower layers of road pavements, colony and rural roads.

(7) Criteria for storage, processing or recycling facilities for construction and demolition waste and application of construction and demolition waste and its products-

(1) The site for storage and processing or recycling facilities for construction and demolition waste shall be selected as per the criteria given in **Schedule I**;

(2) The operator of the facility as specified in sub- rules (1) shall apply in **Form I** for authorization from State Pollution Control Board or Pollution Control Committee.

(3) The operator of the facility shall submit the annual report to the State Pollution Control Board in **Form II.**

(3) Application of materials made from construction and demolition waste in operation of sanitary landfill shall be as per the criteria given in **Schedule II.**

(8) Duties of State Pollution Control Board or Pollution Control Committee-

(1) State Pollution Control Board or Pollution Control Committee shall monitor the implementation of these rules by the concerned local bodies and the competent authorities and the annual report shall be sent to the Central Pollution Control Board and the State Government or Union Territory or any other State level nodal agency identified by the State Government or Union Territory administration for generating State level comprehensive data. Such reports shall also contain the comments and suggestions of the State Pollution Control Board or Pollution Control Committee with respect to any comments or changes required;

(2) State Pollution Control Board or Pollution Control Committee shall grant authorization to construction and demolition waste processing facility in **Form-III** as specified under these rules after examining the application received in **Form I**;

(3) State Pollution Control Board or Pollution Control Committee shall prepare annual report in **Form IV** with special emphasis on the implementation status of compliance of these rules and forward report to Central Pollution Control Board before the 31st July for each financial year.

(9) Duties of State Government or Union Territory Administration-

(1) The Secretary in-charge of development in the State Government or Union territory administration shall prepare their policy document with respect to management of construction and demolition of waste in accordance with the provisions of these rules within one year from date of final notification of these rules.

(2) The concerned department in the State Government dealing with land shall be responsible for providing suitable sites for setting up of the storage, processing and recycling facilities for construction and demolition waste.

(3) The Town and Country planning Department shall incorporate the site in the approved land use plan so that there is no disturbance to the processing facility on a long term basis.

(4) Procurement of materials made from construction and demolition waste shall be made mandatory to a certain percentage (say 10-20%) in municipal and Government contracts subject to strict quality control.

(10) Duties of the Central Pollution Control Board - (1) The Central Pollution Control Board shall,-

(a) prepare operational guidelines related to environmental management of construction and demolition waste management;

(b) analyze and collate the data received from the State Pollution Control Boards or Pollution Control Committee to review these rules from time to time;

(c) coordinate with all the State Pollution Control Board and Pollution Control Committees for any matter related to development of environmental standards;

(d) forward annual compliance report to Central Government before the 30th August for each financial year based on reports given by State Pollution Control Boards of Pollution Control Committees.

(11) Duties of Bureau of Indian Standards and Indian Roads Congress -The Bureau of Indian Standards and Indian Roads Congress shall be responsible for preparation of code of practices and standards for use of recycled materials and products of construction and demolition waste in respect of construction activities and the role of Indian Road Congress shall be specific to the standards and practices pertaining to construction of roads.

(12) Duties of the Central Government -

(1) The Ministry of Urban Development, and the Ministry of Rural Development, Ministry of Panchayat Raj, shall be responsible for facilitating local bodies in compliance of these rules;

(2) The Ministry of Environment, Forest and Climate Change shall be responsible for reviewing implementation of these rules as and when required.

13. Timeframe for implementation of the provisions of these rules -The timeline for implementation of these rules shall be as specified in **Schedule III:**

14. Accident reporting by the construction and demolition waste processing facilities-In case of any accident during construction and demolition waste processing or treatment or disposal facility, the officer in charge of the facility in the local authority or the operator of the facility shall report of the accident in **Form-V** to the local authority. Local body shall review and issue instruction if any, to the in-charge of the facility.

Schedule I
Criteria for Site Selection for Storage and Processing or Recycling Facilities for construction and demolition Waste
[See Rule 7(1)]

(1) The concerned department in the State Government dealing with land shall be responsible for providing suitable sites for setting up of the storage, processing and recycling facilities for construction and demolition and hand over the sites to the concerned local authority for development, operation and maintenance, which shall ultimately be given to the operators by Competent Authority and wherever above Authority is not available, shall lie with the concerned local authority.

(2) The Local authority shall co-ordinate (in consultation with Department of Urban Development of the State or the Union territory) with the concerned organizations for giving necessary approvals and clearances to the operators.

(3) Construction and demolition waste shall be utilized in sanitary landfill for municipal solid waste of the city or region as mentioned at Schedule I of thse rule. Residues from construction and demolition waste processing or recycling industries shall be land filled in the sanitary landfill for solid waste.

(4) The processing or recycling shall be large enough to last for 20-25 years (project based on-site recycling facilities).

(5) The processing or recycling site shall be away from habitation clusters, forest areas, water bodies, monuments, National Parks, Wetlands and places of important cultural, historical or religious interest.

(6) A buffer zone of no development shall be maintained around solid waste processing and disposal facility, exceeding five Tonnes per day of installed capacity. This will be maintained within the

total area of the solid waste processing and disposal facility. The buffer zone shall be prescribed on case to case basis by the local authority in consultation with concerned State Pollution Control Board.

(7) Processing or recycling site shall be fenced or hedged and provided with proper gate to monitor incoming vehicles or other modes of transportation.

(8) The approach and or internal roads shall be concreted or paved so as to avoid generation of dust particles due to vehicular movement and shall be so designed to ensure free movement of vehicles and other machinery.

(9) Provisions of weigh bridge to measure quantity of waste brought at landfill site, fire protection equipment and other facilities as may be required shall be provided.

(10) Utilities such as drinking water and sanitary facilities (preferably washing/bathing facilities for workers) and lighting arrangements for easy landfill operations during night hours shall be provided and Safety provisions including health inspections of workers at landfill sites shall be carried out made.

(11) In order to prevent pollution from processing or recycling operations, the following provisions shall be made, namely:

(a) Provision of storm water drains to prevent stagnation of surface water;
(b) Provision of paved or concreted surface in selected areas in the processing or recycling facility for minimizing dust and damage to the site.
(c) Prevention of noise pollution from processing and recycling plant:
(d) provision for treatment of effluent if any, to meet the discharge norms as per Environment (Protection) Rules, 1986.

(12) Work Zone air quality at the Processing or Recycling site and ambient air quality at the vicinity shall be monitored.

(13) The measurement of ambient noise shall be done at the interface of the facility with the surrounding area, i.e., at plant boundary.

(14) The following projects shall be exempted from the norms of pollution from dust and noise as mentioned above:

For construction work, where at least 80 percent construction and demolition waste is recycled or reused in-situ and sufficient buffer area is available to protect the surrounding habitation from any adverse impact.

(15) A vegetative boundary shall be made around Processing or Recycling plant or site to strengthen the buffer zone.

Schedule II

Application of materials made from construction and demolition waste and its products.

[See Rule 7(3)]

Sl. No.	Parameters	Compliance Criteria
1	Drainage layer in leachate collection system at bottom of Sanitary Landfill Gas Collection Layer above the waste at top of Sanitary Landfill and Drainage Layer in top Cover System above Gas Collection Layer of Sanitary Landfill For capping of sanitary landfill or dumpsite, drainage layer at the top	Only crushed and graded hard material (stone, concrete etc.) shall be used having coarse sand size graded material (2mm – 4.75mm standard sieve size). Since the coarse sand particles will be angular in shape (and not rounded as for riverbed sand), protection layers of non-woven geo-textiles may be provided, wherever required, to prevent puncturing of adjacent layers or components.
2	Daily cover	Fines from construction and demolition processed waste having size up to 2 mm shall be used for daily cover over the fresh waste. Use of construction and demolition fines as landfill cover shall be mandatory where such material is available. Fresh soil (sweet earth) shall not be used for such places and borrow-pits shall not be allowed. Exception – soil excavated during construction of the same landfill. During hot windy days in summer months, some fugitive dust problems may arise. These can be minimised by mixing with local soil wherever available for limited period.
3	Civil construction in a sanitary landfill	Non-structural applications, such as kerb stones, drain covers, paving blocks in pedestrian areas.

Schedule III
Timeframe for Planning and Implementation
[See Rule 13]

Sl. No.	Compliance Criteria	Cities with population of 01 million and above	Cities with population of 0.5-01 million	Cities with population of less than 0.5 million
1	Formulation of policy by State Government	12 months	12 months	12 months
2	Identification of sites for collection and processing facility	18 months	18 months	18 months
3	Commissioning and implementation of the facility	18 months	24 months	36 months
4	Monitoring by SPCBs	3 times a year – once in 4 months	2 times a year – once in 6 months	2 times a year – once in 6 months

The time Schedule is effective from the date of notification of these rules.

FORM – I
See [Rule 7 (2)]
Application for obtaining authorisation

To,
The Member Secretary

_____Name of the local authority or Name of the agency appointed by the municipal authority :

Correspondence address Telephone No. Fax No.	
Nodal Officer and designation (Officer authorized by the competent authority or agency responsible for operation of processing or recycling or disposal facility)	
Authorisation applied for (Please tick mark)	Setting up of processing or recycling facility of construction and demolition waste
Detailed proposal of construction and demolition waste processing or recycling facility to include the following Location of site approved and allotted by the Competent Authority. Average quantity (in tons per day) and composition of construction and demolition waste to be handled	

at the specific site. Details of construction and demolition waste processing or recycling technology to be used. Quantity of construction and demolition waste to be processed per day. Site clearance from Prescribed Authority. Salient points of agreement between competent authority or local authority and operating agency (attach relevant document). Plan for utilization of recycled product. Expected amount of process rejects and plan for its disposal (e.g., sanitary landfill for solid waste). Measures to be taken for prevention and control of environmental pollution. Investment on project and expected returns. Measures to be taken for safety of workers working in the processing or recycling plant. Any preventive plan for accident during the collection, transportation and treatment including processing and recycling should be informed to the Competent Authority (Local Authority) or Prescribed Authority	
Date:	**Signature of Nodal Officer**

Form-II

See [Rule (7) (3)]
Format for Issue of Authorisation to the Operator

File No.: _____
Date : _____

To,

_____
_____
_____

Ref : Your application number _____Dt. ……

The _____ State Pollution Control Board or Pollution Control Committee after examining the proposal hereby authorizes _____ having their administrative office at _____ to set up and operate construction and demolition waste processing facility at_____ on the terms and conditions (including the standards to comply) attached to this authorisation letter.

1. The validity of this authorisation is till _____. After expiry of the validity period, renewal of authorisation is to be sought.

2. The _____ State Pollution Control Board or Pollution Control Committee may, at any time, for justifiable reason, revoke any of the conditions applicable under the authorisation and shall communicate the same in writing.

3. Any violation of the provision of the construction and demolition Waste Management Rules, 2016 shall attract the penal provision of the Environment (Protection) Act, 1986 (29 of 1986).

Date: **(Member Secretary)**
Place: **State Pollution Control Board/**
Pollution Control Committee

Form –III

See [Rule 8(2)]

Format of Annual Report to be submitted by Local Authority to the State Pollution Control Board

(i) Name of the City or Town…….
(ii) Population……
(iii) Name and address of local authority or competent authority

Telephone No : ……
Fax : …….
Email ID: …….
Website: ……..

(iv) Name of In-charge or Nodal Officer dealing with construction and demolition wastes management with designation ……

1. Quantity and composition of construction and demolition waste including any deconstruction waste

(a) Total quantity of construction and demolition waste generated during the whole year in metric ton

Any figures for lean period and peak period generation per day ……..
Average generation of construction and demolition waste (TPD)
Total quantity of construction and demolition waste collected per day
Any Processing / Recycling Facility set up in the city ……
Status of the facility

(b) Total quantity of construction and demolition waste processed / recycled (in metric ton)

Non-structural concrete aggregate :
Manufactured sand :
Ready-mix concrete (RMC) :
Paving blocks :
GSB :

Others, if any, please specify :

(c) Total quantity of Construction & Demolition waste disposed by land filling without processing (last option) or filling low lying areas

No of landfill sites used :
Area used :
Whether weigh-bridge facility used for quantity estimation? : Yes No

(d) Whether construction and demolition waste used in sanitary landfill (for solid waste) as per Schedule III

: Yes No

2. Storage facilities

(a) Area orlocation or plot or societies covered for collection of Construction and Demolition waste

(b) No. of large Projects (including roadways project) covered

(c) Whether Area or location or plot or societies collection is Practiced (if yes, whether done by Competent Authority or Local Authority or through Private Agency or Non-Governmental Organization) :

(d) Storage Bins :

	Specifications (Shape & Size)	Existing Number	Proposed for future
(i) Containers or receptacle (Capacity)			
(ii) Others, please specify			

(e) Whether all storage bins/collection spots are attended for daily lifting : Yes No

(e) Whether lifting of Construction & Demolition Waste from Storage bins is manual or mechanical (please tick mark) please specify mode and equipment used : Manual Mechanical Others, (specify equipment)

3. Transportation

	Existing	Actually Required/Proposed number
Truck		
Truck-Hydraulic		
Tractor-Trailer		
Dumper-placers		
Tricycle		

Refuse-collector :
Others (Please specify) :

4. Whether any proposal has been made to improve Construction and Demolition waste management practices

5. Have any efforts been made to involve PPP for processing of Construction & Demolition waste : If yes, what is (are) the technologies being used, such as:

Processing / recycling Technology	(Quantity to be processed)	Steps taken
Dry Process	:	
Wet Process	:	
Others, if any, Please specify	:	

6. What provisions are available to check unauthorized operations of:

Encroachment on river bank or wet bodies :
Unauthorized filling of low line areas :
Mixing with solid waste :
Encroachment in Parks, Footpaths etc. :

7. How many slums are provided with construction and demolition waste receptacles facilities:

8. Are municipal magistrates appointed for taking penal action for non-compliance with these rules: Yes No
[If yes, how many cases registered & settled during last three years (give year wise details)]

Dated: **Signature of Municipal Commissioner**

Form –IV

See [Rule (8)(3)]

Format of Annual Report to be submitted by the State Pollution Control Board / Committees to the Central Pollution Control Board

To,

The Chairman,
Central Pollution Control Board,
PariveshBhawan, East Arjun Nagar,
Delhi-110032

1. Name of the State/Union territory :

2. Name & address of the State Pollution Control Board/Pollution Control Committee :

3. Number of municipal authorities responsible for management of municipal solid wastes in the State/Union territory under these rules :

4. A Summary Statement on progress made by municipal authorities in respect of implementation of **Schedule III**] : Please attach as Annexure-I

5. A Summary Statement on progress made by municipal authorities in respect of implementation of **Schedule IV** : Please attach as Annexure-II

Date: **Chairman or the Member Secretary**
State Pollution Control Board/
Place: **Pollution Control Committee**

Form –V
See [Rule14]
Accident reporting

1. Date and time of accident :
2. Sequence of events leading to accident :
3. The type of construction and demolition waste involved in accident :
4. Assessment of the effects of the accidents
   a. on traffic, drainage system and the environment :
5. Emergency measures taken :
6. Steps taken to alleviate the effects
   a. of accidents :
7. Steps taken to prevent the recurrence
   a. of such an accident :
8. Regular monthly health checkup of workers at

a. Processing / recycling site shall be made

9. Any accident during the collection,
   a. transportation and treatment including
   b. processing and recycling should be informed
   c. to the Competent Authority (Local Authority) or
   d. Prescribed Authority

Date : Authorized Signatory
Place: Designation

[18-6/2014-HSMD]
Bishwanath Sinha, Joint Secretary

[PUBLISHED IN THE GAZETTE OF INDIA, EXTRAORDINARY PART-II, SECTION-3, SUB-SECTION (i)]

GOVERNMENT OF INDIA
MINISTRY OF ENVIRONMENT, FOREST AND CLIMATE CHANGE

NOTIFICATION

New Delhi, the 23rd March , 2016

G.S.R 338(E). - Whereas the draft rules, namely the e-waste (Management) Rules, 2015, were published by the Government of India in the Ministry of Environment, Forest and Climate Change *vide* number G.S.R. 472(E), dated the 10th June, 2015 in the Gazette of India, Extraordinary Part II, section 3, sub-section (ii) inviting objections and suggestions from all persons likely to be affected thereby, before the expiry of the period of sixty days from the date on which copies of the Gazette containing the said notification were made available to the public;

AND WHEREAS the copies of the Gazette containing the said notification were made available to the public on the 10th day of June, 2015;

AND WHEREAS the objections and suggestions received within the specified period from the public in respect of the said draft rules have been duly considered by the Central Government;

NOW, THEREFORE, in exercise of the powers conferred by sections 6, 8 and 25 of the Environment (Protection) Act, 1986 (29 of 1986), and in supersession of the e-waste (Management and Handling) Rules, 2011, published in the Gazette of India, section 3, sub-section (ii), *vide* number S.O. 1035(E), dated the 12th May, 2011, except as respects things done or omitted to be done before such supersession, the Central Government hereby makes the following rules, namely:-

CHAPTER I

PRELIMINARY

1. Short title and commencement. - (1) These rules may be called the E-Waste (Management) Rules, 2016.
(2) They shall come into force from the 1st day of October, 2016.

2. Application. - These rules shall apply to every manufacturer, producer, consumer, bulk consumer, collection centres, dealers, e-retailer, refurbisher**,** dismantler and recycler involved in manufacture, sale, transfer, purchase, collection, storage and processing of e-waste or electrical and electronic equipment listed in Schedule I, including their components, consumables, parts and spares which make the product operational but shall not apply to -

(a) used lead acid batteries as covered under the Batteries (Management and Handling) Rules, 2001 made under the Act;
(b) micro enterprises as defined in the Micro, Small and Medium Enterprises Development Act, 2006 (27 of 2006); and

(c) radio-active wastes as covered under the provisions of the Atomic Energy Act, 1962 (33 of 1962) and rules made there under.

3. Definitions. - (1) In these rules, unless the context otherwise requires, -

(a) 'Act' means the Environment (Protection) Act, 1986 (29 of 1986);
(b) 'authorisation' means permission for generation, handling, collection, reception, storage, transportation, refurbishing, dismantling, recycling, treatment and disposal of e-waste, granted to manufacturer, dismantler, refurbisher and recycler;
(c) 'bulk consumer' means bulk users of electrical and electronic equipment such as Central Government or State Government Departments, public sector undertakings, banks, educational institutions, multinational organisations, international agencies, partnership and public or private companies that are registered under the Factories Act, 1948 (63 of 1948) and the Companies Act, 2013 (18 of 2013) and health care facilities which have turnover of more than one crore or have more than twenty employees;
(d) 'Central Pollution Control Board' means the Central Pollution Control Board constituted under sub-section (1) of section 3 of the Water (Prevention and Control of Pollution) Act, 1974 (6 of 1974);
(e) 'collection centre' means a centre or a collection point or both established by producer individually or as association jointly to collect e-waste for channelising the e-waste to recycler and play such role as indicated in the authorisation for Extended Producer Responsibility granted to the producer and having facilities as per the guidelines of Central Pollution Control Board, including the collection centre established by the dismantler or refurbisher or recycler which should be a part of their authorisation issued by the State Pollution Control Board where the facility exists;
(f) 'component' means one of the parts of a sub-assembly or assembly of which a manufactured product is made up and into which it may be resolved and includes an accessory or attachment to another component;
(g) 'consumables' means an item, which participates in or is required for a manufacturing process or for functioning of the electrical and electronic equipment and may or may not form part of end-product. Items, which are substantially or totally consumed during a manufacturing process, shall be deemed to be consumables;
(h) 'consumer' means any person using electrical and electronic equipment excluding the bulk consumers;
(i) 'channelisation' means to direct the path for movement of e-wastes from collection onwards to authorised dismantler or recycler. In case of fluorescent and other mercury containing lamps, where recyclers are not available, this means path for movement from collection centre to Treatment, Storage and Disposal Facility;
(j) 'dealer' means any individual or firm that buys or receives electrical and electronic equipment as listed in Schedule I of these rules and their components or consumables or parts or spares from producers for sale;
(k) 'deposit refund scheme' means a scheme whereby the producer charges an additional amount as a deposit at the time of sale of the electrical and electronic equipment and returns it to the consumer along with interest when the end-of-life electrical and electronic equipment is returned;
(l) 'dismantler' means any person or organisation engaged in dismantling of used electrical and electronic equipment into their components and having facilities

as per the guidelines of Central Pollution Control Board and having authorisation from concerned State Pollution Control Board;

(m) 'disposal' means any operation which does not lead to recycling, recovery or reuse and includes physico-chemical or biological treatment, incineration and deposition in secured landfill;

(n) 'end-of-life' of the product means the time when the product is intended to be discarded by the user;

(o) 'environmentally sound management of e-waste' means taking all steps required to ensure that e-waste is managed in a manner which shall protect health and environment against any adverse effects, which may result from such e-waste;

(p) 'electrical and electronic equipment' means equipment which are dependent on electric current or electro-magnetic field in order to become functional;

(q) 'e-retailer' means an individual or company or business entity that uses an electronic network such as internet, telephone, to sell its goods;

(r) 'e-waste' means electrical and electronic equipment, whole or in part discarded as waste by the consumer or bulk consumer as well as rejects from manufacturing, refurbishment and repair processes;

(s) 'e-waste exchange' means an independent market instrument offering assistance or independent electronic systems offering services for sale and purchase of e-waste generated from end-of-life electrical and electronic equipment between agencies or organisations authorised under these rules;

(t) 'Extended Producer Responsibility' means responsibility of any producer of electrical or electronic equipment, for channelisation of e-waste to ensure environmentally sound management of such waste. Extended Producer Responsibility may comprise of implementing take back system or setting up of collection centres or both and having agreed arrangements with authorised dismantler or recycler either individually or collectively through a Producer Responsibility Organisation recognised by producer or producers in their Extended Producer Responsibility - Authorisation;

(u) 'Extended Producer Responsibility - Authorisation' means a permission given by Central Pollution Control Board to a producer, for managing Extended Producer Responsibility with implementation plans and targets outlined in such authorisation including detail of Producer Responsibility Organisation and e-waste exchange, if applicable;

(v) 'Extended Producer Responsibility Plan' means a plan submitted by a producer to Central Pollution Control Board, at the time of applying for Extended Producer Responsibility - Authorisation in which a producer shall provide details of e-waste channelisation system for targeted collection including detail of Producer Responsibility Organisation and e-waste exchange, if applicable;

(w) 'facility' means any location wherein the process incidental to the collection, reception, storage, segregation, refurbishing, dismantling, recycling, treatment and disposal of e-waste are carried out;

(x) 'Form' means a form appended to these rules;

(y) 'historical e-waste' means e-waste generated from electrical and electronic equipment as specified in Schedule I, which was available on the date from which these rules come into force;

(z) 'manufacturer' means a person or an entity or a company as defined in the Companies Act, 2013 (18 of 2013) or a factory as defined in the Factories Act, 1948 (63 of 1948) or Small and Medium Enterprises as defined in Micro, Small and Medium Enterprises Development Act, 2006 (27 of 2006), which has facilities for manufacture of electrical and electronic equipment;

(aa) 'orphaned products' means non-branded or assembled electrical and electronic equipment as specified in Schedule I or those produced by a company, which has closed its operations;

(bb) 'part' means an element of a sub-assembly or assembly not normally useful by itself, and not amenable to further disassembly for maintenance purposes. A part may be a component, spare or an accessory;

(cc) 'producer' means any person who, irrespective of the selling technique used such as dealer, retailer, e-retailer, etc.;

(i) manufactures and offers to sell electrical and electronic equipment and their components or consumables or parts or spares under its own brand; or

(ii) offers to sell under its own brand, assembled electrical and electronic equipment and their components or consumables or parts or spares produced by other manufacturers or suppliers; or

(iii) offers to sell imported electrical and electronic equipment and their components or consumables or parts or spares;

(dd) 'Producer Responsibility Organisation' means a professional organisation authorised or financed collectively or individually by producers, which can take the responsibility for collection and channelisation of e-waste generated from the 'end-of-life' of their products to ensure environmentally sound management of such e-waste;

(ee) 'recycler' - means any person who is engaged in recycling and reprocessing of waste electrical and electronic equipment or assemblies or their components and having facilities as elaborated in the guidelines of Central Pollution Control Board;

(ff) 'refurbishment' means repairing of used electrical and electronic equipment as listed in Schedule I for extending its working life for its originally intended use and selling the same in the market or returning to owner;

(gg) 'refurbisher' for the purpose of these rules, means any company or undertaking registered under the Factories Act, 1948 or the Companies Act, 1956 or both or district industries centre engaged in refurbishment of used electrical and electronic equipment;

(hh) 'Schedule' means the Schedule appended to these rules;

(ii) "spares" means a part or a sub-assembly or assembly for substitution which is ready to replace an identical or similar part or sub-assembly or assembly including a component or an accessory;

(jj) 'State Government in relation to an Union territory means, the Administrator thereof appointed under article 239 of the Constitution;

(kk) 'State Pollution Control Board' means the concerned State Pollution Control Board or the Pollution Control Committee of the Union Territories constituted under sub-section (1) of section 4 of the Water (Prevention and Control of Pollution) Act, 1974 (6 of 1974);

(ll) 'target' means the quantity of e-waste to be collected by the producer in fulfilment of Extended Producer Responsibility;

(mm) 'transporter' means a person or company or entity engaged in the off-site transportation of e-waste by air, rail, road or water carrying a manifest system issued by the person or company or entity who has handed over the e-waste to the transporter, giving the origin, destination and quantity of the e-waste being transported;

(2) Words and expressions used in these rules and not defined but defined in the Act shall have the meanings respectively assigned to them in the Act.

CHAPTER II

RESPONSIBILITIES

4. Responsibilities of the manufacturer. - (1) collect e-waste generated during the manufacture of any electrical and electronic equipment and channelise it for recycling or disposal;

(2) apply for an authorisation in Form 1 (a) in accordance with the procedure prescribed under sub-rule (2) of rule 13 from the concerned State Pollution Control Board, which shall give the authorisation in accordance with Form 1 (bb);

(3) ensure that no damage is caused to the environment during storage and transportation of e-waste;

(4) maintain records of the e-waste generated, handled and disposed in Form-2 and make such records available for scrutiny by the concerned State Pollution Control Board;

(5) file annual returns in Form-3, to the concerned State Pollution Control Board on or before the 30th day of June following the financial year to which that return relates.

5. Responsibilities of the producer. - The producer of electrical and electronic equipment listed in Schedule I shall be responsible for -

(1) implementing the Extended Producers Responsibility with the following frameworks, namely:-

(a) collection and channelisation of e-waste generated from the 'end-of-life' of their products or 'end-of-life' products with same electrical and electronic equipment code and historical waste available on the date from which these rules come into force as per Schedule I in line with the targets prescribed in Schedule III in Extended Producer Responsibility - Authorisation;

(b) the mechanism used for channelisation of e-waste from 'end-of-life' products including those from their service centres to authorised dismantler or recycler shall be in accordance with the Extended Producer Responsibility - Authorisation. In cases of fluorescent and other mercury containing lamps, where recyclers are not available, channelisation may be from collection centre to Treatment, Storage and Disposal Facility;

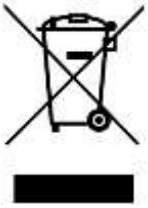
(c) for disposal in Treatment, Storage and Disposal Facility, a pre-treatment is necessary to immobilise the mercury and reduce the volume of waste to be disposed off;

(d) Extended Producer Responsibility - Authorisation should comprise of general scheme for collection of waste Electrical and Electronic Equipment from the Electrical and Electronic Equipment placed on the market earlier, such as through dealer, collection centres, Producer Responsibility Organisation, through buy-back arrangement, exchange scheme, Deposit Refund System, etc. whether directly or through any authorised agency and channelising the items so collected to authorised recyclers;

(e) providing contact details such as address, e-mail address, toll-free telephone numbers or helpline numbers to consumer(s) or bulk consumer(s) through their website and product user documentation so as to facilitate return of end-of-life electrical and electronic equipment;

(f) creating awareness through media, publications, advertisements, posters, or by any other means of communication and product user documentation accompanying the equipment, with regard to -

(i) information on address, e-mail address, toll-free telephone numbers or helpline numbers and web site;
(ii) information on hazardous constituents as specified in sub-rule 1 of rule 16 in electrical and electronic equipment;
(iii) information on hazards of improper handling, disposal, accidental breakage, damage or improper recycling of e-waste;
(iv) instructions for handling and disposal of the equipment after its use, along with the Do's and Don'ts;
(v) affixing a visible, legible and indelible symbol given below on the products or product user documentation to prevent e-waste from being dropped in garbage bins containing waste destined for disposal;



(vi) means and mechanism available for their consumers to return e-waste for recycling including the details of Deposit Refund Scheme, if applicable;

(g) the producer shall opt to implement Extended Producer Responsibility individually or collectively. In individual producer responsibility, producer may set up his own collection centre or implement take back system or both to meet Extended Producer Responsibility. In collective system, producers may tie-up as a member with a Producer Responsibility Organisation or with e-waste exchange or both. It shall be mandatory upon on the individual producer in every case to seek Extended Producer Responsibility - Authorisation from Central Pollution Control Board in accordance with the Form-1 and the procedure laid down in sub-rule (1) of rule 13;

(2) to provide information on the implementation of Deposit Refund Scheme to ensure collection of end-of-life products and their channelisation to authorised dismantlers or recyclers, if such scheme is included in the Extended Producer Responsibility Plan.

Provided that the producer shall refund the deposit amount that has been taken from the consumer or bulk consumer at the time of sale, along with interest at the prevalent rate for the period of the deposit at the time of take back of the end-of-life product;

(3) the import of electrical and electronic equipment shall be allowed only to producers having Extended Producer Responsibility authorisation;

(4) maintaining records in Form-2 of the e-waste handled and make such records available for scrutiny by the Central Pollution Control Board or the concerned State Pollution Control Board;

(5) filing annual returns in Form-3, to the Central Pollution Control Board on or before the 30th day of June following the financial year to which that return relates. In case of the Producer with multiple offices in a State, one annual return combining information from all the offices shall be filed;

(6) the Producer shall apply to the Central Pollution Control Board for authorisation in Form 1, which shall thereafter grant the Extended Producer Responsibility - Authorisation in Form 1(aa).
(7) Operation without Extended Producer Responsibility-Authorisation by any producer, as defined in this rule, shall be considered as causing damage to the environment.

6. Responsibilities of collection centres. - (1) collect e-waste on behalf of producer or dismantler or recycler or refurbisher including those arising from orphaned products;
Provided the collection centres established by producer can also collect e-waste on behalf of dismantler, refurbisher and recycler including those arising from orphaned products
(2) ensure that the facilities are in accordance with the standards or guidelines issued by Central Pollution Control Board from time to time;
(3) ensure that the e-waste collected by them is stored in a secured manner till it is sent to authorised dismantler or recycler as the case may be;
(4) ensure that no damage is caused to the environment during storage and transportation of e-waste;
(5) maintain records in Form-2 of the e-waste handled as per the guidelines of Central Pollution Control Board and make such records available for scrutiny by the Central Pollution Control Board or the concerned State Pollution Control Board as and when asked for.

7. Responsibilities of dealers. – (1) in the case the dealer has been given the responsibility of collection on behalf of the producer, the dealer shall collect the e-waste by providing the consumer a box, bin or a demarcated area to deposit e-waste, or through take back system and send the e-waste so collected to collection centre or dismantler or recycler as designated by producer;
(2) the dealer or retailer or e-retailer shall refund the amount as per take back system or Deposit Refund Scheme of the producer to the depositor of e-waste;
(3) every dealer shall ensure that the e-waste thus generated is safely transported to authorised dismantlers or recyclers;
(4) ensure that no damage is caused to the environment during storage and transportation of e-waste.

8. Responsibilities of the refurbisher. – (1) collect e-waste generated during the process of refurbishing and channelise the waste to authorised dismantler or recycler through its collection centre;
(2) make an application in Form 1(a) in accordance with the procedure laid down in sub-rule (4) of rule 13 to the concerned State Pollution Control Board for grant of one time authorisation;
(a) the concerned State Pollution Control Board shall authorise the Refurbisher on one time basis as per Form 1 (bb) and authorisation would be deemed as considered if not objected to within a period of thirty days;
(b) the authorised Refurbisher shall be required to submit details of e-waste generated to the concerned State Pollution Control Board on yearly basis;
(3) ensure that no damage is caused to the environment during storage and transportation of e-waste;
(4) ensure that the refurbishing process do not have any adverse effect on the health and the environment;

(5) ensure that the e-waste thus generated is safely transported to authorised collection centres or dismantlers or recyclers;
(6) file annual returns in Form-3 to the concerned State Pollution Control Board, on or before the 30th day of June following the financial year to which that return relates;
(7) maintain records of the e-waste handled in Form-2 and such records should be available for scrutiny by the appropriate authority.

9. Responsibilities of consumer or bulk consumer. – (1) consumers or bulk consumers of electrical and electronic equipment listed in Schedule I shall ensure that e-waste generated by them is channelised through collection centre or dealer of authorised producer or dismantler or recycler or through the designated take back service provider of the producer to authorised dismantler or recycler;
(2) bulk consumers of electrical and electronic equipment listed in Schedule I shall maintain records of e-waste generated by them in Form-2 and make such records available for scrutiny by the concerned State Pollution Control Board;
(3) consumers or bulk consumers of electrical and electronic equipment listed in Schedule I shall ensure that such end-of-life electrical and electronic equipment are not admixed with e-waste containing radioactive material as covered under the provisions of the Atomic Energy Act, 1962 (33 of 1962) and rules made there under;
(4) bulk consumers of electrical and electronic equipment listed in Schedule I shall file annual returns in Form-3, to the concerned State Pollution Control Board on or before the 30th day of June following the financial year to which that return relates. In case of the bulk consumer with multiple offices in a State, one annual return combining information from all the offices shall be filed to the concerned State Pollution Control Board on or before the 30th day of June following the financial year to which that return relates

10. Responsibilities of the dismantler. - (1)ensure that the facility and dismantling processes are in accordance with the standards or guidelines prescribed by Central Pollution Control Board from time to time;
(2) obtain authorisation from the concerned State Pollution Control Board in accordance with the procedure under sub-rule (3) of rule 13;
(3) ensure that no damage is caused to the environment during storage and transportation of e-waste;
(4) ensure that the dismantling processes do not have any adverse effect on the health and the environment;
(5) ensure that dismantled e-waste are segregated and sent to the authorised recycling facilities for recovery of materials;
(6) ensure that non-recyclable or non-recoverable components are sent to authorised treatment storage and disposal facilities;
(7) maintain record of e-waste collected, dismantled and sent to authorised recycler in Form-2 and make such record available for scrutiny by the Central Pollution Control Board or the concerned State Pollution Control Board;
(8) file a return in Form-3, to the concerned State Pollution Control Board as the case may be, on or before 30th day of June following the financial year to which that return relates;
(9) not process any e-waste for recovery or refining of materials, unless he is authorised with concerned State Pollution Control Board as a recycler for refining and recovery of materials;
(10) operation without Authorisation by any dismantler, as defined in this rule, shall be considered as causing damage to the environment.

11. Responsibilities of the recycler. – (1) shall ensure that the facility and recycling processes are in accordance with the standards or guidelines prescribed by the Central Pollution Control Board from time to time;

(2) obtain authorisation from concerned State Pollution Control Board in accordance with the procedure under the sub-rule (3) of rule 13;

(3) ensure that no damage is caused to the environment during storage and transportation of e-waste;

(4) ensure that the recycling processes do not have any adverse effect on the health and the environment;

(5) make available all records to the Central Pollution Control Board or the concerned State Pollution Control Board for inspection;

(6) ensure that the fractions or material not recycled in its facility is sent to the respective authorised recyclers;

(7) ensure that residue generated during recycling process is disposed of in an authorised treatment storage disposal facility;

(8) maintain record of e-waste collected, dismantled, recycled and sent to authorised recycler in Form-2 and make such record available for scrutiny by the Central Pollution Control Board or the concerned State Pollution Control Board;

(9) file annual returns in Form-3, to the concerned State Pollution Control Board as the case may be, on or before 30th day of June following the financial year to which that return relates;

(10) may accept waste electrical and electronic equipment or components not listed in Schedule I for recycling provided that they do not contain any radioactive material and same shall be indicated while taking the authorisation from concerned State Pollution Control Board;

(11) operation without Authorisation by any recycler, as defined in this rule, shall be considered as causing damage to the environment.

12. Responsibilities of State Government for environmentally sound management of E-waste. – (1) Department of Industry in State or any other government agency authorised in this regard by the State Government, to ensure earmarking or allocation of industrial space or shed for e-waste dismantling and recycling in the existing and upcoming industrial park, estate and industrial clusters;

(2) Department of Labour in the State or any other government agency authorised in this regard by the State Government shall:

a. ensure recognition and registration of workers involved in dismantling and recycling;
b. assist formation of groups of such workers to facilitate setting up dismantling facilities;
c. undertake industrial skill development activities for the workers involved in dismantling and recycling;
d. undertake annual monitoring and to ensure safety & health of workers involved in dismantling and recycling;

(3) State Government to prepare integrated plan for effective implementation of these provisions, and to submit annual report to Ministry of Environment, Forest and Climate Change.

CHAPTER III

PROCEDURE FOR SEEKING AND GRANT OF AUTHORISATION FOR MANAGEMENT OF E-WASTE

13. Procedure for Seeking and Grant of Authorisation. -

(1) **Extended Producer Responsibility - Authorisation of Producers.** – (i) every producer of electrical and electronic equipment listed in Schedule I, shall make an application for Extended Producer Responsibility - Authorisation within a period of ninety days starting from the date of these rules coming into force in Form-1 to Central Pollution Control Board;

(ii) on receipt of the application complete in all respects, the Central Pollution Control Board will carry out evaluation of the Extended Producer Responsibility Plan and on being satisfied that the producer has detailed out an effective system to manage Extended Producer Responsibility in the country, shall grant Extended Producer Responsibility - Authorisation, in Form 1(aa) within a period of one hundred and twenty days. The Extended Producer Responsibility - Authorisation shall be valid for a period of five years;

This authorisation shall include among others the targeted quantity of e-waste, product code wise, to be collected during the year. The actual target for collection of e-waste for dismantling or recycling will be fixed on the basis of quantity of electrical and electronic equipment, product code wise, placed in the market in the previous years and taking into consideration the average life of the equipment. The estimated quantity of e-waste generated during the current year will be indicated by the producer and the quantity expected to be collected with the collection scheme proposed to be implemented by the producer will be indicated in the Extended Producer Responsibility plan. The Central Pollution Control Board shall fix the targets in accordance with Schedule III.

(iii) the Central Pollution Control Board, after giving reasonable opportunity of being heard to the applicant shall refuse to grant Extended Producer Responsibility – Authorisation;

(iv) in the event of refusal of Extended Producer Responsibility - Authorisation by the Central Pollution Control Board, the producer will forfeit his right to put any Electrical and Electronic Equipment in the market till such time the Extended Producer Responsibility - Authorisation is granted;

(v) the Central Pollution Control Board after grant of Extended Producer Responsibility - Authorisation shall forward the Extended Producer Responsibility Plan to respective State Pollution Control Board for monitoring;

(vi) an application for the renewal of Extended Producer Responsibility-Authorisation shall be made in Form-1 before one hundred and twenty days of its expiry to Central Pollution Control Board. The Central Pollution Control Board may renew the authorisation for a period of five years after receipt of compliance report from the concerned State Pollution Control Board which shall submit the compliance report to Central Pollution Control Board within sixty days from the date of the receipt of the application. In case of non receipt of the compliance report from the State Pollution Control Board within stipulated time period of sixty days, Central Pollution Control Board may renew the Extended Producer Responsibility-Authorisation after examining such case on merit basis, subject to no report of violation of the provisions of the Act or the rules made there under or the conditions specified in the Extended Producer Responsibility - Authorisation;

(vii) every producer of Electrical and Electronic Equipment listed in Schedule I, shall take all steps, wherever required, to comply with the conditions specified in the Extended Producer Responsibility – Authorisation;

(viii) the concerned State Pollution Control Board shall monitor the compliance of Extended Producer Responsibility - Authorisation, take cognizance of any non-compliance and inform Central Pollution Control Board for taking action, as necessary;

(ix) Central Pollution Control Board shall conduct random check and if in its opinion, the holders of the Extended Producer Responsibility - Authorisation has failed to comply with any of the conditions of the authorisation or with any provisions of the Act or these rules and after giving a reasonable opportunity of being heard and after recording reasons thereof in writing cancel or suspend the Extended Producer Responsibility - Authorisation issued under these rules for such period as it considers necessary in the public interest and inform the concerned State Pollution Control Board within ten days of cancellation.

(x) the Central Pollution Control Board shall maintain an online register of Extended Producer Responsibility - Authorisation granted with conditions imposed under these rules for environmentally sound management of e-waste, and which shall be accessible to any citizen of the country.

(xi) The producer authorised under the provision of this rule shall maintain records in Form-2 and shall file annual returns of its activities of previous year in Form-3 to the Central Pollution Control Board on or before 30th day of June of every year;

(2) **Authorisation of Manufacturer. –** (i) the manufacturer generating e-waste shall obtain an authorisation from the concerned State Pollution Control Board;

(ii) the manufacturer shall make an application for authorisation, within a period of ninety days from the date of these rules coming into force in Form 1(a) to the concerned State Pollution Control Board for grant of authorisation;

(iii) on receipt of the application complete in all respects for the authorisation, the concerned State Pollution Control Board may, after such enquiry as it considers necessary and on being satisfied that the applicant possesses appropriate facilities, technical capabilities and equipment to handle e-waste safely, grant within a period of one hundred and twenty days an authorisation in Form 1(bb) to the applicant to carry out safe operations in the authorised place only, which shall be valid for a period of five years;

(iv) the concerned State Pollution Control Board after giving reasonable opportunity of being heard to the applicant may refuse to grant any authorisation;

(v) every person authorised under these rules shall maintain the record of e-waste handled by them in Form-2 and prepare and submit to the concerned State Pollution Control Board, an annual return containing the details specified in Form-3 on or before the 30th day of June following the financial year to which that return relates;

(vi) an application for the renewal of an authorisation shall be made in Form-1(a) before one hundred and twenty days of its expiry and the concerned State Pollution Control Board may renew the authorisation for a period of five years after examining each case on merit and subject to the condition that there is no report of violation of the provisions of the Act or the rules made thereunder or the conditions specified in the authorisation;

(vii) manufacturer shall take all steps to comply with the conditions specified in the authorisation;

(viii) the concerned State Pollution Control Board shall maintain an online register of authorisations granted with conditions imposed under these rules for

environmentally sound management of e-waste, and which shall be accessible to any citizen of the country.

(3) **Procedure for grant of authorisation to dismantler or recycler.** - (i) every Dismantler or Recycler of e-waste shall make an application, within a period of one hundred and twenty days starting from the date of coming into force of these rules, in Form-4 in triplicate to the concerned State Pollution Control Board accompanied with a copy of the following documents for the grant or renewal of authorisation, namely:-

(a) consent to establish granted by the concerned State Pollution Control Board under the Water (Prevention and Control of Pollution) Act, 1974, (25 of 1974) and the Air (Prevention and Control of Pollution) Act, 1981(21 of 1981);
(b) certificate of registration issued by the District Industries Centre or any other government agency authorised in this regard;
(c) proof of installed capacity of plant and machinery issued by the District Industries Centre or any other government agency authorised in this behalf;
(d) in case of renewal, a certificate of compliance of effluent and emission standards, treatment and disposal of hazardous wastes as applicable from the concerned State Pollution Control Board or any other agency designated for this purpose:

Provided that any person authorised or registered under the provisions of the Hazardous Wastes (Management, Handling and Transboundary Movements) Rules, 2008, and the E-waste (Management & Handling) Rules, 2011 prior to the date of coming into force of these rules shall not be required to make an application for authorisation till the period of expiry of such authorisation or registration:

(ii) the concerned State Pollution Control Board, on being satisfied that the application is complete in all respects and that the applicant is utilising environmentally sound technologies and possess adequate technical capabilities, requisite facilities and equipment to dismantle or recycle and process e-waste in compliance to the guidelines specified by Central Pollution Control Board from time to time and through site inspection, may grant authorisation to such applicants stipulating therein necessary conditions as deemed necessary for carrying out safe operations in the authorised place only;
(iii) the concerned State Pollution Control Board shall dispose of the application for authorisation within a period of one hundred and twenty days from the date of the receipt of such application complete in all respects;
(iv) the authorisation granted under these rules shall be valid for a period of five years from the date of its issue and shall be accompanied with a copy of the field inspection report signed by that Board indicating the adequacy of facilities for dismantling or recycling of e-waste and compliance to the guidelines specified by Central Pollution Control Board from time to time;
(v) the concerned State Pollution Control Board may refuse, cancel or suspend an authorisation granted under these rules, if it has reasons to believe that the authorised dismantler or recycler has failed to comply with any of the conditions of authorisation, or with any provisions of the Act or rules made thereunder, after giving an opportunity to the dismantler or recycler to be heard and after recording the reasons thereof;
(vi) an application for the renewal of authorisation shall be made in Form - 4 before one hundred and twenty days of its expiry and the concerned State Pollution Control Board may renew the authorisation for a period of five years after

examining each case on merit and subject to the condition that there is no report of violation of the provisions of the Act or the rules made there under or the conditions specified in the authorisation;

(vii) the Dismantler and Recycler shall maintain records of the e-waste purchased, processed in Form-2 and shall file annual returns of its activities of previous year in Form-3 to the concerned State Pollution Control Board on or before 30th day of June of every year;

(viii) the Central Government and the Central Pollution Control Board may issue guidelines for standards of performance for dismantling and recycling processes from time to time.

(4) **Procedure for grant of authorisation to refurbisher.** – (i) every refurbisher of e-waste shall make an application, with in a period of one hundred and twenty days starting from the date of coming into force of these rules, in Form 1 (a) in triplicate to the concerned State Pollution Control Board accompanied with a copy of the following documents for the grant or renewal of authorisation, namely:-

(a) consent to establish granted by the concerned State Pollution Control Board under the Water (Prevention and Control of Pollution) Act, 1974, (25 of 1974) and the Air (Prevention and Control of Pollution) Act, 1981 (21 of 1981);
(b) certificate of registration issued by the District Industries Centre or any other government agency authorised in this regard;
(c) proof of installed capacity of plant and machinery issued by the District Industries Centre or any other government agency authorised in this behalf.

(ii) the concerned State Pollution Control Board, on being satisfied that the application is complete in all respects and complies with the guidelines prescribed by Central Pollution Control Board from time to time, may grant one time authorisation in Form 1 (bb) to such applicants stipulating therein necessary conditions as deemed necessary for carrying out refurbishing activities in the authorised place only;

(iii) the concerned State Pollution Control Board shall dispose of the application for authorisation within a period of one hundred and twenty days from the date of the receipt of such application complete in all respects;

(iv) the concerned State Pollution Control Board may refuse, cancel or suspend a authorisation granted under these rules, if it has reasons to believe that the authorised refurbisher has failed to comply with any of the conditions of authorisation, or with any provisions of the Act or rules made thereunder, after giving an opportunity to the refurbisher to be heard and after recording the reasons thereof;

(v) the Refurbisher shall maintain records of the e-waste purchased and refurbished in Form-2 and shall file annual returns of its activities of previous year in Form-3 to the concerned State Pollution Control Board on or before 30th day of June of every year.

14. Power to suspend or cancel an authorisation.- (1) The State Pollution Control Board may, if in its opinion, the holder of Manufacturer or Dismantler or Recycler or Refurbisher Authorisation has failed to comply with any of the conditions of the authorisation or with any provisions of the Act or these rules and after giving a reasonable opportunity of being heard and after recording reasons thereof in writing

cancel or suspend the authorisation issued under these rules for such period as it considers necessary in the public interest and inform Central Pollution Control Board within ten days of cancellation;

(2) The Central Pollution Control Board, if in its opinion, the holders of the Extended Producer Responsibility- Authorisation has failed to comply with any of the conditions of the authorisation or with any provisions of the Act or these rules and after giving a reasonable opportunity of being heard and after recording reasons thereof in writing cancel or suspend the Extended Producer Responsibility- Authorisation issued under these rules for such period as it considers necessary in the public interest and inform State Pollution Control Boards or Pollution Control Committees within ten days of cancellation;

(3) Upon suspension or cancellation of the authorisation, the Central Pollution Control Board or State Pollution Control Board may give directions to the persons whose authorisation has been suspended or cancelled for the safe storage and management of the e-waste and such persons shall comply with such directions.

CHAPTER IV

15. Procedure for storage of e-waste. - Every manufacturer, producer, bulk consumer, collection centre, dealer, refurbisher, dismantler and recycler may store the e-waste for a period not exceeding one hundred and eighty days and shall maintain a record of collection, sale, transfer and storage of wastes and make these records available for inspection:

Provided that the concerned State Pollution Control Board may extend the said period up to three hundred and sixty five days in case the waste needs to be specifically stored for development of a process for its recycling or reuse.

CHAPTER V

REDUCTION IN THE USE OF HAZARDOUS SUBSTANCES IN THE MANUFACTURE OF ELECTRICAL AND ELECTRONIC EQUIPMENT AND THEIR COMPONENTS OR CONSUMABLES OR PARTS OR SPARES

16. Reduction in the use of hazardous substances in the manufacture of electrical and electronic equipment and their components or consumables or parts or spares. – (1) Every producer of electrical and electronic equipment and their components or consumables or parts or spares listed in Schedule I shall ensure that, new Electrical and Electronic Equipment and their components or consumables or parts or spares do not contain Lead, Mercury, Cadmium, Hexavalent Chromium, polybrominated biphenyls and polybrominated diphenyl ethers beyond a maximum concentration value of 0.1% by weight in homogenous materials for lead, mercury, hexavalent chromium, polybrominated biphenyls and polybrominated diphenyl ethers and of 0.01% by weight in homogenous materials for cadmium.

(2) Components or consumables or parts or spares required for the electrical and electronic equipment placed in the market prior to 1st May, 2014 may be exempted from the provisions of sub-rule (1) of rule 16 provided Reduction of Hazardous Substances compliant parts and spares are not available.

(3) The applications listed in Schedule II shall be exempted from provisions of sub-rule (1) of rule 16.

(4) Every producer of applications listed in Schedule II shall ensure that the limits of hazardous substances as given in Schedule II are to be complied.
(5) Every producer shall provide the detailed information on the constituents of the equipment and their components or consumables or parts or spares alongwith a declaration of conformance to the Reduction of Hazardous Substances provisions in the product user documentation.
(6) Imports or placement in the market for new electrical and electronic equipment shall be permitted only for those which are compliant to provisions of sub-rule (1) and sub rule (4) of rule 16.
(7) Manufacture and supply of electrical and electronic equipment used for defence and other similar strategic applications shall be excluded from provisions of sub-rule (1) of rule 16.
(8) Every producer while seeking Extended Producer Responsibility - Authorisation will provide information on the compliance of the provisions of sub-rule (1) of rule 16. This information shall be in terms of self-declaration.
(9) Central Pollution Control Board shall conduct random sampling of electrical and electronic equipment placed on the market to monitor and verify the compliance of Reduction of Hazardous Substances provisions and the cost for sample and testing shall be borne by the Producer. The random sampling shall be as per the guidelines of Central Pollution Control Board.
(10) If the product does not comply with Reduction of Hazardous Substances provisions, the Producers shall take corrective measures to bring the product into compliance and withdraw or recall the product from the market, within a reasonable period as per the guidelines of the Central Pollution Control Board.
(11) Central Pollution Control Board shall publish the methods for sampling and analysis of Hazardous Substances as listed in sub-rule(1) of rule 16 with respect to the items listed in Schedule I and II and also enlist the labs for this purpose.

CHAPTER VI

MISCELLANEOUS

17. **Duties of authorities. -** Subject to other provisions of these rules, the authorities shall perform duties as specified in Schedule IV.

18. Annual Report. – (1) The concerned State Pollution Control Board shall prepare and submit to the Central Pollution Control Board an annual report with regard to the implementation of these rules by the 30th day of September every year in Form-5.
(2) The Central Pollution Control Board shall prepare the consolidated annual review report on management of e-waste and forward it to the Central Government along with its recommendations before the 30th day of December every year.

19. **Transportation of e-waste.** –The transportation of e-waste shall be carried out as per the manifest system whereby the transporter shall be required to carry a document (three copies) prepared by the sender, giving the details as per Form-6:

Provided that the transportation of waste generated from manufacturing or recycling destined for final disposal to a treatment, storage and disposal facility shall follow the provisions under Hazardous Wastes (Management, Handling and Transboundary Movement) Rules, 2008.

20. Accident reporting.- Where an accident occurs at the facility processing e-waste or during transportation of e-waste, the producer, refurbisher, transporter, dismantler, or recycler, as the case may be, shall report immediately to the concerned State Pollution Control Board about the accident through telephone and e-mail.

21. Liability of manufacturer, producer, importer, transporter, refurbisher, dismantler and recycler.- (1) The manufacturer, producer, importer, transporter, refurbisher, dismantler and recycler shall be liable for all damages caused to the environment or third party due to improper handling and management of the e-waste;

(2) The manufacturer, producer, importer, transporter, refurbisher, dismantler and recycler shall be liable to pay financial penalties as levied for any violation of the provisions under these rules by the State Pollution Control Board with the prior approval of the Central Pollution Control Board.

22. Appeal.- (1) Any person aggrieved by an order of suspension or cancellation or refusal of authorisation or its renewal passed by the Central Pollution Control Board or State Pollution Control Board may, within a period of thirty days from the date on which the order is communicated to him, prefer a appeal in Form 7 to the Appellate Authority comprising of the Environment Secretary of the State.

(2) The Appellate Authority may entertain the appeal after expiry of the said period of thirty days if it is satisfied that the appellant was prevented by sufficient cause from filing the appeal in time.

(3) Every appeal filed under this rule shall be disposed of within a period of sixty days from the date of its filing.

23. The collection, storage, transportation, segregation, refurbishment, dismantling, recycling and disposal of e-waste shall be in accordance with the procedures prescribed in the guidelines published by the Central Pollution Control Board from time to time. Implementation of e-waste (Management and Handling) Amendment Rules, 2011 shall be in accordance with the guidelines prescribed by the Central Pollution Control Board from time to time.

24. Urban Local Bodies (Municipal Committee or Council or Corporation) shall ensure that e-waste pertaining to orphan products is collected and channelised to authorised dismantler or recycler.

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SCHEDULE I

[See rules 2, 3(j), 3(y), 3(aa) and 3(ff); 5; 9; 11(10); 13 (1) (i), 13 (1) (vii) and 16(1), 16(11)]

Categories of electrical and electronic equipment including their components, consumables, parts and spares covered under the rules

Sr. No.	Categories of electrical and electronic equipment	Electrical and electronic equipment code
i.	**Information technology and telecommunication equipment :**	
	Centralised data processing: Mainframes, Minicomputers	ITEW1
	Personal Computing: Personal Computers (Central Processing Unit with input and output devices)	ITEW2
	Personal Computing: Laptop Computers(Central Processing Unit with input and output devices)	ITEW3
	Personal Computing: Notebook Computers	ITEW4
	Personal Computing: Notepad Computers	ITEW5
	Printers including cartridges	ITEW6
	Copying equipment	ITEW7
	Electrical and electronic typewriters	ITEW8
	User terminals and systems	ITEW9
	Facsimile	ITEW10
	Telex	ITEW11
	Telephones	ITEW12
	Pay telephones	ITEW13
	Cordless telephones	ITEW14
	Cellular telephones	ITEW15
	Answering systems	ITEW16
ii.	**Consumer electrical and electronics:**	
	Television sets (including sets based on (Liquid Crystal Display and Light Emitting Diode technology)	CEEW1
	Refrigerator	CEEW2
	Washing Machine	CEEW3
	Air-conditioners excluding centralised air conditioning plants	CEEW4
	Fluorescent and other Mercury containing lamps	CEEW5

SCHEDULE II

[See rules 16 (3), 16 (4) and 16 (11)]

Applications, which are exempted from the requirements of sub-rule (1) of rule 16	
	Substance
1	Mercury in single capped (compact) fluorescent lamps not exceeding (per burner):
1(a)	For general lighting purposes <30 W : 2.5 mg
1(b)	For general lighting purposes ≥ 30 W and <50 W : 3.5mg
1(c)	For general lighting purposes ≥ 50 W and <150 W : 5mg
1(d)	For general lighting purposes ≥150 W : 15 mg
1(e)	For general lighting purposes with circular or square structural shape and tube diameter ≤17 mm : 7mg
1(f)	For special purposes:5 mg
2(a)	Mercury in double-capped linear fluorescent lamps for general lighting purposes not exceeding (per lamp):
2(a)(1)	Tri-band phosphor with normal life time and a tube diameter < 9mm (e.g. T2): 4mg
2(a)(2)	Tri-band phosphor with normal life time and a tube diameter ≥ 9 mm and ≤ 17 mm (e.g. T5): 3 mg
2(a)(3)	Tri- band phosphor with normal life time and a tube diameter >17 mm and ≤ 28 mm(e.g. T8): 3.5 mg
2(a)(4)	Tri-band phosphor with normal life time and a tube diameter >28 mm (e.g. T 12):3.5 mg
2(a)(5)	Tri-band phosphor with long life time (≥25000 h):5mg
2(b)	Mercury in other fluorescent lamps not exceeding(per lamp):
2(b)(1)	Linear halophosphate lamps with tube >28 mm (e.g. T 10 and T12):10 mg
2(b)(2)	Non-linear halophosphate lamps(all diameters):15mg
2(b)(3)	Non-linear tri-band phosphor lamps with tube diameter >17 mm(e.g.T9): 15 mg
2(b)(4)	Lamps for other general lighting and special purposes (e.g. induction lamps):15mg
3	Mercury in cold cathode fluorescent lamps and external electrode fluorescent lamps (CCFL and EEFL)for special purposes not exceeding (per lamp):
3(a)	Short length(≤ 500 mm):3.5mg
3(b)	Medium length(>500 mm and≤1500 mm): 5mg
3(c)	Long length(>1500 mm): 13mg
4(a)	Mercury in other low pressure discharge lamps (per lamp): 15mg
4(b)	Mercury in High Pressure Sodium(vapour) lamps for general lighting purposes not exceeding (per burner)in lamps with improved colour rendering index Ra>60:

4(b)-I	P ≤155 W : 30 mg
4(b)-II	155 W < P ≤405 W : 40 mg
4(b)-III	P >405 W: 40 mg
4(c)	Mercury in other High Pressure Sodium(vapour)lamps for general lighting purposes not exceeding (per burner):
4(c)-I	P≤155 W:25mg
4(c)-II	155 W < P ≤ 405 W:30 mg
4(c)-III	P >405 W:40 mg
4(d)	Mercury in High Pressure Mercury (vapour) lamps (HPMV)
4(e)	Mercury in metal halide lamps (MH)
4(f)	Mercury in other discharge lamps for special purposes not specifically mentioned in this Schedule
5(a)	Lead in glass of cathode ray tubes
5(b)	Lead in glass of fluorescent tubes not exceeding 0.2% by weight
6(a)	Lead as an alloying element in steel for machining purposes and in galvanized steel containing up to 0.35% lead by weight
6(b)	Lead as an alloying element in aluminium containing up to 0.4% lead by weight
6(c)	Copper alloy containing up to 4% lead by weight
7(a)	Lead in high melting temperature type solders (i.e. lead-based alloys containing 85% by weight or more lead)
7(b)	Lead in solders for servers, storage and storage array systems, network infrastructure equipment for switching, signalling, transmission, and network management for telecommunications
7(c)-I	Electrical and electronic components containing lead in a glass or ceramic other than dielectric ceramic in capacitors, e.g. piezoelectronic devices, or in a glass or ceramic matrix compound.
7(c)-II	Lead in dielectric ceramic in capacitors for a rated voltage of 125 V AC or 250 V DC or higher
7(c)-III	Lead in dielectric ceramic in capacitors for a rated voltage of less than 125 V AC or 250 V DC
8(a)	Cadmium and its compounds in one shot pellet type thermal cut-offs
8(b)	Cadmium and its compounds in electrical contracts
9	Hexavalent chromium as an anticorrosion agent of the carbon steel cooling system in absorption refrigerators up to 0.75% by weight in the cooling solution
9(b)	Lead in bearing shells and bushes for refrigerant-containing compressors for heating, ventilation, air conditioning and refrigeration (HVACR) application.

11(a)	Lead used in C-press compliant pin connector systems
11(b)	Lead used in other than C-press compliant pin connector systems
12	Lead as a coating material for the thermal conduction module C- ring
13(a)	Lead in white glasses used for optical applications
13(b)	Cadmium and lead in filter glasses and glasses used for reflectance standards.
14	Lead in solders consisting of more than two elements for the connection between the pins and the package of microprocessors with a lead content of more than 80% and less than 85% by weight
15	Lead in solders to complete a viable electrical connection between semiconductor die and carrier within integrated circuit flip chip packages.
16	Lead in linear incandescent lamps with silicate coated tubes
17	Lead halide as radiant agent in high intensity discharge (HID) lamps used for professional reprography applications.
18(a)	Lead as activator in the fluorescent powder (1% lead by weight or less) of discharge lamps when used as specialty lamps for diazoprinting reprography, lithography, insect traps, photochemical and curing processes containing phosphors such as SMS ($(Sr, Ba)_2Mg\ Si_2O_7$:Pb)
18(b)	Lead as activator in the fluorescent powder (1% lead by weight or less) of discharge lamps when used as sun tanning lamps containing phosphors such as BSP ($Ba\ Si_2O_5$:Pb)
19	Lead with PbBiSn-Hg and PblnSn-Hg in specific compositions as main amalgam and with PbSn-Hg as auxiliary amalgam in very compact energy saving lamps (ESL)
20	Lead oxide in glass used for bonding front and rear substrates of flat fluorescent lamps used for Liquid Crystal Displays (LCDs)
21	Lead and cadmium in printing inks for the application of enamels on glasses, such as borosilicate and soda lime glasses
23	Lead in finishes of fine pitch components other than connectors with a pitch of 0.65 mm and less
24	Lead in solders for the soldering to machined through hole discoidal and planar array ceramic multilayer capacitors
25	Lead oxide in surface conduction electron emitter displays (SED) used in structural elements, notably in the seal frit and frit ring.
26	Lead oxide in the glass envelope of black light blue lamps
27	Lead alloys as solder for transducers used in high-powered (designated to operate for several hours at acoustic power levels of 125 dB SPL and above) loudspeakers
29	Lead bound in crystal glass

30	Cadmium alloys as electrical/mechanical solder joints to electrical conductors located directly on the voice coil in transducers used in high-powered loudspeakers with sound pressure levels of 100 dB(A) and more
31	Lead in soldering materials in mercury free flat fluorescent lamps (which e.g. are used for liquid crystal displays, design or industrial lighting)
32	Lead oxide in seal frit used for making window assemblies for Argon and Krypton laser tubes
33	Lead in solders for the soldering of thin copper wires of 100 µm diameter and less in power transformers
34	Lead in cermet-based trimmer potentiometer elements
36	Mercury used as a cathode sputtering inhibitor in DC plasma displays with a content up to 30 mg per display
37	Lead in the plating layer of high voltage diodes on the basis of a zinc borate glass body
38	Cadmium and cadmium oxide in thick film pastes used on aluminium bonded beryllium oxide
39	Cadmium in colour converting II-VI LEDs (<10 µg Cd per mm^2 of light-emitting area) for use in solid state illumination or display systems.

SCHEDULE III

[See rules 5 (1) (a) and 13 (1) (ii)]

Targets for Extended Producer Responsibility - Authorisation

No.	Year	E-Waste Collection Target (Number/Weight)
(i)	During first two year of implementation of rules	30% of the quantity of waste generation as indicated in Extended Producer Responsibility Plan.
(ii)	During third and fourth years of implementation of rules	40% of the quantity of waste generation as indicated in Extended Producer Responsibility Plan.
(iii)	During Fifth and Sixth years of implementation of rules	50% of the quantity of waste generation as indicated in Extended Producer Responsibility Plan.
(iv)	Seventh year onward of implementation of rules	70% of the quantity of waste generation as indicated in Extended Producer Responsibility Plan.

SCHEDULE IV

[See rule (17)]

LIST OF AUTHORITIES AND CORREPONDING DUTIES

Sr. No	AUTHORITY	CORRESPONDING DUTIES
1.	Central Pollution Control Board, Delhi	(i) Grant and Renewal of Extended Producer Responsibility - Authorisation and monitoring of its compliance. (ii) Maintain information on Extended Producer Responsibility - Authorisation on its web site. (iii) Set and revise targets for collection of e-waste from time to time. (iv) Coordination with State Pollution Control Boards (v) Preparation of Guidelines for Environmentally Sound Management of e-waste. (vi) Conduct random check for ascertaining compliance of the e-waste rules and identification of such importers or producers who have not applied for Extended Producer Responsibility authorisation or are not complying with RoHS provision. Wherever necessary, Central Pollution Control Board will seek the help of customs department or any other agency of the Government of India. (vii) Conduct random inspection of dismantler or recycler or refurbisher. (viii) Documentation, compilation of data on e-waste and uploading on websites of Central Pollution Control Board (ix) Actions against violation of these rules. (x) Conducting training programmes. (xi) Submit Annual Report to the Ministry. (xii) Enforcement of provisions regarding reduction in use of hazardous substances in manufacture of electrical and electronic equipment. (xiii) Interaction with IT industry for reducing hazardous substances. (xiv) Set and revise targets for compliance to the reduction in use of hazardous substance in manufacture of electrical and electronic equipment from time to time. (xv) Any other function delegated by the Ministry under these rules from time to time.
2.	State Pollution Control Boards or Committees of Union territories	(i) Inventorisation of e-waste. (ii) Grant and renewal of authorisation to manufacturers, dismantlers, recyclers and refurbishers. (iii) Monitoring and compliance of Extended Producer Responsibility - Authorisation as directed by Central Pollution Control Board and that of dismantlers, recyclers and refurbishers authorisation. (iv) Conduct random inspection of dismantler or recycler or refurbisher. (v) Maintain online information regarding authorisation granted to manufacturers, dismantlers, recyclers and refurbishers.

Sr. No	AUTHORITY	CORRESPONDING DUTIES
		(vi) Implementation of programmes to encourage environmentally sound recycling. (vii) Action against violations of these rules. (viii) Any other function delegated by the Ministry under these rules.
3.	Urban Local Bodies (Municipal Committee or Council or Corporation)	(i) To ensure that e-waste if found to be mixed with Municipal Solid Waste is properly segregated, collected and is channelised to authorised dismantler or recycler. (ii) To ensure that e-waste pertaining to orphan products is collected and channelised to authorised dismantler or recycler.
4.	Port authority under Indian Ports Act, 1908 (15 of 1908) and Customs Authority under the Customs Act, 1962 (52 of 1962)	(i) Verify the Extended Producer Responsibility - Authorisation. (ii) Inform Central Pollution Control Board of any illegal traffic for necessary action. (iii) Take action against importer for violations under the Indian Ports Act, 1908/Customs Act, 1962.

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FORM-1

[See Rules 5(1) (g), 13(1) (i), 13(1) (vi)]

Applicable to producers seeking Extended Producer Responsibility - Authorisation

The application form should contain the following information:

1.	Name and full address along with telephone numbers, e-mail and other contact details of Producer (It should be the place from where sale in entire country is being managed)	:	
2.	Name of the Authorised Person and full address with e-mail, telephone and fax number	:	
3.	Name, address and contact details of Producer Responsibility Organisation, if any with full address, e-mail, telephone and fax number, if engaged for implementing the Extended Producer Responsibility	:	
4.	Details of electrical and electronic equipment placed on market year-wise during previous 10 years in the form of Table 1 as given below:	:	

Table 1: Details of Electrical and Electronic Equipment placed on the market in previous years - Code wise

Sr. No.	Electrical and Electronic Equipment Item	Electrical and Electronic Equipment Code	Quantity, number and weight placed on market (year-wise)									
A	**Information technology and telecommunication equipment:**											
1	Centralised data processing: Mainframes, Minicomputers	ITEW1										
2	Personal Computing: Personal Computers (Central Processing Unit with input and output devices)	ITEW2										
3	Personal Computing: Laptop Computers(Central Processing Unit with input and	ITEW3										

	output devices)											
4	Personal Computing: Notebook Computers	ITEW4										
5	Personal Computing: Notepad Computers	ITEW5										
6	Printers including cartridges	ITEW6										
7	Copying equipment	ITEW7										
8	Electrical and electronic typewriters	ITEW8										
9	User terminals and systems	ITEW9										
10	Facsimile	ITEW10										
11	Telex	ITEW11										
12	Telephones	ITEW12										
13	Pay telephones	ITEW13										
14	Cordless telephones	ITEW14										
15	Cellular telephones	ITEW15										
16	Answering systems	ITEW16										
B	**Consumer electrical and electronics:**											
17	Television sets (including sets based on (Liquid Crystal Display and Light Emitting Diode technology)	CEEW1										
18	Refrigerator	CEEW2										
19	Washing Machine	CEEW3										
20	Air-conditioners excluding centralised air conditioning plants	CEEW4										
21	Fluorescent and other Mercury containing lamps	CEEW5										

5. Estimated generation of Electrical and Electronic Equipment waste item-wise and estimated collection target for the forthcoming year in the form of Table 2 including those being generated from their service centres, as given below:

Table 2: Estimated generation of Electrical and Electronic Equipment waste item-wise and estimated collection target for the forthcoming year

Sr. No.	Item	Estimated waste electrical and electronic equipment generation Number and weight	Targeted collection Number and weight

6. Extended Producer Responsibility Plans:

(a) Please provide details of your overall scheme to fulfil Extended Producer Responsibility obligations including targets. This should comprise of general scheme of collection of used/waste Electrical and Electronic Equipment from the Electrical and Electronic Equipment placed on the market earlier such as through dealers and collection centres, Producer Responsibility Organisation, through buy-back arrangement, exchange scheme, Deposit Refund Scheme, etc. whether directly or through any authorised agency and channelising the items so collected to authorised recyclers.

(b) Provide the list with addresses along with agreement copies with dealers, collection centres, recyclers, Treatment, Storage and Disposal Facility, etc. under your scheme.

7. Estimated budget for Extended Producer Responsibility and allied initiatives to create consumer awareness.

8. Details of proposed awareness programmes.

9. Details for Reduction of Hazardous Substances compliance (to be filled if applicable):

(a) Whether the Electrical and Electronic Equipment placed on market complies with the rule 16 (1) limits with respect to lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls and polybrominateddiphenyl ethers;

(b)Provide the technical documents (Supplier declarations, Materials declarations/Analytical reports) as evidence that the Reduction of Hazardous Substances (RoHS) provisions are complied by the product based on standard EN 50581 of EU;

(c) Documents required:

i. Extended Producer Responsibility plan;
ii. Copy of the permission from the relevant Ministry/Department for selling their product;

iii. Copies of agreement with dealers, collection centre, recyclers, Treatment, Storage and Disposal Facility, etc.;
iv. Copy of Directorate General of Foreign Trade license/permission as applicable;
v. Self-declaration regarding Reduction of Hazardous Substances provision;
vi. Any other document as required.

(Authorised signature)

Place: _____

Date: _____

FORM 1(a)

[See rules 4(2), 8 (2), 13(2) (ii), 13(2) (vi) and 13(4) (i)]

APPLICATION FOR OBTAINING AUTHORISATION FOR GENERATION OR STORAGE OR TREATMENT OR DISPOSAL OF E-WASTE BY MANUFACTURER OR REFURBISHER*

From: .....
.....

To

The Member Secretary,
..... Pollution Control Board or…… Pollution Control Committee
.....
.....

Sir,

I / We hereby apply for authorisation/renewal of authorisation under rule 13(2) (i) to 13(2) (viii) and/or 13 (4) (i) of the E-Waste (Management) Rules, 2016 for collection/storage/ transportation/ treatment/ refurbishing/disposal of e-wastes.

For Office Use Only

Code No. :

Whether the unit is situated in a critically polluted area as identified by Ministry of Environment and Forests (yes/no);

To be filled in by Applicant

1. Name and full address:
2. Contact Person with designation and contact details such as telephone Nos, Fax. No. and E-mail:
3. Authorisation required for (Please tick mark appropriate activity/ies*)
   - (i) Generation during manufacturing or refurbishing* ☐
   - (ii) Treatment, if any ☐
   - (iii) Collection, Transportation, Storage ☐
   - (iv) Refurbishing ☐

4. E-waste details:
   - (a) Total quantity e-waste generated in MT/A
   - (b) Quantity refurbished (applicable to refurbisher)
   - (c) Quantity sent for recycling
   - (d) Quantity sent for disposal

5. Details of Facilities for storage/handling/treatment/refurbishing:

6. In case of renewal of authorisation previous authorisation no. and date and details of annual returns:

Place : _____ Signature _____

(Name_____)

Date : _____

Designation: _____

Note:-

(1) * The authorisation for e-waste may be obtained along with authorisation for hazardous waste under the Hazardous Wastes (Management, Handling and Transboundary Movement) Rules, 2008, if applicable.

(2) Wherever necessary, use additional sheets to give requisite and necessary details.

FORM 1 (aa)

[See rules 5 (6) and 13(1)(ii)]

FORMAT OF EXTENDED PRODUCER RESPONSIBILITY - AUTHORISATION

[Extended Producer Responsibility Authorisation for Producer of the Electrical & Electronic Equipment]

Ref: Your application for Grant of Extended Producer Responsibility - Authorisation for following Electrical & Electronic Equipment under E-Waste (Management) Rules, 2016

1. Number of Authorisation:

   Date:

2. **M/s. ----------** is hereby granted Extended Producer Responsibility - Authorisation based on:
   (a) overall Extended Producer Responsibility plan
   (b) proposed target for collection of e-waste

3. The Authorisation shall be valid for a period of ___ years from date of issue with following conditions:

   (i) you shall strictly follow the approved Extended Producer Responsibility plan, a copy of which is enclosed herewith;

   (ii) you shall ensure that collection mechanism or centre are set up or designated as per the details given in the Extended Producer Responsibility plan. Information on collection mechanism/centre including the state-wise setup should be provided;

   (iii) you shall ensure that all the collected e-waste is channelised to authorised dismantler or recycler designated as per the details. Information on authorised dismantler or recycler designated state-wise should be provided;

   (iv) you shall maintain records, in Form-2 of these Rules, of e-waste and make such records available for scrutiny by Central Pollution Control Board;

   (v) you shall file annual returns in Form-3 to the Central Pollution Control Board on or before 30th day of June following the financial year to which that returns relates;

   (vi) General Terms & Conditions of the Authorisation:

   a. The authorisation shall comply with provisions of the Environment (Protection) Act, 1986 and the Rules made there under;

   b. The authorisation or its renewal shall be produced for inspection at the request of an officer authorised by the Central Pollution Control Board;

   c. Any change in the approved Extended Producer Responsibility plan should be informed to Central Pollution Control Board on which decision

shall be communicated by Central Pollution Control Board within sixty days;

d. It is the duty of the authorised person to take prior permission of the concerned State Pollution Control Boards and Central Pollution Control Board to close down the facility;

e. An application for the renewal of authorisation shall be made as laid down in sub-rule (vi) of rule of 13(1) the E-Waste (Management) Rules, 2016;

f. The Board reserves right to cancel/amend/revoke the authorisation at any time as per the Policy of the Board or Government.

Authorized signatory
(with designation)

To,
Concerned Producer
Copy to:

1. Member Secretary, Concerned State.
2. In-charge, concerned Zonal Office, Central Pollution Control Board.

FORM 1(bb)

[See rules 4(2), 8(2)(a), 13(2) (iii) and 13(4)(ii)]

FORMAT FOR GRANTING AUTHORISATION FOR GENERATION OR STORAGE OR TREATMENT OR REFURBISHING OR DISPOSAL OF E-WASTE BY MANUFACTURER OR REFURBISHER

Ref: **Your application for Grant of Authorisation**

1. (a) Authorisation no. ..... and (b) date of issue …….

2. ……..…..……of……is hereby granted an authorisation for generation, storage, treatment, disposal of e-waste on the premises situated at…… for the following:
   a. quantity of e-waste;
   b. nature of e-waste.

3. The authorisation shall be valid for a period from …… to ……

4. The e-waste mentioned above shall be treated/ disposed off in a manner ..... at .....

5. The authorisation is subject to the conditions stated below and such conditions as may be specified in the rules for the time being in force under the Environment (Protection) Act, 1986.

Signature ----------
Designation ---------- Date: ----------

Terms and conditions of authorisation

1. The authorisation shall comply with the provisions of the Environment (Protection) Act, 1986, and the rules made thereunder.
2. The authorisation or its renewal shall be produced for inspection at the request of an officer authorized by the concerned State Pollution Control Board.
3. Any unauthorised change in personnel, equipment as working conditions as mentioned in the application by the person authorized shall constitute a breach of his authorisation.
4. It is the duty of the authorised person to take prior permission of the concerned State Pollution Control Board to close down the operations.
5. An application for the renewal of an authorisation shall be made as laid down in sub-rule (vi) of rule 13(2).

FORM-2

[See rules 4(4), 5(4), 6(5), 8(7), 9(2), 10(7), 11(8), 13 (1) (xi), 13(2)(v), 13(3)(vii) and 13 (4)(v)]

FORM FOR MAINTAINING RECORDS OF E-WASTE HANDLED OR GENERATED

Generated Quantity in Metric Tonnes (MT) per year

<table>
<tr><td>1.</td><td>Name & Address: Producer or Manufacturer or Refurbisher or Dismantler or Recycler or Bulk Consumer*</td><td colspan="2"></td></tr>
<tr><td>2.</td><td>Date of Issue of Extended Producer Responsibility Authorisation*/ Authorisation*</td><td colspan="2"></td></tr>
<tr><td>3.</td><td>Validity of Extended Producer Responsibility Authorisation*/ Authorisation*</td><td colspan="2"></td></tr>
<tr><td rowspan="2">4.</td><td rowspan="2">Types & Quantity of e-waste handled or generated**</td><td>Category</td><td>Quantity</td></tr>
<tr><td colspan="2">Item Description</td></tr>
<tr><td rowspan="2">5.</td><td rowspan="2">Types & Quantity of e-waste stored</td><td>Category</td><td>Quantity</td></tr>
<tr><td colspan="2">Item Description</td></tr>
<tr><td rowspan="2">6.</td><td rowspan="2">Types & Quantity of e-waste sent to collection centre authorised by producer/ dismantler/recycler / refurbisher or authorised dismantler/recycler or refurbisher**</td><td>Category</td><td>Quantity</td></tr>
<tr><td colspan="2">Item Description</td></tr>
<tr><td rowspan="3">7.</td><td rowspan="2">Types & Quantity of e-waste transported*</td><td>Category</td><td>Quantity</td></tr>
<tr><td colspan="2">Quantity</td></tr>
<tr><td>Name, address and contact details of the destination</td><td colspan="2"></td></tr>
<tr><td rowspan="3">8.</td><td rowspan="2">Types & Quantity of e-waste refurbished*</td><td>Category</td><td>Quantity</td></tr>
<tr><td colspan="2">Item Description</td></tr>
<tr><td>Name, address and contact details of the destination of refurbished materials</td><td colspan="2"></td></tr>
<tr><td rowspan="3">9.</td><td rowspan="2">Types & Quantity of e-waste dismantled*</td><td>Category</td><td>Quantity</td></tr>
<tr><td colspan="2">Item Description</td></tr>
<tr><td>Name, address and contact details of the destination</td><td colspan="2"></td></tr>
</table>

10.	Types & Quantity of e-waste recycled*	Category	Quantity
	Types & Quantity of materials recovered	Item Description	
		Quantity	
	Name, address and contact details of the destination		
11.	Types & Quantity of e-waste sent to recyclers by dismantlers	Category	Quantity
		Item Description	
	Name, address and contact details of the destination		
12.	Types & Quantity of other waste sent to respective recyclers by dismantlers/recyclers of e-waste	Category	Quantity
		Item Description	
	Name, address and contact details of the destination		
13.	Types & Quantity of e-waste treated & disposed	Category	Quantity
		Item Description	
	Name, address and contact details of the destination		

Note:-

(1) * Strike off whichever is not applicable

(2) Provide any other information as stipulated in the conditions to the authoriser

(3) ** For producers this information has to be provided state-wise

FORM-3

[See rules 4(5), 5(5), 8(6), 9(4), 10(8), 11(9), 13 (1) (xi), 13(2)(v), 13(3)(vii) and 13(4)(v)]

FORM FOR FILING ANNUAL RETURNS

[To be submitted by producer or manufacturer or refurbisher or dismantler or recycler by 30th day of June following the financial year to which that return relates].

Quantity in Metric Tonnes (MT) and numbers

1	Name and address of the producer or manufacturer or refurbisher or dismantler or recycler			
2	Name of the authorised person and complete address with telephone and fax numbers and e-mail address			
3	Total quantity of e-waste collected or channelised to recyclers or dismantlers for processing during the year for each category of electrical and electronic equipment listed in the Schedule I (Attach list) by PRODUCERS			
	Details of the above	TYPE	QUANTITY	No.
3(A)*	BULK CONSUMERS: Quantity of e-waste			
3(B)*	REFURBISHERS: Quantity of e-waste:			
3(C)*	DISMANTLERS: i Quantity of e-waste processed (Code wise); ii. Details of materials or components recovered and sold; iii. Quantity of e-waste sent to recycler; iv. Residual quantity of e-waste sent to Treatment, Storage and Disposal Facility.			
3(D)*	RECYCLERS: i. Quantity of e-waste processed (Code wise); ii. Details of materials recovered and sold in the market; iii. Details of residue sent to Treatment, Storage and Disposal Facility.			
4	Name and full address of the destination with respect to 3(A)-3(D) above			
5	Type and quantity of materials segregated or recovered from e-waste of different codes as applicable to 3(A)-3(D)	Type	Quantity	

✔Enclose the list of recyclers to whom e-waste have been sent for recycling.

Place_____

Date_____ **Signature of the authorised person**

Note:-

(1) * Strike off whichever is not applicable
(2) Provide any other information as stipulated in the conditions to the authoriser
(3) In case filing on behalf of multiple regional offices, Bulk Consumers and Producers need to add extra rows to 1 & 3(A) with respect to each office.

FORM-4

[See rules 13(3)(i) and 13(3)(vi)]

APPLICATION FORM FOR AUTHORISATION OF FACILITIES POSSESSING ENVIRONMENTALLY SOUND MANAGEMENT PRACTICE FOR DISMANTLING OR RECYCLING OF E-WASTE

(To be submitted in triplicate)

1.	Name and Address of the unit			
2.	Contact person with designation, Tel./Fax			
3.	Date of Commissioning			
4.	No.of workers (including contract labour)			
5.	Consents Validity	a. Water (Prevention and Control of Pollution) Act, 1974; Valid up to _____ b. Air (Prevention and Control of Pollution) Act, 1981; Valid up to_____		
6.	Validity of current authorisation if any	e-waste (Management & Handling) Rules, 2011; Valid up to _____		
7.	Dismantling or Recycling Process	Please attach complete details		
8.	Installed capacity in MT/year	Products	Installed capacity (MTA)	
9.	E-waste processed during last three years	Year	Product	Quantity
10.	Waste Management:			
	a. Waste generation in processing e-waste	Please provide details material wise		
	b. Provide details of disposal of residue.	Please provide details		
	c. Name of Treatment Storage and Disposal Facility utilized for			
11.	Details of e-waste proposed to be procured from re-processing	Please provide details		
12.	Occupational safety and health aspects	Please provide details		
13.	Details of Facilities for dismantling both manual as well as mechanised:			

14.	Copy of agreement with Collection Centre	
15.	Copy agreement with Producer	
16.	Details of storage for dismantled e-waste	
17.	Copy of agreement with Recycler	
18.	Details of Facilities for Recycling	
19.	Copy of agreement with Collection Centre	
20.	Copy agreement with Producer	
21.	Details of storage for raw materials and recovered materials	

II. In case of renewal of **authorisation, previous registration or authorisation no. and date**

I hereby declare that the above statements or information are true and correct to the best of my knowledge and belief.

Signature

Place:_____ Name:_____

Date:_____ Designation:_____

Form-5

[See rule 18 (1)]

FORM FOR ANNUAL REPORT TO BE SUBMITTED BY THE STATE POLLUTION CONTROL BOARD TO THE CENTRAL POLLUTION CONTROL BOARD

To,

The Chairman,
Central Pollution Control Board,
(Ministry of Environment And Forests)
Government Of India, 'Parivesh Bhawan', East Arjun Nagar,
Delhi- 110 0032

1.	Number of authorised manufacturer, refurbisher, collection centre, dismantler and recycler for management of e-waste in the State or Union territory under these rules	:	
2.	Categories of waste collected along with their quantities on a monthly average basis:	:	Please attach as Annexure-I
3.	A Summary Statement code-wise of e-waste collected	:	Please attach as Annexure-II
4.	Details of material recovered from recycling of e-waste	:	
5.	Quantity of CFL received at Treatment, Storage and Disposal Facility	:	
6.	The above report is for the period from ……to .....……		

Place: _____

Date: _____

Chairman or the Member Secretary
State Pollution Control Board

Form-6

[See rule 19]

E-WASTE MANIFEST

1.	Sender's name and mailing address (including Phone No.) :	
2.	Sender's authorisation No, if applicable. :	
3.	Manifest Document No. :	
4.	Transporter's name and address : (including Phone No.)	
5.	Type of vehicle :	(Truck or Tanker or Special Vehicle)
6.	Transporter/s registration No. :	
7.	Vehicle registration No. :	
8.	Receiver's name & address :	
9.	Receiver's authorisation No, if applicable. :	
10.	Description of E-Waste (Item, Weight/ Numbers) :	
11.	Name and stamp of Sender* (Manufacturer or Producer or Bulk Consumer or Collection Centre or Refurbisher or Dismantler): Signature: Month Day Year	
12.	Transporter acknowledgement of receipt of E-Wastes	
	Name and stamp: Signature: Month Day Year	
13.	Receiver* (Collection Centre or Refurbisher or Dismantler or Recycler) certification of receipt of E-waste	
	Name and stamp: Signature: Month Day Year	

* As applicable

Note:-

Copy number with colour code (1)	**Purpose (2)**
Copy 1 (Yellow)	To be retained by the sender after taking signature on it from the transporter and other three copies will be carried by transporter.
Copy 2 (Pink)	To be retained by the receiver after signature of the transporter.
Copy 3 (Orange)	To be retained by the transporter after taking signature of the receiver.
Copy 4 (Green)	To be returned by the receiver with his/her signature to the sender

FORM 7
[See rule 22]

APPLICATION FOR FILING APPEAL AGAINST THE ORDER PASSED BY CENTRAL POLLUTION CONTROL BOARD/STATE POLLUTION CONTROL BOARD

1.	Name and address of the person making the appeal	:
2.	Number, date of order and address of the authority to which passed the order, against which appeal is	: (certified copy of the order be attached)
3.	Ground on which the appeal is being made	:
4.	Relief sought for	:
5.	List of enclosures other than the order referred in point 2 against which the appeal is being filed.	:

Signature…….

Name and address…….

Place:

Date:

Bishwanath Sinha
Joint Secretary to Government of India
(F No. 12-6/2013-HSMD)

****

[PUBLISHED IN THE GAZETTE OF INDIA, EXTRAORDINARY, PART II, SECTION 3, SUB-SECTION (i)]

GOVERNMENT OF INDIA
MINISTRY OF ENVIRONMENT, FOREST AND CLIMATE CHANGE

NOTIFICATION

New Delhi, the 04th April, 2016

G.S.R No. 395 (E). - Whereas the draft rules, namely the Hazardous And Other Wastes (Management and Transboundary Movement) Rules, 2015, were published by the Government of India in the Ministry of Environment, Forest and Climate Change *vide* number G.S.R. 582(E), dated the 24th July, 2015 in the Gazette of India, Extraordinary Part II, section 3, sub-section (ii) inviting objections and suggestions from all persons likely to be affected thereby, before the expiry of the period of sixty days from the date on which copies of the Gazette containing the said notification were made available to the public;

AND WHEREAS the copies of the said Gazette containing the said notification were made available to the public on the 24th day of July, 2015;

AND WHEREAS the objections and suggestions received within the specified period from the public in respect of the said draft rules have been duly considered by the Central Government;

NOW, THEREFORE, in exercise of the powers conferred by sections 6, 8 and 25 of the Environment (Protection) Act, 1986 (29 of 1986), and in supersession of the Hazardous Wastes (Management, Handling and Transboundary Movement) Rules, 2008, except as respects things done or omitted to be done before such supersession, the Central Government hereby makes the following rules, namely:-

CHAPTER I

PRELIMINARY

1. Short title and commencement. - (1) These rules may be called the Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016.

(2) They shall come into force on the date of their publication in the Official Gazette.

2. Application. - These rules shall apply to the management of hazardous and other wastes as specified in the Schedules to these rules but shall not apply to -

(a) waste-water and exhaust gases as covered under the provisions of the Water (Prevention and Control of Pollution) Act, 1974 (6 of 1974) and the Air (Prevention and Control of Pollution) Act, 1981 (14 of 1981) and the rules made thereunder and as amended from time to time;
(b) wastes arising out of the operation from ships beyond five kilometres of the relevant baseline as covered under the provisions of the Merchant Shipping Act, 1958 (44 of 1958) and the rules made thereunder and as amended from time to time;

(c) radio-active wastes as covered under the provisions of the Atomic Energy Act, 1962 (33 of 1962) and the rules made thereunder and as amended from time to time;
(d) bio-medical wastes covered under the Bio-Medical Wastes (Management and Handling) Rules, 1998 made under the Act and as amended from time to time; and
(e) wastes covered under the Municipal Solid Wastes (Management and Handling) Rules, 2000 made under the Act and as amended from time to time.

3. Definitions. - (1) In these rules, unless the context otherwise requires,-

1. "Act" means the Environment (Protection) Act, 1986 (29 of 1986);

2. "actual user" means an occupier who procures and processes hazardous and other waste for reuse, recycling, recovery, pre-processing, utilisation including co-processing;

3. "authorisation" means permission for generation, handling, collection, reception, treatment, transport, storage, reuse, recycling, recovery, pre-processing, utilisation including co-processing and disposal of hazardous wastes granted under sub-rule (2) of rule 6;

4. "Basel Convention" means the United Nations Environment Programme Convention on the Control of Transboundary Movement of Hazardous Wastes and their Disposal;

5. "captive treatment, storage and disposal facility" means a facility developed within the premises of an occupier for treatment, storage and disposal of wastes generated during manufacture, processing, treatment, package, storage, transportation, use, collection, destruction, conversion, offering for sale, transfer or the like of hazardous and other wastes;

6. "Central Pollution Control Board" means the Central Pollution Control Board constituted under sub-section (1) of section 3 of the Water (Prevention and Control of Pollution) Act, 1974 (6 of 1974);

7. "common treatment, storage and disposal facility" means a common facility identified and established individually or jointly or severally by the State Government, occupier, operator of a facility or any association of occupiers that shall be used as common facility by multiple occupiers or actual users for treatment, storage and disposal of the hazardous and other wastes;

8. "co-processing" means the use of waste materials in manufacturing processes for the purpose of energy or resource recovery or both and resultant reduction in the use of conventional fuels or raw materials or both through substitution;

9. "critical care medical equipment" means life saving equipment and includes such equipment as specified by the Ministry of Health and Family Welfare from time to time;

10. "disposal" means any operation which does not lead to reuse, recycling, recovery, utilisation including co-processing and includes physico-chemical treatment, biological treatment, incineration and disposal in secured landfill;

11. "export", with its grammatical variations and cognate expressions, means taking out of India to a place outside India;

12. "exporter" means any person or occupier under the jurisdiction of the exporting country who exports hazardous or other wastes, including the country which exports hazardous or other waste;

13. "environmentally sound management of hazardous and other wastes" means taking all steps required to ensure that the hazardous and other wastes are managed in a manner which shall protect health and the environment against the adverse effects which may result from such waste;

14. "environmentally sound technologies" means any technology approved by the Central Government from time to time;

15. "facility" means any establishment wherein the processes incidental to the generation, handling, collection, reception, treatment, storage, reuse, recycling, recovery, pre-processing, co-processing, utilisation and disposal of hazardous and, or, other wastes are carried out;

16. "Form" means a form appended to these rules;

17. "hazardous waste" means any waste which by reason of characteristics such as physical, chemical, biological, reactive, toxic, flammable, explosive or corrosive, causes danger or is likely to cause danger to health or environment, whether alone or in contact with other wastes or substances, and shall include -
    (i) waste specified under column (3) of Schedule I;
    (ii) waste having equal to or more than the concentration limits specified for the constituents in class A and class B of Schedule II or any of the characteristics as specified in class C of Schedule II; and
    (iii) wastes specified in Part A of Schedule III in respect of import or export of such wastes or the wastes not specified in Part A but exhibit hazardous characteristics specified in Part C of Schedule III;

18. "import", with its grammatical variations and cognate expressions, means bringing into India from a place outside India;

19. "importer" mean any person or occupier who imports hazardous or other waste;

20. "manifest" means transporting document prepared and signed by the sender authorised in accordance with the provisions of these rules;

21. "occupier" in relation to any factory or premises, means a person who has, control over the affairs of the factory or the premises and includes in relation to any hazardous and other wastes, the person in possession of the hazardous or other waste;

22. "operator of disposal facility" means a person who owns or operates a facility for collection, reception, treatment, storage and disposal of hazardous and other wastes;

23. "other wastes**"** means wastes specified in Part B and Part D of Schedule III for import or export and includes all such waste generated indigenously within the country;

24. "pre-processing" means the treatment of waste to make it suitable for co-processing or recycling or for any further processing;

25. "recycling" means reclamation and processing of hazardous or other wastes in an environmentally sound manner for the originally intended purpose or for other purposes;

26. "reuse" means use of hazardous or other waste for the purpose of its original use or other use;

27. "recovery" means any operation or activity wherein specific materials are recovered;

28. "Schedule" means a Schedule appended to these rules;

29. "State Government" in relation to a Union territory means, the Administrator thereof appointed under article 239 of the Constitution;

30. "State Pollution Control Board" means the State Pollution Control Board constituted under section 4 of the Water (Prevention and Control of Pollution) Act, 1974 (6 of 1974) and includes, in relation to a Union territory, the Pollution Control Committee;

31. "storage" mean storing any hazardous or other waste for a temporary period, at the end of which such waste is processed or disposed of;

32. "transboundary movement" means any movement of hazardous or other wastes from an area under the jurisdiction of one country to or through an area under the jurisdiction of another country or to or through an area not under the jurisdiction of any country, provided that at least two countries are involved in the movement;

33. "transport" means off-site movement of hazardous or other wastes by air, rail, road or water;

34. "transporter" means a person engaged in the off-site transportation of hazardous or other waste by air, rail, road or water;

35. "treatment" means a method, technique or process, designed to modify the physical, chemical or biological characteristics or composition of any hazardous or other waste so as to reduce its potential to cause harm;

36. "used oil" means any oil-

    (i) derived from crude oil or mixtures containing synthetic oil including spent oil, used engine oil, gear oil, hydraulic oil, turbine oil, compressor oil, industrial gear oil, heat transfer oil, transformer oil and their tank bottom sludges; and
    (ii) suitable for reprocessing, if it meets the specification laid down in Part A of Schedule V but does not include waste oil;

37. "utilisation" means use of hazardous or other waste as a resource;

38. "waste" means materials that are not products or by-products, for which the generator has no further use for the purposes of production, transformation or consumption.

Explanation.- for the purposes of this clause,

(i) waste includes the materials that may be generated during, the extraction of raw materials, the processing of raw materials into intermediates and final products, the consumption of final products, and through other human activities and excludes residuals recycled or reused at the place of generation; and

(ii) by-product means a material that is not intended to be produced but gets produced in the production process of intended product and is used as such;

39. "waste oil" means any oil which includes spills of crude oil, emulsions, tank bottom sludge and slop oil generated from petroleum refineries, installations or ships and can be used as fuel in furnaces for energy recovery, if it meets the specifications laid down in Part-B of Schedule V either as such or after reprocessing.

(2) Words and expressions used in these rules and not defined but defined in the Act shall have the meanings respectively assigned to them in the Act.

CHAPTER II

PROCEDURE FOR MANAGEMENT OF HAZARDOUS AND OTHER WASTES

4. Responsibilities of the occupier for management of hazardous and other wastes.-

(1) For the management of hazardous and other wastes, an occupier shall follow the following steps, namely:-

(a) prevention;
(b) minimization;
(c) reuse,
(d) recycling;
(e) recovery, utilisation including co-processing;
(f) safe disposal.

(2) The occupier shall be responsible for safe and environmentally sound management of hazardous and other wastes.

(3) The hazardous and other wastes generated in the establishment of an occupier shall be sent or sold to an authorised actual user or shall be disposed of in an authorised disposal facility.

(4) The hazardous and other wastes shall be transported from an occupier's establishment to an authorised actual user or to an authorised disposal facility in accordance with the provisions of these rules.

(5) The occupier who intends to get its hazardous and other wastes treated and disposed of by the operator of a treatment, storage and disposal facility shall give to the operator of that facility, such specific information as may be needed for safe storage and disposal.

(6) The occupier shall take all the steps while managing hazardous and other wastes to-

(a) contain contaminants and prevent accidents and limit their consequences on human beings and the environment; and

(b) provide persons working in the site with appropriate training, equipment and the information necessary to ensure their safety.

5. Responsibilities of State Government for environmentally sound management of hazardous and other wastes. – (1) Department of Industry in the State or any other government agency authorised in this regard by the State Government, to ensure earmarking or allocation of industrial space or shed for recycling, pre-processing and other utilisation of hazardous or other waste in the existing and upcoming industrial park, estate and industrial clusters;

(2) Department of Labour in the State or any other government agency authorised in this regard by the State Government shall,-

(a) ensure recognition and registration of workers involved in recycling, pre-processing and other utilisation activities;
(b) assist formation of groups of such workers to facilitate setting up such facilities;
(c) undertake industrial skill development activities for the workers involved in recycling, pre-processing and other utilisation;
(d) undertake annual monitoring and to ensure safety and health of workers involved in recycling, pre-processing and other utilisation.

(3) Every State Government may prepare integrated plan for effective implementation of these provisions and to submit annual report to the Ministry of Environment, Forest and Climate Change, in the Central Government.

6. Grant of authorisation for managing hazardous and other wastes.- (1) Every occupier of the facility who is engaged in handling, generation, collection, storage, packaging, transportation, use, treatment, processing, recycling, recovery, pre-processing, co-processing, utilisation, offering for sale, transfer or disposal of the hazardous and other wastes shall be required to make an application in **Form 1** to the State Pollution Control Board and obtain an authorisation from the State Pollution Control Board within a period of sixty days from the date of publication of these rules. Such application for authorisation shall be accompanied with a copy each of the following documents, namely:-

(a) consent to establish granted by the State Pollution Control Board under the Water (Prevention and Control of Pollution) Act, 1974 (25 of 1974) and the Air (Prevention and Control of Pollution) Act, 1981 (21 of 1981);
(b) Consent to operate granted by the State Pollution Control Board under the Water (Prevention and Control of Pollution) Act, 1974 (25 of 1974) and/or Air (Prevention and Control of Pollution) Act, 1981, (21 of 1981);
(c) in case of renewal of authorisation, a self-certified compliance report in respect of effluent, emission standards and the conditions specified in the authorisation for hazardous and other wastes:

Provided that an application for renewal of authorisation may be made three months before the expiry of such authorisation:

Provided further that-

(i) any person authorised under the provisions of the Hazardous Waste (Management, Handling and Transboundary Movement) Rules, 2008, prior to the date of commencement

of these rules, shall not be required to make an application for authorisation till the period of expiry of such authorisation;

(ii) any person engaged in recycling or reprocessing of the hazardous waste specified in Schedule IV and having registration under the provisions of the Hazardous Waste (Management, Handling and Transboundary Movement) Rules, 2008, shall not be required to make an application for authorisation till the period of expiry of such registration.

(2) On receipt of an application complete in all respects for the authorisation, the State Pollution Control Board may, after such inquiry as it considers necessary, and on being satisfied that the applicant possesses appropriate facilities for collection, storage, packaging, transportation, treatment, processing, use, destruction, recycling, recovery, pre-processing, co-processing, utilisation, offering for sale, transfer or disposal of the hazardous and other waste, as the case may be, and after ensuring technical capabilities and equipment complying with the standard operating procedure or other guidelines specified by the Central Pollution Control Board from time to time and through site inspection, grant within a period of one hundred and twenty days, an authorisation in **Form 2** to the applicant, which shall be valid for a period of five years subject to such conditions as may be laid down therein. For commonly recyclable hazardous waste as given in Schedule IV, the guidelines already prepared by the Central Pollution Control Board shall be followed:

Provided that in the case of an application for renewal of authorisation, the State Pollution Control Board may, before granting such authorisation, satisfy itself that there has been no violation of the conditions specified in the authorisation earlier granted by it and same shall be recorded in the inspection report.

(3) The authorisation granted by the State Pollution Control Board under sub-rule (2) shall be accompanied by a copy of the field inspection report signed by that Board indicating the adequacy of facilities for collection, storage, packaging, transportation, treatment, processing, use, destruction, recycling, recovery, pre-processing, co-processing, utilisation, offering for sale, transfer or disposal of the hazardous and other wastes and compliance to the guidelines or standard operating procedures specified by the Central Pollution Control Board from time to time.

(4) The State Pollution Control Board may, for the reasons to be recorded in writing and after giving reasonable opportunity of being heard to the applicant, refuse to grant any authorisation under these rules.

(5) Every occupier authorised under these rules, shall maintain a record of hazardous and other wastes managed by him in **Form 3** and prepare and submit to the State Pollution Control Board, an annual return containing the details specified in **Form 4** on or before the 30th day of June following the financial year to which that return relates.

(6) The State Pollution Control Board shall maintain a register containing particulars of the conditions imposed under these rules for management of hazardous and other wastes and it shall be open for inspection during office hours to any interested or affected person.

(7) The authorised actual user of hazardous and other wastes shall maintain records of hazardous and other wastes purchased in a passbook issued by the State Pollution Control Board along with the authorisation.

(8) Handing over of the hazardous and other wastes to the authorised actual user shall be only after making the entry into the passbook of the actual user.

7. Power to suspend or cancel an authorisation.- (1) The State Pollution Control Board, may, if in its opinion the holder of the authorisation has failed to comply with any of the conditions of the authorisation or with any provisions of the Act or these rules and after giving him a reasonable opportunity of being heard and after recording reasons thereof in writing cancel or suspend the authorisation issued under rule 6 for such period as it considers necessary in the public interest.

(2) Upon suspension or cancellation of the authorisation, the State Pollution Control Board may give directions to the person whose authorisation has been suspended or cancelled for the safe storage and management of the hazardous and other wastes, and such occupier shall comply with such directions.

8. Storage of hazardous and other wastes.- (1) The occupiers of facilities may store the hazardous and other wastes for a period not exceeding ninety days and shall maintain a record of sale, transfer, storage, recycling, recovery, pre-processing, co-processing and utilisation of such wastes and make these records available for inspection:

Provided that the State Pollution Control Board may extend the said period of ninety days in following cases, namely:-

(i) small generators (up to ten tonnes per annum) up to one hundred and eighty days of their annual capacity;
(ii) actual users and disposal facility operators up to one hundred and eighty days of their annual capacity,
(iii) occupiers who do not have access to any treatment, storage, disposal facility in the concerned State; or
(iv) the waste which needs to be specifically stored for development of a process for its recycling, recovery, pre-processing, co-processing or utilisation;
(v) in any other case, on justifiable grounds up to one hundred and eighty days.

9. Utilisation of hazardous and other wastes.- (1) The utilisation of hazardous and other wastes as a resource or after pre-processing either for co-processing or for any other use, including within the premises of the generator (if it is not part of process), shall be carried out only after obtaining authorisation from the State Pollution Control Board in respect of waste on the basis of standard operating procedures or guidelines provided by the Central Pollution Control Board.

(2) Where standard operating procedures or guidelines are not available for specific utilisation, the approval has to be sought from Central Pollution Control Board which shall be granting approval on the basis of trial runs and thereafter, standard operating procedures or guidelines shall be prepared by Central Pollution Control Board:

Provided, if trial run has been conducted for particular waste with respect to particular utilisation and compliance to the environmental standards has been demonstrated, authorisation may be granted by the State Pollution Control Board with respect to the same waste and utilisation, without need of separate trial run by Central Pollution Control Board and such cases of successful trial run, Central Pollution Control Board shall intimate all the State Pollution Control Board regarding the same.

(3) No trial runs shall be required for co-processing of waste in cement plants for which guidelines by the Central Pollution Control Board are already available; however, the actual users shall

ensure compliance to the standards notified under the Environment (Protection) Act,1986 (29 of 1986), for cement plant with respect to co-processing of waste:

Provided that till the time the standards are notified, the procedure as applicable to other kind of utilisation of hazardous and other waste, as enumerated above shall be followed.

10. Standard Operating Procedure or guidelines for actual users.- The Ministry of Environment, Forest and Climate Change or the Central Pollution Control Board may issue guidelines or standard operating procedures for environmentally sound management of hazardous and other wastes from time to time.

CHAPTER III

IMPORT AND EXPORT OF HAZARDOUS AND OTHER WASTES

11. Import and export (transboundary movement) of hazardous and other wastes.- The Ministry of Environment, Forest and Climate Change shall be the nodal Ministry to deal with the transboundary movement of the hazardous and other wastes in accordance with the provisions of these rules.

12. Strategy for Import and export of hazardous and other wastes.- (1) No import of the hazardous and other wastes from any country to India for disposal shall be permitted.

(2) The import of hazardous and other wastes from any country shall be permitted only for recycling, recovery, reuse and utilisation including co-processing.

(3) The import of hazardous waste in Part A of Schedule III may be allowed to actual users with the prior informed consent of the exporting country and shall require the permission of the Ministry of Environment, Forest and Climate Change.

(4) The import of other wastes in Part B of Schedule III may be allowed to actual users with the permission of the Ministry of Environment, Forest and Climate Change.

(5) The import of other wastes in Part D of Schedule III will be allowed as per procedure given in rule 13 and as per the note below the said Schedule.

(6) No import of the hazardous and other wastes specified in Schedule VI shall be permitted.

(7) The export of hazardous and other wastes from India listed in Part A and Part B of Schedule III and Schedule VI shall be with the permission of Ministry of Environment, Forest and Climate Change. In case of applications for export of hazardous and other waste listed in Part A of Schedule III and Schedule VI, they shall be considered on the basis of prior informed consent of the importing country.

(8) The import and export of hazardous and other wastes not specified in Schedule III, but exhibiting the hazardous characteristics outlined in Part C of Schedule III shall require prior written permission of the Ministry of Environment, Forest and Climate Change before it is imported to or exported from India, as the case may be.

13. Procedure for import of hazardous and other wastes.- (1) Actual users intending to import or transit for transboundary movement of hazardous and other wastes specified in Part A and Part B of Schedule III shall apply in **Form 5** along with the documents listed therein, to the Ministry of Environment, Forest and Climate Change for the proposed import together with the prior informed consent of the exporting country in respect of Part A of Schedule III waste, and shall send a copy of the application, simultaneously, to the concerned State Pollution Control Board for information and the acknowledgement in this respect from the concerned State Pollution Control Board shall be submitted to the Ministry of Environment, Forest and Climate Change along with the application.

(2) For the import of other wastes listed in Part D of Schedule III, the importer shall not require the permission of the Ministry of Environment, Forest and Climate Change. However, the importer shall furnish the required information as per **Form 6** to the Customs authorities, accompanied with the following documents in addition to those listed in Schedule VIII, wherever applicable. For used electrical and electronic assemblies listed at serial numbers 4 (e) to 4(i) of Schedule VIII (Basel No. B1110), there is no specific requirement of documentation under these rules:

(a) the import license from Directorate General of Foreign Trade, if applicable;
(b) the valid consents under the Water (Prevention and Control of Pollution) Act, 1974 (25 of 1974) and the Air (Prevention and Control of Pollution) Act, 1981 (21 of 1981)and the authorisation under these rules as well as the authorisation under the E-Waste (Management and Handling) Rules, 2011, as amended from time to time, whichever applicable;
(c) importer who is a trader, importing waste on behalf of actual users, shall obtain one time authorisation in **Form 7** and copy of this authorisation shall be appended to **Form 6**.

(3) For Part B of Schedule III, in case of import of any used electrical and electronic assemblies or spares or part or component or consumables as listed under Schedule I of the E-Waste (Management and Handling) Rules, 2011, as amended from time to time, the importer need to obtain extended producer responsibility-authorisation as producer under the said E-Waste (Management and Handling) Rules, 2011.

(4) Prior to clearing of consignment of wastes listed in Part D of Schedule III, the Custom authorities shall verify the documents as given in column (3) of Schedule VIII.

(5) On receipt of the complete application with respect to Part A and Part B of Schedule III, the Ministry of Environment, Forest and Climate Change shall examine the application considering the comments and observations, if any, received from the State Pollution Control Boards, and may grant the permission for import within a period of sixty days subject to the condition that the importer has -

(i) the environmentally sound facilities;
(ii) adequate arrangements for treatment and disposal of wastes generated;
(iii)a valid authorisation and consents from the State Pollution Control Board;
(iv) prior informed consent from the exporting country in case of Part A of Schedule III wastes.

(6) The Ministry of Environment, Forest and Climate Change shall forward a copy of the permission to the concerned Port and Customs authorities, Central Pollution Control Board and the concerned State Pollution Control Board for ensuring compliance with respect to their respective functions given in Schedule VII.

(7) The importer of the hazardous and other wastes shall maintain records of the hazardous and other waste imported by him in **Form 3** and the record so maintained shall be made available for inspection.

(8) The importer of the hazardous and other wastes shall file an annual return in **Form 4** to the State Pollution Control Board on or before the 30th day of June following the financial year to which that return relates.

(9) Samples of hazardous and other wastes being imported for testing or research and development purposes up to 1000 gm or 1000 ml shall be exempted from need of taking permission for import under these rules.

(10) The Port and Customs authorities shall ensure that shipment is accompanied with the movement document as given in **Form 6** and the test report of analysis of the waste, consignment, wherever applicable, from a laboratory accredited or recognised by the exporting country. In case of any doubt, the customs may verify the analysis.

14. Procedure for Export of hazardous and other wastes from India.- (1) Any occupier intending to export waste specified in Part A of Schedule III, Part B of Schedule III and Schedule VI, shall make an application in **Form 5** along with insurance cover to the Ministry of Environment, Forest and Climate Change for the proposed transboundary movement of the hazardous and other wastes together with the prior informed consent in writing from the importing country in respect of wastes specified in Part A of Schedule III and Schedule VI.

(2) On receipt of an application under sub-rule (1), the Ministry of Environment, Forest and Climate Change may give permission for the proposed export within a period of sixty days from the date of submission of complete application and may impose such conditions as it may consider necessary.

(3) The Ministry of Environment, Forest and Climate Change shall forward a copy of the permission granted under sub-rule (2) to the State Pollution Control Board of the State where the waste is generated and the Pollution Control Board of the State where the port of export is located and the concerned Port and Customs authorities for ensuring compliance of the conditions of the export permission.

(4) The exporter shall ensure that no consignment is shipped before the prior informed consent is received from the importing country, wherever applicable.

(5) The exporter shall also ensure that the shipment is accompanied with movement document in **Form 6.**

(6) The exporter of the hazardous and other wastes shall maintain the records of the hazardous or other waste exported by him in **Form 3** and the record so maintained shall be available for inspection.

15. Illegal traffic.- (1) The export and import of hazardous or other wastes from and into India, respectively shall be deemed illegal, if,-

(i) it is without permission of the Central Government in accordance with these rules; or
(ii) the permission has been obtained through falsification, mis-representation or fraud; or
(iii) it does not conform to the shipping details provided in the movement documents; or

(iv) it results in deliberate disposal (i.e., dumping) of hazardous or other waste in contravention of the Basel Convention and of general principles of international or domestic law.

(2) In case of illegal import of the hazardous or other waste, the importer shall re-export the waste in question at his cost within a period of ninety days from the date of its arrival into India and its implementation will be ensured by the concerned Port and the Custom authority. In case of disposal of such waste by the Port and Custom authorities, they shall do so in accordance with these rules with the permission of the Pollution Control Board of the State where the Port exists.

(3) In case of illegal import of hazardous or other waste, where the importer is not traceable then the waste either can be sold by the Customs authority to any user having authorisation under these rules from the concerned State Pollution Control Board or can be sent to authorised treatment, storage and disposal facility.

CHAPTER - IV

TREATMENT, STORAGE AND DISPOSAL FACILITY FOR HAZARDOUS AND OTHER WASTES

16. Treatment, storage and disposal facility for hazardous and other wastes.- (1) The State Government, occupier, operator of a facility or any association of occupiers shall individually or jointly or severally be responsible for identification of sites for establishing the facility for treatment, storage and disposal of the hazardous and other waste in the State.

(2) The operator of common facility or occupier of a captive facility, shall design and set up the treatment, storage and disposal facility as per technical guidelines issued by the Central Pollution Control Board in this regard from time to time and shall obtain approval from the State Pollution Control Board for design and layout in this regard.

(3) The State Pollution Control Board shall monitor the setting up and operation of the common or captive treatment, storage and disposal facility, regularly.

(4) The operator of common facility or occupier of a captive facility shall be responsible for safe and environmentally sound operation of the facility and its closure and post closure phase, as per guidelines or standard operating procedures issued by the Central Pollution Control Board from time to time.

(5) The operator of common facility or occupier of a captive facility shall maintain records of hazardous and other wastes handled by him in **Form 3.**

(6) The operator of common facility or occupier of a captive facility shall file an annual return in **Form 4** to the State Pollution Control Board on or before the 30th day of June following the financial year to which that return relates.

CHAPTER - V

PACKAGING, LABELLING, AND TRANSPORT OF HAZARDOUS AND OTHER WASTES.

17. Packaging and Labelling.- (1) Any occupier handling hazardous or other wastes and operator of the treatment, storage and disposal facility shall ensure that the hazardous and other wastes are packaged in a manner suitable for safe handling, storage and transport as per the guidelines issued by the Central Pollution Control Board from time to time. The labelling shall be done as per **Form 8.**

(2) The label shall be of non-washable material, weather proof and easily visible.

18. Transportation of hazardous and other wastes.- (1) The transport of the hazardous and other waste shall be in accordance with the provisions of these rules and the rules made by the Central Government under the Motor Vehicles Act, 1988 and the guidelines issued by the Central Pollution Control Board from time to time in this regard.

(2) The occupier shall provide the transporter with the relevant information in **Form 9,** regarding the hazardous nature of the wastes and measures to be taken in case of an emergency and shall label the hazardous and other wastes containers as per **Form 8**.

(3) In case of transportation of hazardous and other waste for final disposal to a facility existing in a State other than the State where the waste is generated, the sender shall obtain 'No Objection Certificate' from the State Pollution Control Board of both the States.

(4) In case of transportation of hazardous and other waste for recycling or utilisation including co-processing, the sender shall intimate both the State Pollution Control Boards before handing over the waste to the transporter.

(5) In case of transit of hazardous and other waste for recycling, utilisation including co-processing or disposal through a State other than the States of origin and destination, the sender shall give prior intimation to the concerned State Pollution Control Board of the States of transit before handing over the wastes to the transporter.

(6) In case of transportation of hazardous and other waste, the responsibility of safe transport shall be either of the sender or the receiver whosoever arranges the transport and has the necessary authorisation for transport from the concerned State Pollution Control Board. This responsibility should be clearly indicated in the manifest.

(7) The authorisation for transport shall be obtained either by the sender or the receiver on whose behalf the transport is being arranged.

19. Manifest system (Movement Document) for hazardous and other waste to be used within the country only.- (1) The sender of the waste shall prepare seven copies of the manifest in **Form 10** comprising of colour code indicated below and all seven copies shall be signed by the sender:

Copy number with colour code	Purpose
(1)	(2)
Copy 1 (White)	To be forwarded by the sender to the State Pollution Control Board after signing all the seven copies.
Copy 2 (Yellow)	To be retained by the sender after taking signature on it from the transporter and the rest of the five signed copies to be carried by the transporter.
Copy 3 (Pink)	To be retained by the receiver (actual user or treatment storage and disposal facility operator) after receiving the waste and the remaining four copies are to be duly signed by the receiver.
Copy 4 (Orange)	To be handed over to the transporter by the receiver after accepting waste.
Copy 5 (Green)	To be sent by the receiver to the State Pollution Control Board.
Copy 6 (Blue)	To be sent by the receiver to the sender.
Copy 7 (Grey)	To be sent by the receiver to the State Pollution Control Board of the sender in case the sender is in another State.

(2) The sender shall forward copy 1 (white) to the State Pollution Control Board, and in case the hazardous or other wastes is likely to be transported through any transit State, the sender shall intimate State Pollution Control Boards of transit States about the movement of the waste.

(3) No transporter shall accept waste from the sender for transport unless it is accompanied by signed copies 3 to 7 of the manifest.

(4) The transporter shall submit copies 3 to 7 of the manifest duly signed with date to the receiver along with the waste consignment.

(5) The receiver after acceptance of the waste shall hand over copy 4 (orange) to the transporter and send copy 5 (green) to his State Pollution Control Board and send copy 6 (blue) to the sender and the copy 3 (pink) shall be retained by the reciever.

(6) The copy 7 (grey) shall only be sent to the State Pollution Control Board of the sender, if the sender is in another State.

CHAPTER VI
MISCELLANIOUS

20. Records and returns.- (1) The occupier handling hazardous or other wastes and operator of disposal facility shall maintain records of such operations in **Form 3.**

(2) The occupier handling hazardous and other wastes and operator of disposal facility shall send annual returns to the State Pollution Control Board in **Form 4.**

(3) The State Pollution Control Board based on the annual returns received from the occupiers and the operators of the facilities for disposal of hazardous and other wastes shall prepare an annual inventory of the waste generated; waste recycled, recovered, utilised including co-processed; waste re-exported and waste disposed and submit to the Central Pollution Control Board by the 30th day of September every year. The State Pollution Control Board shall also prepare the inventory of hazardous waste generators, actual users, and common and captive

disposal facilities and shall submit the information to Central Pollution Control Board every two years.

(4) The Central Pollution Control Board shall prepare the consolidated review report on management of hazardous and other wastes and forward it to the Ministry of Environment, Forest and Climate Change, along with its recommendations before the 30th day of December once in every year.

21. Responsibility of authorities. - The authority specified in column (2) of Schedule VII shall perform the duties as specified in column (3) of the said Schedule subject to the provisions of these rules.

22. Accident reporting. - Where an accident occurs at the facility of the occupier handling hazardous or other wastes and operator of the disposal facility or during transportation, the occupier or the operator or the transporter shall immediately intimate the State Pollution Control Board through telephone, e-mail about the accident and subsequently send a report in **Form 11.**

23. Liability of occupier, importer or exporter and operator of a disposal facility.-

(1) The occupier, importer or exporter and operator of the disposal facility shall be liable for all damages caused to the environment or third party due to improper handling and management of the hazardous and other waste.

(2) The occupier and the operator of the disposal facility shall be liable to pay financial penalties as levied for any violation of the provisions under these rules by the State Pollution Control Board with the prior approval of the Central Pollution Control Board.

24. Appeal.- (1) Any person aggrieved by an order of suspension or cancellation or refusal of authorisation or its renewal passed by the State Pollution Control Board may, within a period of thirty days from the date on which the order is communicated to him, prefer an appeal in **Form 12** to the Appellate Authority, namely, the Environment Secretary of the State.

(2) The Appellate Authority may entertain the appeal after expiry of the said period of thirty days, if it is satisfied that the appellant was prevented by sufficient cause from filing the appeal in time.

(3) Every appeal filed under this rule shall be disposed of within a period of sixty days from the date of its filing.

SCHEDULE I

[See rule 3 (1) (17) (i)]

List of processes generating hazardous wastes

S.No.	Processes	Hazardous Waste*
(1)	(2)	(3)
1.	Petrochemical processes and pyrolytic operations	1.1 Furnace or reactor residue and debris 1.2 Tarry residues and still bottoms from distillation 1.3 Oily sludge emulsion 1.4 Organic residues 1.5 Residues from alkali wash of fuels

(1)	(2)	(3)
		1.6 Spent catalyst and molecular sieves 1.7 Oil from wastewater treatment
2.	Crude oil and natural gas production	2.1 Drill cuttings excluding those from water based mud 2.2 Sludge containing oil 2.3 Drilling mud containing oil
3.	Cleaning, emptying and maintenance of petroleum oil storage tanks including ships	3.1 cargo residue, washing water and sludge containing oil 3.2 cargo residue and sludge containing chemicals 3.3 Sludge and filters contaminated with oil 3.4 Ballast water containing oil from ships
4.	Petroleum refining or re-processing of used oil or recycling of waste oil	4.1 Oil sludge or emulsion 4.2 Spent catalyst 4.3 Slop oil 4.4 Organic residue from processes 4.5 Spent clay containing oil
5.	Industrial operations using mineral or synthetic oil as lubricant in hydraulic systems or other applications	5.1 Used or spent oil 5.2 Wastes or residues containing oil 5.3 Waste cutting oils
6.	Secondary production and / or industrial use of zinc	6.1 Sludge and filter press cake arising out of production of Zinc Sulphate and other Zinc Compounds. 6.2 Zinc fines or dust or ash or skimmings in dispersible form 6.3 Other residues from processing of zinc ash or skimmings 6.4 Flue gas dust and other particulates
7.	Primary production of zinc or lead or copper and other non-ferrous metals except aluminium	7.1 Flue gas dust from roasting 7.2 Process residues 7.3 Arsenic-bearing sludge 7.4 Non-ferrous metal bearing sludge and residue. 7.5 Sludge from scrubbers
8.	Secondary production of copper	8.1 Spent electrolytic solutions 8.2 Sludge and filter cakes 8.3 Flue gas dust and other particulates
9.	Secondary production of lead	9.1 Lead bearing residues 9.2 Lead ash or particulate from flue gas 9.3 Acid from used batteries
10.	Production and/or industrial use of cadmium and arsenic and their compounds	10.1 Residues containing cadmium and arsenic
11.	Production of primary and secondary aluminum	11.1 Sludges from off-gas treatment 11.2 Cathode residues including pot lining wastes 11.3 Tar containing wastes 11.4 Flue gas dust and other particulates 11.5 Drosses and waste from treatment of salt sludge

(1)	(2)	(3)
		11.6 Used anode butts 11.7 Vanadium sludge from alumina refineries
12.	Metal surface treatment, such as etching, staining, polishing, galvanizing, cleaning, degreasing, plating, etc.	12.1 Acidic and alkaline residues 12.2 Spent acid and alkali 12.3 Spent bath and sludge containing sulphide, cyanide and toxic metals 12.4 Sludge from bath containing organic solvents 12.5 Phosphate sludge 12.6 Sludge from staining bath 12.7 Copper etching residues 12.8 Plating metal sludge
13.	Production of iron and steel including other ferrous alloys (electric furnace; steel rolling and finishing mills; Coke oven and by products plant)	13.1 Spent pickling liquor 13.2 Sludge from acid recovery unit 13.3 Benzol acid sludge 13.4 Decanter tank tar sludge 13.5 Tar storage tank residue 13.6 Residues from coke oven by product plant.
14.	Hardening of steel	14.1 Cyanide-, nitrate-, or nitrite -containing sludge 14.2 Spent hardening salt
15.	Production of asbestos or asbestos-containing materials	15.1 Asbestos-containing residues 15.2 Discarded asbestos 15.3 Dust or particulates from exhaust gas treatment.
16.	Production of caustic soda and chlorine	16.1 Mercury bearing sludge generated from mercury cell process 16.2 Residue or sludges and filter cakes 16.3 Brine sludge
17.	Production of mineral acids	17.1 Process acidic residue, filter cake, dust 17.2 Spent catalyst
18.	Production of nitrogenous and complex fertilizers	18.1 Spent catalyst 18.2 Carbon residue 18.3 Sludge or residue containing arsenic 18.4 Chromium sludge from water cooling tower
19.	Production of phenol	19.1 Residue or sludge containing phenol 19.2 Spent catalyst
20.	Production and/or industrial use of solvents	20.1 Contaminated aromatic, aliphatic or napthenic solvents may or may not be fit for reuse. 20.2 Spent solvents 20.3 Distillation residues 20.4 Process Sludge
21.	Production and/or industrial use of paints, pigments, lacquers, varnishes and inks	21.1 Process wastes, residues and sludges 21.2 Spent solvent
22.	Production of plastics	22.1 Spent catalysts 22.2 Process residues
23.	Production and /or industrial use of glues, organic cements,	23.1 Wastes or residues (not made with vegetable or animal materials)

(1)	(2)	(3)
	adhesive and resins	23.2 Spent solvents
24.	Production of canvas and textiles	24.1 Chemical residues
25.	Industrial production and formulation of wood preservatives	25.1 Chemical residues 25.2 Residues from wood alkali bath
26.	Production or industrial use of synthetic dyes, dye-intermediates and pigments	26.1 Process waste sludge/residues containing acid, toxic metals, organic compounds 26.2 Dust from air filtration system 26.3 Spent acid 26.4 Spent solvent 26.5 Spent catalyst
27.	Production of organic-silicone compound	27.1 Process residues
28.	Production/formulation of drugs/pharmaceutical and health care product	28.1 Process Residue and wastes 28.2 Spent catalyst 28.3 Spent carbon 28.4 Off specification products 28.5 Date-expired products 28.6 Spent solvents
29.	Production, and formulation of pesticides including stock-piles	29.1 Process wastes or residues 29.2 Sludge containing residual pesticides 29.3 Date-expired and off-specification pesticides 29.4 Spent solvents 29.5 Spent catalysts 29.6 Spent acids
30.	Leather tanneries	30.1 Chromium bearing residue and sludge
31.	Electronic Industry	31.1 Process residue and wastes 31.2 Spent etching chemicals and solvents
32.	Pulp and Paper Industry	32.1 Spent chemicals 32.2 Corrosive wastes arising from use of strong acid and bases 32.3 Process sludge containing adsorbable organic halides(AO_X)
33.	Handling of hazardous chemicals and wastes	33.1 Empty barrels/containers/liners contaminated with hazardous chemicals /wastes 33.2 Contaminated cotton rags or other cleaning materials
34.	De-contamination of barrels / containers used for handling of hazardous wastes/chemicals	34.1 Chemical-containing residue arising from decontamination. 34.2 Sludge from treatment of waste water arising out of cleaning / disposal of barrels / containers
35.	Purification and treatment of exhaust air/gases, water and waste water from the processes in this schedule and common industrial effluent treatment plants (CETP's)	35.1 Exhaust Air or Gas cleaning residue 35.2 Spent ion exchange resin containing toxic metals 35.3 Chemical sludge from waste water treatment 35.4 Oil and grease skimming 35.5 Chromium sludge from cooling water
36.	Purification process for organic	36.1 Any process or distillation residue

(1)	(2)	(3)
	compounds/solvents	36.2 Spent carbon or filter medium
37.	Hazardous waste treatment processes, e.g. pre-processing, incineration and concentration	37.1 Sludge from wet scrubbers 37.2 Ash from incinerator and flue gas cleaning residue 37.3 Concentration or evaporation residues
38.	Chemical processing of Ores containing heavy metals such as Chromium, Manganese, Nickel, Cadmium etc.	38.1 Process residues 38.2 Spent acid

*** The inclusion of wastes contained in this Schedule does not preclude the use of Schedule II to demonstrate that the waste is not hazardous. In case of dispute, the matter would be referred to the Technical Review Committee constituted by Ministry of Environment, Forest and Climate Change.**

Note: *The high volume low effect wastes such as fly ash, Phosphogypsum, red mud, jarosite, Slags from pyrometallurgical operations, mine tailings and ore beneficiation rejects are excluded from the category of hazardous wastes. Separate guidelines on the management of these wastes shall be issued by Central Pollution Control Board.*

SCHEDULE II

[See rule 3 (1) (17) (ii)]

List of waste constituents with concentration limits

Class A: Based on leachable concentration limits [Toxicity Characteristic Leaching Procedure (TCLP) or Soluble Threshold Limit Concentration (STLC)]

Class	Constituents	Concentration in mg/l
(1)	(2)	(3)
A1	Arsenic	5.0
A2	Barium	100.0
A3	Cadmium	1.0
A4	Chromium and/or Chromium (III) compounds	5.0
A5	Lead	5.0
A6	Manganese	10.0
A7	Mercury	0.2
A8	Selenium	1.0
A9	Silver	5.0
A10	Ammonia	50*
A11	Cyanide	20*
A12	Nitrate (as nitrate-nitrogen)	1000.0
A13	Sulphide (as H_2S)	5.0
A14	1,1-Dichloroethylene	0.7
A15	1,2-Dichloroethane	0.5
A16	1,4-Dichlorobenzene	7.5
A17	2,4,5-Trichlorophenol	400.0
A18	2,4,6-Trichlorophenol	2.0
A19	2,4-Dinitrotoluene	0.13
A20	Benzene	0.5
A21	Benzo (a) Pyrene	0.001
A22	Bromodicholromethane	6.0
A23	Bromoform	10.0
A24	Carbon tetrachloride	0.5
A25	Chlorobenzene	100.0
A26	Chloroform	6.0
A27	Cresol (ortho+ meta+ para)	200.0
A28	Dibromochloromethane	10.0
A29	Hexachlorobenzene	0.13
A30	Hexachlorobutadiene	0.5
A31	Hexachloroethane	3.0
A32	Methyl ethyl ketone	200.0
A33	Naphthalene	5.0
A34	Nitrobenzene	2.0
A35	Pentachlorophenol	100.0
A36	Pyridine	5.0
A37	Tetrachloroethylene	0.7
A38	Trichloroethylene	0.5

(1)	(2)	(3)
A39	Vinyl chloride	0.2
A40	2,4,5-TP (Silvex)	1.0
A41	2,4-Dichlorophenoxyacetic acid	10.0
A42	Alachlor	2.0
A43	Alpha HCH	0.001
A44	Atrazine	0.2
A45	Beta HCH	0.004
A46	Butachlor	12.5
A47	Chlordane	0.03
A48	Chlorpyriphos	9.0
A49	Delta HCH	0.004
A50	Endosulfan (alpha+ beta+ sulphate)	0.04
A51	Endrin	0.02
A52	Ethion	0.3
A53	Heptachlor (& its Epoxide)	0.008
A54	Isoproturon	0.9
A55	Lindane	0.4
A56	Malathion	19
A57	Methoxychlor	10
A58	Methyl parathion	0.7
A59	Monocrotophos	0.1
A60	Phorate	0.2
A61	Toxaphene	0.5
A62	Antimony	15
A63	Beryllium	0.75
A64	Chromium (VI)	5.0
A65	Cobalt	80.0
A66	Copper	25.0
A67	Molybdenum	350
A68	Nickel	20.0
A69	Thallium	7.0
A70	Vanadium	24.0
A71	Zinc	250
A72	Fluoride	180.0
A73	Aldrin	0.14
A74	Dichlorodiphenyltrichloroethane (DDT), Dichlorodiphenyldichloroethylene (DDE), Dichlorodiphenyldichloroethane (DDD)	0.1
A75	Dieldrin	0.8
A76	Kepone	2.1
A77	Mirex	2.1
A78	Polychlorinated biphenyls	5.0
A79	Dioxin (2,3,7,8-TCDD)	0.001

Class B: Based on Total Threshold Limit Concentration (TTLC)

Class	Constituent	Concentration in mg/kg
(1)	**(2)**	**(3)**
B1	Asbestos	10000
B2	Total Petroleum Hydrocarbons (TPH) (C5 - C36)	5,000

Note:

(1) The testing method for list of constituents at A1 to A61 in Class-A, shall be based on Toxicity Characteristic Leaching Procedure (TCLP) and for extraction of leachable constituents, USEPA Test Method 1311 shall be used.
(2) The testing method for list of constituents at A62 to A79 in Class- A, shall be based on Soluble Threshold Limit Concentration (STLC) and Waste Extraction Test (WET) Procedure given in Appendix II of section 66261 of Title 22 of California Code regulation (CCR) shall be used.
(3) In case of ammonia (A10), cyanide (A11) and chromium VI (A64), extractions shall be conducted using distilled water in place of the leaching media specified in the TCLP/STLC procedures.
(4) A summary of above specified leaching/extraction procedures is included in manual for characterization and analysis of hazardous waste published by Central Pollution Control Board and in case the method is not covered in the said manual, suitable reference method may be adopted for the measurement.
(5) In case of asbestos, the specified concentration limits apply only if the substances are in a friable, powdered or finely divided state.
(6) The hazardous constituents to be analyzed in the waste shall be relevant to the nature of the industry and the materials used in the process.
(7) Wastes which contain any of the constituents listed below shall be considered as hazardous, provided they exhibit the characteristics listed in Class-C of this Schedule :

1.	Acid Amides
2.	Acid anhydrides
3.	Amines
4.	Anthracene
5.	Aromatic compounds other than those listed in Class A
6.	Bromates, (hypo-bromites)
7.	Chlorates (hypo-chlorites)
8.	Carbonyls
9.	Ferro-silicate and alloys
10.	Halogen- containing compounds which produce acidic vapours on contact with humid air or water e.g. silicon tetrachloride, aluminum chloride, titanium tetrachloride
11.	Halogen- silanes
12.	Halogenated Aliphatic Compounds
13.	Hydrazine (s)

14.	Hydrides
15.	Inorganic Acids
16.	Inorganic Peroxides
17.	Inorganic Tin Compounds
18.	Iodates
19.	(Iso- and thio-) Cyanates
20.	Manganese-silicate
21.	Mercaptans
22.	Metal Carbonyls
23.	Metal hydrogen sulphates
24.	Nitrides
25.	Nitriles
26.	Organic azo and azooxy Compounds
27.	Organic Peroxides
28.	Organic Oxygen Compounds
29.	Organic Sulphur Compounds
30.	Organo- Tin Compounds
31.	Organo nitro- and nitroso compounds
32.	Oxides and hydroxides except those of hydrogen, carbon, silicon, iron, aluminum, titanium, manganese, magnesium, calcium
33.	Phenanthrene
34.	Phenolic Compounds
35.	Phosphate compounds except phosphates of aluminum, calcium and iron
36.	Salts of pre-acids
37.	Total Sulphur
38.	Tungsten Compounds
39.	Tellurium and tellurium compounds
40.	White and Red Phosphorus
41.	2-Acetylaminofluorene
42.	4-Aminodiphenyl
43.	Benzidine and its salts
44.	Bis (Chloromethyl) ether
45.	Methyl chloromethyl ether
46.	1,2-Dibromo-3-chloropropane
47.	3,3'-Dichlorobenzidine and its salts
48.	4-Dimethylaminoazobenzene
49.	4-Nitrobiphenyl
50.	Beta-Propiolactone

CLASS C : Based on hazardous Characteristics

Apart from the concentration limit given above, the substances or wastes shall be classified as hazardous waste if it exhibits any of the following characteristics due to the presence of any hazardous constituents:

Class C1: Flammable- A waste exhibits the characteristic of flammability or ignitability if a representative sample of the waste has any of the following properties, namely:-

(i) flammable liquids, or mixture of liquids, or liquids containing solids in solution or suspension (for example, paints, varnishes, lacquers, etc; but not including substances or wastes otherwise classified on account of their dangerous characteristics), which give off a flammable vapour at temperature less than 60°C. This flash point shall be measured as per ASTM D 93-79 closed-cup test method or as determined by an equivalent test method published by Central Pollution Control Board;

(ii) it is not a liquid and is capable, under standard temperature and pressure, of causing fire through friction, absorption of moisture or spontaneous chemical changes and, when ignited, burns vigorously and persistently creating a hazard;

(iii) it is an ignitable compressed gas;

(iv) It is an oxidizer and for the purposes of characterisation is a substance such as a chlorate, permanganate, inorganic peroxide, or a nitrate, that yields oxygen readily to stimulate the combustion of organic matter.

Class C2: Corrosive- A waste exhibits the characteristic of corrosivity if a representative sample of the waste has either of the following properties, namely:-

(i) it is aqueous and has a pH less than or equal to 2 or greater than or equal to 12.5;

(ii) it is a liquid and corrodes steel (SAE 1020) at a rate greater than 6.35 mm per year at a test temperature of 55 °C;

(iii) it is not aqueous and, when mixed with an equivalent weight of water, produces a solution having a pH less than or equal to 2 or greater than or equal to 12.5;

(iv) it is not a liquid and, when mixed with an equivalent weight of water, produces a liquid that corrodes steel (SAE1020) at a rate greater than 6.35 mm per year at a test temperature of 55 °C.

Note:

For the purpose of determining the corrosivity, the Bureau of Indian Standard 9040 C method for pH determination, NACE TM 01 69 : Laboratory Corrosion Testing of Metals and EPA 1110A method for corrosivity towards steel (SAE1020) to establish the corrosivity characteristics shall be adopted.

Class C3: Reactive or explosive- A waste exhibits the characteristic of reactivity if a representative sample of the waste it has any of the following properties, namely:-

(i) it is normally unstable and readily undergoes violent change without detonating;

(ii) it reacts violently with water or forms potentially explosive mixtures with water;

(iii) when mixed with water, it generates toxic gases, vapours or fumes in a quantity sufficient to present a danger to human health or the environment;

(iv) it is a cyanide or sulphide bearing waste which, when exposed to pH conditions between 2 and 12.5, can generate toxic gases, vapours or fumes in a quantity sufficient to present a danger to human health or the environmental;

(v) it is capable of detonation or explosive reaction if it is subjected to a strong initiating source or if heated under confinement;

(vi) it is readily capable of detonation or explosive decomposition or reaction at standard temperature and pressure;

(vii) it is a forbidden explosive.

Class C4: Toxic- A waste exhibits the characteristic of toxicity, if, :-

(i) the concentration of the waste constituents listed in Class A and B (of this schedule) are equal to or more than the permissible limits prescribed therein;
(ii) it has an acute oral LD50 less than 2,500 milligrams per kilogram;
(iii) it has an acute dermal LD50 less than 4,300 milligrams per kilogram;
(iv) it has an acute inhalation LC50 less than 10,000 parts per million as a gas or vapour;
(v) it has acute aquatic toxicity with 50% mortality within 96 hours for zebra fish (*Brachidanio rerio*) at a concentration of 500 milligrams per litre in dilution water and test conditions as specified in BIS test method 6582 – 2001.
(vi) it has been shown through experience or by any standard reference test- method to pose a hazard to human health or environment because of its carcinogenicity, mutagenecity, endocrine disruptivity, acute toxicity, chronic toxicity, bio-accumulative properties or persistence in the environment.

Class C5: Substances or Wastes liable to spontaneous combustion - Substances or Wastes which are liable to spontaneous heating under normal conditions encountered in transport, or to heating up on contact with air, and being then liable to catch fire.

Class C6: Substances or Wastes which, in contact with water emit flammable gases- Substances or Wastes which, by interaction with water, are liable to become spontaneously flammable or to give off flammable gases in dangerous quantities.

Class C5: Oxidizing - Substances or Wastes which, while in themselves not necessarily combustible, may, generally by yielding oxygen cause, or contribute to, the combustion of other materials.

Class C8: Organic Peroxides - Organic substances or Wastes which contain the bivalent O−O structure, which may undergo exothermic self-accelerating decomposition.

Class C9: Poisons (acute) - Substances or Wastes liable either to cause death or serious injury or to harm human health if swallowed or inhaled or by skin contact.

Class C10: Infectious ~~substances~~ - Substances or Wastes containing viable micro-organisms or their toxins which are known or suspected to cause disease in animals or humans.

Class C11: Liberation of toxic gases in contact with air or water - Substances or Wastes which, by interaction with air or water, are liable to give off toxic gases in dangerous quantities.

Class C12: Eco-toxic- Substances or Wastes which if released, present or may present immediate or delayed adverse impacts to the environment by means of bioaccumulation or toxic effects upon biotic systems or both.

Class C13: Capable, by any means, after disposal, of yielding another material, e.g., leachate, which possesses any of the characteristics listed above.

SCHEDULE III

[See rules 3 (1) (17) (iii), 3 (23), 12, 13 and 14]

Part A

List of hazardous wastes applicable for import and export with Prior Informed Consent [Annexure VIII of the Basel Convention*]

Basel No.	Description of Hazardous Wastes
(1)	**(2)**
A1	**Metal and Metal bearing wastes**
A1010	Metal wastes and waste consisting of alloys of any of the following but excluding such wastes specifically listed in Part B and Part D
	- Antimony
	- Cadmium
	- Lead
	- Tellurium
A1020	Waste having as constituents or contaminants, excluding metal wastes in massive form, any or the following:
	- Antimony, antimony compounds
	- Cadmium, cadmium compounds
	- Lead, lead compounds
	- Tellurium, tellurium compounds
A1040	Waste having metal carbonyls as constituents
A1050	Galvanic sludges
A1070	Leaching residues from zinc processing, dust and sludges such as jarosite, hematite, etc.
A1080	Waste zinc residues not included in Part B, containing lead and cadmium in concentrations sufficient to exhibit hazard characteristics indicated in Part C
A1090	Ashes from the incineration of insulated copper wire
A1100	Dusts and residues from gas cleaning systems of copper smelters
A1120	Waste sludges, excluding anode slimes, from electrolyte purification systems in copper electrorefining and electrowinning operations
A1140	Waste cupric chloride and copper cyanide catalysts not in liquid form note the related entry in Schedule VI
A1150	Precious metal ash from incineration of printed circuit boards not included in Part B
A1160	Waste lead acid batteries, whole or crushed
A1170	Unsorted waste batteries excluding mixtures of only Part B batteries. Waste batteries not specified in Part B containing constituents mentioned in Schedule II to an extent to render them hazardous
A2	**Wastes containing principally inorganic constituents, which may contain metals and organic materials**
A2010	Glass waste from cathode-ray tubes and other activated glasses
A2030	Waste catalysts but excluding such wastes specified in Part B
A3	**Wastes containing principally organic constituents, which may contain metals and inorganic materials**
A3010	Waste from the production or processing of petroleum coke and bitumen
A3020	Waste mineral oils unfit for their originally intended use
A3050	Wastes from production, formulation and use of resins, latex, plasticizers, glues or adhesives excluding such wastes specified in Part B (B4020)
A3120	Fluff-light fraction from shredding

(1)	(2)
A3130	Waste organic phosphorus compounds
A4	**Wastes which may contain either inorganic or organic constituents**
A4010	Wastes from the production, preparation and use of pharmaceutical products but excluding such waste specified in Part B
A4040	Wastes from the manufacture, formulation and use of wood-preserving chemicals (does not include wood treated with wood preserving chemicals)
A4070	Waste from the production, formulation and use of inks, dyes, pigments, paints, lacquers, varnish excluding those specified in Part B (B4010)
A4100	Wastes from industrial pollution control devices for cleaning of industrial off-gases but excluding such wastes specified in Part B
A4120	Wastes that contain, consist of or are contaminated with peroxides.
A4130	Wastes packages and containers containing Schedule II constituents in concentration sufficient to exhibit Part C of Schedule III hazard characteristics.
A4140	Waste consisting of or containing off specification or outdated chemicals (unused within the period recommended by the manufacturer) corresponding to constituents mentioned in Schedule II and exhibiting Part C of Schedule III hazard characteristics.
A4160	Spent activated carbon not included in Part B, B2060

*This List is based on Annexure VIII of the Basel Convention on Transboundary Movement of Hazardous Wastes and comprises of wastes characterized as hazardous under Article I, paragraph 1(a) of the Convention. Inclusion of wastes on this list does not preclude the use of hazard.

Characteristics given in Annexure VIII of the Basel Convention (Part C of this Schedule) to demonstrate that the wastes are not hazardous. **Hazardous wastes in Part-A are restricted and cannot be allowed to be imported without permission from the Ministry of Environment, Forest and Climate Change and the Directorate General of Foreign Trade license, if applicable.**

Part B

List of other wastes applicable for import and export and not requiring Prior Informed Consent [Annex IX of the Basel Convention*]

Basel No.	Description of wastes
(1)	(2)
B1	**Metal and metal-bearing wastes**
B1010	Metal and metal-alloy wastes in metallic, non-dispersible form:
	- Thorium scrap
	- Rare earths scrap
B1020	Clean, uncontaminated metal scrap, including alloys, in bulk finished form (sheet, plates, beams, rods, etc.), of:
	- Antimony scrap
	- Beryllium scrap
	- Cadmium scrap
	- Lead scrap (excluding lead acid batteries)
	- Selenium scrap
	- Tellurium scrap
B1030	Refractory metals containing residues

(1)	(2)
B1031	Molybdenum, tungsten, titanium, tantalum, niobium and rhenium metal and metal alloy wastes in metallic dispersible form (metal powder), excluding such wastes as specified in Part A under entry A1050, Galvanic sludges
B1040	Scrap assemblies from electrical power generation not contaminated with lubricating oil, PCB or PCT to an extent to render them hazardous
B1050	Mixed non-ferrous metal, heavy fraction scrap, containing cadmium, antimony, lead & tellurium mentioned in Schedule II in concentrations sufficient to exhibit Part C characteristics
B1060	Waste selenium and tellurium in metallic elemental form including powder
B1070	Waste of copper and copper alloys in dispersible form, unless they contain any of the constituents mentioned in Schedule II to an extent that they exhibit Part C characteristics
B1080	Zinc ash and residues including zinc alloys residues in dispersible form unless they contain any of the constituents mentioned in Schedule II in concentration such as to exhibit Part C characteristics
B1090	Waste batteries conforming to a standard battery specification, excluding those made with lead, cadmium or mercury
B1100	Metal bearing wastes arising from melting, smelting and refining of metals:
	- Slags from copper processing for further processing or refining containing arsenic, lead or cadmium
	- Slags from precious metals processing for further refining
	- Wastes of refractory linings, including crucibles, originating from copper smelting
	- Tantalum-bearing tin slags with less than 0.5% tin
B1110	Used Electrical and electronic assemblies other than those listed in Part D of Schedule III
	Electronic assemblies consisting only of metals or alloys Waste electrical and electronic assemblies or scrap (including printed circuit boards) not containing components such as accumulators and other batteries included in Part A of Schedule III, mercury-switches, glass from cathode-ray tubes and other activated glass and PCB-capacitors, or not contaminated with Schedule II constituents such as cadmium, mercury, lead, polychlorinated biphenyl) or from which these have been removed, to an extent that they do not possess any of the characteristics contained in Part C of Schedule III (note the related entry in Schedule VI, A1180)
B1120	Spent catalysts excluding liquids used as catalysts, containing any of: Transition metals, excluding waste catalysts (spent catalysts, liquid used catalysts or other catalysts) in Part A and Schedule VI: - Scandium - Titanium - Vanadium - Chromium - Manganese - Iron - Cobalt - Nickel - Copper - Zinc - Yttrium - Zirconium - Niobium - Molybdenum - Hafnium - Tantalum

(1)	(2)
	- Tungsten - Rhenium Lanthanides (rare earth metals): - Lanthanum - Cerium
	- Praseodymium - Neodymium - Samarium - Europium - Gadolinium - Terbium - Dysprosium - Holmium - Erbium - Thulium - Ytterbium - Lutetium
B1130	Cleaned spent precious metal bearing catalysts
B1140	Precious metal bearing residues in solid form which contain traces of inorganic cyanides
B1150	Precious metals and alloy wastes (gold , silver, the platinum group but not mercury) in a dispersible form, non-liquid form with appropriate packaging and labelling
B1160	Precious metal ash from the incineration of printed circuit boards (note the related entry in Part A A1150)
B1170	Precious metal ash from the incineration of photographic film
B1180	Waste photographic film containing silver halides and metallic silver
B1190	Waste photographic paper containing silver halides and metallic silver
B1200	Granulated slag arising from the manufacture of iron and steel
B1210	Slag arising from the manufacture of iron and steel including slags as a source of Titanium dioxide and Vanadium
B1220	Slag from zinc production, chemically stabilised, having a high iron content (above 20%) and processed according to industrial specifications mainly for construction
B1230	Mill scale arising from the manufacture of iron and steel
B1240	Copper Oxide mill-scale
B2	**Wastes containing principally inorganic constituents, which may contain metals and organic materials**
B2010	Wastes from mining operations in non-dispersible form:
	- Natural graphite waste
	- Slate wastes
	- Mica wastes
	- Leucite, nepheline and nepheline syenite waste
	- Feldspar waste
	- Fluorspar waste
	- Silica wastes in solid form excluding those used in foundry operations
B2020	Glass wastes in non-dispersible form: - Cullet and other waste and scrap of glass except for glass from cathode-ray tubes and other activated glasses
B2030	Ceramic wastes in non-dispersible form: - Cermet wastes and scrap (metal ceramic composites) - Ceramic based fibres
B2040	Other wastes containing principally inorganic constituents: - Partially refined calcium sulphate produced from flue gas desulphurization (FGD) - Waste gypsum wallboard or plasterboard arising from the demolition of buildings

(1)	(2)
	- Slag from copper production, chemically stabilized, having a high iron content (above 20%) and processed according to industrial specifications mainly for construction and abrasive applications - Sulphur in solid form - Limestone from production of calcium cyanamide (pH<9) - Sodium, potassium, calcium chlorides - Carborundum (silicon carbide) - Broken concrete - Lithium-tantalum and lithium-niobium containing glass scraps
B2060	Spent activated carbon not containing any of Schedule II constituents to the extent they exhibit Part C characteristics, for example, carbon resulting from the treatment of potable water and processes of the food industry and vitamin production (note the related entry in Part A A4160)
B2070	Calcium fluoride sludge
B2080	Waste gypsum arising from chemical industry processes not included in Schedule VI (note the related entry in A2040)
B2090	Waste anode butts from steel or aluminium production made of petroleum coke or bitumen and cleaned to normal industry specifications (excluding anode butts from chlor alkali electrolyses and from metallurgical industry)
B2100	Waste hydrates of aluminium and waste alumina and residues from alumina production, excluding such materials used for gas cleaning, flocculation or filtration processes
B2130	Bituminous material (asphalt waste) from road construction and maintenance, not containing tar (note the related entry in Schedule VI, A3200)
B3	**Wastes containing principally organic constituents, which may contain metals and inorganic materials**
B3027	Self-adhesive label laminate waste containing raw materials used in label material production
B3030	Textile wastes The following materials, provided they are not mixed with other wastes and are prepared to a specification: - Silk waste (including cocoons unsuitable for reeling, yarn waste and garnetted stock) • not carded or combed • other - Waste of wool or of fine or coarse animal hair, including yarn waste but excluding garnetted stock • noils of wool or of fine animal hair • other waste of wool or of fine animal hair • waste of coarse animal hair - Cotton waste (including yarn waste and garnetted stock) • yarn waste (including thread waste) • garnetted stock • other - Flax tow and waste - Tow and waste (including yarn waste and garnetted stock) of true hemp (Cannabis sativa L.) - Tow and waste (including yarn waste and garnetted stock) of jute and other textile bast fibres (excluding flax, true hemp and ramie) - Tow and waste (including yarn waste and garnetted stock) of sisal

(1)	(2)
	and other textile fibres of the genus Agave - Tow, noils and waste (including yarn waste and garneted stock) of coconut - Tow, noils and waste (including yarn waste and garneted stock) of abaca (Manila hemp or Musa textilis Nee) - Tow, noils and waste (including yarn waste and garneted stock) of ramie and other vegetable textile fibres, not elsewhere specified or included - Waste (including noils, yarn waste and garnetted stock) of man-made fibres • of synthetic fibres • of artificial fibres - Worn clothing and other worn textile articles - Used rags, scrap twine, cordage, rope and cables and worn out articles of twine, cordage, rope or cables of textile materials • sorted • other
B3035	Waste textile floor coverings, carpets
B3040	Rubber Wastes The following materials, provided they are not mixed with other wastes: - Waste and scrap of hard rubber (e.g., ebonite) - Other rubber wastes (excluding such wastes specified elsewhere)
B3050	Untreated cork and wood waste: - Wood waste and scrap, whether or not agglomerated in logs, briquettes, pellets or similar forms - Cork waste: crushed, granulated or ground cork
B3060	Wastes arising from agro-food industries provided it is not infectious: - Wine lees - Dried and sterilized vegetable waste, residues and by-products, whether or not in the form of pellets, of a kind used in animal feeding, not elsewhere specified or included - Degras: residues resulting from the treatment of fatty substances or animal or vegetable waxes - Waste of bones and horn-cores, unworked, defatted, simply prepared (but not cut to shape), treated with acid or degelatinised - Fish waste - Cocoa shells, husks, skins and other cocoa waste - Other wastes from the agro-food industry excluding by-products which meet national and international requirements and standards for human or animal consumption
B3070	The following wastes: - Waste of human hair - Waste straw - Deactivated fungus mycelium from penicillin production to be used as animal feed
B3080	Waste parings and scrap of rubber
B3090	Paring and other wastes of leather or of composition leather not suitable for the manufacture of leather articles, excluding leather sludges, not containing hexavalent chromium compounds and biocides (note the related entry in Schedule VI, A3100)

(1)	(2)
B3100	Leather dust, ash, sludges or flours not containing hexavalent chromium compounds or biocides (note the related entry in Schedule VI, A3090)
B3110	Fellmongery wastes not containing hexavalent chromium compounds or biocides or infectious substances (note the related entry in Schedule VI, A3110)
B3120	Wastes consisting of food dyes
B3130	Waste polymer ethers and waste non-hazardous monomer ethers incapable of forming peroxides
B3140	Waste pneumatic and other tyres, excluding those which do not lead to resource recovery, recycling, reclamation but not for direct reuse
B4	**Wastes which may contain either inorganic or organic constituents**
B4010	Wastes consisting mainly of water-based or latex paints, inks and hardened varnishes not containing organic solvents, heavy metals or biocides to an extent to render them hazardous (note the related entry in Part A, A4070)
B4020	Wastes from production, formulation and use of resins, latex, plasticizers, glues or adhesives, not listed in Part A, free of solvents and other contaminants to an extent that they do not exhibit Part C characteristics (note the related entry in Part A, A3050)
B4030	Used single-use cameras, with batteries not included in Part A

* This list is based on Annexure IX of the Basel Convention on Transboundary Movement of Hazardous Wastes and comprises of wastes not characterized as hazardous under Article-I of the Basel Convention. **The wastes in Part- B are restricted and cannot be allowed to be imported without permission from the Ministry of Environment, Forest and Climate Change and the Directorate General of Foreign Trade license, if applicable.**

Note:

(1) Copper dross containing copper greater than 65% and lead and Cadmium equal to or less than 1.25% and 0.1% respectively; spent cleaned metal catalyst containing copper; and copper reverts, cake and residues containing lead and cadmium equal to or less than 1.25% and 0.1% respectively are allowed for import without Director General of Foreign Trade license to units (actual users) authorised by State Pollution Control Board and with the Ministry of Environment, Forest and Climate Change's permission. Copper reverts, cake and residues containing lead and cadmium greater than 1.25% and 0.1% respectively are under restricted category for which import is permitted only against Director General of Foreign Trade license for the purpose of processing or reuse by units permitted with the Ministry of Environment, Forest and Climate Change (actual users).

(2) Zinc ash or skimmings in dispersible form containing zinc more than 65% and lead and cadmium equal to or less than 1.25% and 0.1% respectively and spent cleaned metal catalyst containing zinc are allowed for import without Director General of Foreign Trade license to units authorised by State Pollution control Board, Ministry of Environment, Forest and Climate Change's permission (actual users) upto an annual quantity limit indicated in registration letter. Zinc ash and skimmings containing less than 65% zinc and lead and cadmium equal to or more than 1.25% and 0.1% respectively and hard zinc spelter and brass dross containing lead greater than 1.25% are under restricted category for which import is permitted against Director General of Foreign Trade license and only for purpose of processing or reuse by units registered with the Ministry of Environment Forest and Climate Change (actual users).

Part C
List of Hazardous Characteristics

Code	Characteristic
H 1	**Explosive**

An explosive substance or waste is a solid or liquid substance or waste (or mixture of substances or wastes) which is in itself capable by chemical reaction of producing gas at such a temperature and pressure and at such a speed as to cause damage to the surrounding.

H 3 Flammable liquids

The word "flammable" has the same meaning as "inflammable". Flammable liquids are liquids, or mixtures of liquids, or liquids containing solids in solution or suspension (for example, paints, varnishes, lacquers, etc. but not including substances or wastes otherwise classified on account of their dangerous characteristics) which give off a flammable vapour at temperatures of not more than 60.5ºC, closed-cup test, or not more than 65.6ºC, open-cup test. (Since the results of open-cups tests and of closed-cup tests are not strictly comparable and even individual results by the same test are often variable, regulations varying from the above figures to make allowance for such differences would be within the spirit of this definition).

H 4.1 Flammable solids

Solids, or waste solids, other than those classed as explosives, which under conditions encountered in transport are readily combustible, or may cause or contribute to fire through friction.

H 4.2 Substances or wastes liable to spontaneous combustion

Substances or wastes which are liable to spontaneous heating under normal conditions encountered in transport, or to heating up on contact with air, and being then liable to catch fire.

H 4.3 Substances or wastes which, in contact with water emit flammable gases

Substances or wastes which, by interaction with water, are liable to become spontaneously flammable or to give off flammable gases in dangerous quantities.

H 5.1 Oxidizing

Substances or wastes which, while in themselves not necessarily combustible, may, generally by yielding oxygen cause, or contribute to, the combustion or other materials.

H 5.2 Organic Peroxides

Organic substances or wastes which contain the bivalent-o-o-structure are thermally unstable substances which may undergo exothermic self-accelerating decomposition.

H 6.1 **Poisons (acute)**

Substances or wastes liable either to cause death or serious injury or to harm human health if swallowed or inhaled or by skin contact.

H 6.2 **Infectious substances**

Substances or wastes containing viable micro-organisms or their toxins which are known or suspected to cause disease in animals or humans.

H 8 **Corrosives**

Substances or wastes which, by chemical action, will cause severe damage when in contact with living tissue, or, in the case of leakage, will materially damage, or even destroy, other goods or the means of transport; they may also cause other hazards.

H 10 **Liberation of toxic gases in contact with air or water**

Substances or wastes which, by interaction with air or water, are liable to give off toxic gases in dangerous quantities.

H 11 **Toxic (delayed or chronic)**

Substances or wastes which, if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects, including carcinogenicity).

H 12 **Eco-toxic**

Substances or wastes which if released, present or may present immediate or delayed adverse impacts to the environment by means of bioaccumulation or toxic effects upon biotic systems or both.

H 13 **Capable,** by any means, after disposal, of yielding another material, e.g., leachate, which possesses any of the characteristics listed above.

Part D

List of other wastes applicable for import and export without permission from Ministry of Environment, Forest and Climate Change [Annex IX of the Basel Convention*]

Basel No.	Description of wastes
(1)	(2)
B1	**Metal and metal-bearing wastes**
B1010	Metal and metal-alloy wastes in metallic, non-dispersible form :
	- Precious metals (gold, silver, platinum but not mercury) * *
	- Iron and steel scrap * *
	- Nickel scrap * *
	- Aluminium scrap* *
	- Zinc scrap * *
	- Tin scrap * *
	- Tungsten scrap * *
	- Molybdenum scrap * *
	- Tantalum scrap * *
	- Cobalt scrap * *
	- Bismuth scrap * *
	- Titanium scrap * *
	- Zirconium scrap * *
	- Manganese scrap * *
	- Germanium scrap * *
	- Vanadium scrap * *
	- Hafnium scrap * *
	- Indium scrap * *
	- Niobium scrap * *
	- Rhenium scrap * *
	- Gallium scrap * *
	- Magnesium scrap * *
	- Copper scrap * *
	- Chromium scrap * *
B1050	Mixed non-ferrous metal, heavy fraction scrap, containing metals other than specified in Part B1050 and not containing constituents mentioned in Schedule II in concentrations sufficient to exhibit Part C characteristics* *
B1100	Metal bearing wastes arising from melting, smelting and refining of metals:
	- Hard Zinc spelter * *
	- Zinc-containing drosses * *: ~ Galvanizing slab zinc top dross (>90% Zn) ~ Galvanizing slab zinc bottom dross (>92% Zn) ~ Zinc die casting dross (>85% Zn) ~ Hot dip galvanizers slab zinc dross (batch) (>92% Zn) ~ Zinc skimmings
	– Aluminium skimmings (or skims) excluding salt slag

(1)	(2)
B1110	Electrical and electronic assemblies (including printed circuit boards, electronic components and wires) destined for direct reuse and not for recycling or final disposal
	- Used electrical and electronic assemblies imported for repair and to be re-exported back after repair within one year of import * * *
	- Used electrical and electronic assemblies imported for rental purpose and re-exported back within one year of import * * *
	- Used electrical and electronic assemblies exported for repair and to be re-import after repair
	- Used electrical and electronic assemblies imported for testing, research and development, project work purposes and to be re-exported back within a period of three years from the date of import * * *
	- Spares imported for warranty replacements provided equal number of defective or non-functional parts are exported back within one year of the import * * *
	- Used electrical and electronic assemblies imported by Ministry of Defence, Department of Space and Department of Atomic Energy * * *
	- Used electrical and electronic assemblies (not in bulk; quantity less than or equal to three) imported by the individuals for their personal uses
	- Used Laptop, Personal Computers, Mobile, Tablet up to 01 number each imported by organisations in a year
	- Used electrical and electronic assemblies owned by individuals and imported on transfer of residence
	- Used multifunction print and copying machines (MFDs)* * * *
	- Used electrical and electronic assemblies imported by airlines for aircraft maintenance and remaining either on board or under the custodianship of the respective airlines warehouses located on the airside of the custom bonded areas.
B3	**Wastes containing principally organic constituents, which may contain metals and inorganic materials**
B3020	Paper, paperboard and paper product wastes * * The following materials, provided they are not mixed with hazardous wastes: Waste and scrap of paper or paperboard of: - unbleached paper or paperboard or of corrugated paper or paperboard - other paper or paperboard, made mainly of bleached chemical pulp, not coloured in the mass - paper or paperboard made mainly of mechanical pulp (for example newspapers, journals and similar printed matter) - other, including but not limited to (1) laminated paperboard (2) unsorted scrap
B3140	Aircraft Tyres exported to Original Equipment Manufacturers for re-treading and re-imported after re-treading by airlines for aircraft maintenance and remaining either on board or under the custodianship of the respective airlines warehouses located on the airside of the custom bonded areas

Note:

* This list is based on Annexure IX of the Basel Convention on Transboundary Movement of Hazardous Wastes and comprises of wastes not characterized as hazardous under Article-I of the Basel Convention.

* * Import permitted in the country to the actual user or to the trader on behalf of the actual users authorised by SPCB on one time basis and subject to verification of documents specified in Schedule VIII of these rules by the Custom Authority.

* * * Import permitted in the country only to the actual users from Original Equipment Manufacturers (OEM) and subject to verification of documents specified in Schedule VIII of these rules by the Custom Authority.

* * * * Import permitted in the country to the actual users or trader on behalf of the actual user in accordance with the documents required and verified by the Custom Authority as specified under Schedule VIII of these rules. The policy for free trade for multifunction print and copying machine to be reviewed once the MFDs are domestically manufactured.

All other wastes listed in Part D of Schedule III having no "Stars" are permitted without any documents from MoEF&CC subject to compliance of the conditions of the Customs Authority, if any.

SCHEDULE IV

[*See rules 6 (1) (ii) and 6 (2)*]

List of commonly recyclable hazardous wastes

S.No.	Wastes
(1)	**(2)**
1.	Brass Dross
2.	Copper Dross
3.	Copper Oxide mill scale
4.	Copper reverts, cake and residue
5.	Waste Copper and copper alloys in dispersible from
6.	Slags from copper processing for further processing or refining
7.	Insulated Copper Wire Scrap or copper with PVC sheathing including ISRI-code material namely "Druid"
8.	Jelly filled Copper cables
9.	Spent cleared metal catalyst containing copper
10.	Spent catalyst containing nickel, cadmium, Zinc, copper, arsenic, vanadium and cobalt
11.	Zinc Dross-Hot dip Galvanizers SLAB
12.	Zinc Dross-Bottom Dross
13.	Zinc ash/Skimmings arising from galvanizing and die casting operations
14.	Zinc ash/Skimming/other zinc bearing wastes arising from smelting and refining
15.	Zinc ash and residues including zinc alloy residues in dispersible from
16.	Spent cleared metal catalyst containing zinc
17.	Used Lead acid battery including grid plates and other lead scrap/ashes/residues not covered under Batteries (Management and Handling) Rules, 2001. [Battery scrap, namely: Lead battery plates covered by ISRI, Code word "Rails" Battery lugs covered by ISRI, Code word "Rakes". Scrap drained/dry while intact, lead batteries covered by ISRI, Code word "rains".

(1)	(2)
18.	Components of waste electrical and electronic assembles comprising accumulators and other batteries included in Part A of Schedule III, mercury-switches, activated glass cullets from cathode-ray tubes and other activated glass and PCB-capacitors, or any other component contaminated with Schedule II constituents (e.g. cadmium, mercury, lead, polychlorinated biphenyl) to an extent that they exhibit hazard characteristics indicated in part C of Schedule III.
19.	Paint and ink Sludge/residues
20.	Used oil and waste oil

SCHEDULE V

[See rules 3 (36) and 3 (39)]

PART A
Specifications of Used Oil Suitable for recycling

S.No.	Parameter	Maximum permissible Limits
(1)	(2)	(3)
1.	Polychlorinated biphenyls (PCBs)	< 2ppm *
2.	Lead	100 ppm
3.	Arsenic	5 ppm
4.	Cadmium+Chromium+Nickel	500 ppm
5.	Polyaromatic hydrocarbons (PAH)	6%

Part B
Specification of fuel derived from waste oil

S.No.	Parameter	Maximum permissible limits
(1)	(2)	(3)
1.	Sediment	0.25%
2.	Lead	100 ppm
3.	Arsenic	5 ppm
4.	Cadmium+Chromium+Nickel	500 ppm
5.	Polyaromatic hydrocarbons (PAH)	6%
6.	Total halogents	4000 ppm
7.	Polychlorinated biphenyls (PCBs)	<2 ppm *
8.	Sulfur	4.5%
9.	Water Content	1%

***The detection limit is 2 ppm by gas Liquid Chromatography (GLC) using Electron Capture detector (ECD)**

SCHEDULE VI

[See rules 12 (6), 12 (7) and 14(1)]

Hazardous and Other wastes prohibited for import

Basel No	Description of hazardous and other wastes
(1)	**(2)**
A1	**Metal and Metal bearing wastes**
A1010	Metal wastes and waste consisting of alloys of any of the following but excluding such wastes specifically listed in Part B and Part D of Schedule III
	- Arsenic
	- Beryllium
	- Mercury
	- Selenium
	- Thallium
A1020	Wastes having as constituents or contaminants, excluding metal wastes in massive form, any of the following:
	- Beryllium; beryllium compounds
	- Selenium; selenium compounds
A1030	Wastes having as constituents or contaminants any of the following:
	- Arsenic; arsenic compounds
	- Mercury; mercury compounds
	- Thallium; thallium compounds
A1040	Waste having hexavalent chromium compounds as constituents
A1140	Waste cupric chloride and copper cyanide catalysts in liquid form (note the related entry in Part A of Schedule III)
A1060	Wastes liquors from the pickling of metals
A1110	Spent electrolytic solutions from copper electrorefining and electrowinning operations
A1130	Spent etching solutions containing dissolved copper
A1180	Waste electrical and electronic assembles or scrap (does not include scrap assemblies from electric power generation) containing components such as accumulators and other batteries included in Part A of Schedule III, mercury-switches, glass from cathode-ray tubes and other activated glass and PCB-capacitors, or contaminated with Schedule II constituents (e.g. cadmium, mercury, lead, polychlorinated biphenyl) to an extent that they exhibit hazard characteristics indicated in Part C of Schedule III (note the related entry in Part B B1110)
A1190	Waste metal cables coated or insulated with plastics containing or contaminated with coal tar, PCB, lead, cadmium, other organohalogen compounds or other constituents as mentioned in Schedule II to the extent that they exhibit hazard characteristics indicated in Part C of Schedule III
A2	**Wastes containing principally inorganic constituents, which may contain metals and organic materials**
A2020	Waste inorganic fluorine compounds in the form of liquids or sludges but excluding such wastes specified in Part B

(1)	(2)
A2040	Waste gypsum arising from chemical industry processes, if it contains any of the constituents mentioned in Schedule 2 to the extent that they exhibit hazard characteristics indicated in Part C of Schedule III (note the related entry in Part B B2080)
A2050	Waste asbestos (dusts and fibres)
A2060	Coal-fired power plant fly-ash containing Schedule II constituents in concentrations sufficient to exhibit Part C characteristics
A3	**Wastes containing principally organic constituents, which may contain metals and inorganic materials**
A3030	Wastes that contain, consist of or are contaminated with leaded anti-knock compounds sludges.
A3040	Waste thermal (heat transfer) fluids
A3060	Waste nitrocellulose
A3070	Waste phenols, phenol compounds including chlorophenol in the form of liquids or sludges
A3080	Waste ethers not including those specified in Part B
A3090	Waste leather dust, ash, sludges and flours when containing hexavalent chromium compounds or biocides (note the related entry in Part B B3100)
A3100	Waste paring and other waste of leather or of composition leather not suitable for the manufacture of leather articles, containing hexavalent chromium compound and biocides (note the related entry in Part B B3090)
A3110	Fellmongery wastes containing hexavalent chromium compounds or biocides or infectious substances (note the related entry in Part B B3110)
A3140	Waste non-halogenated organic solvents but excluding such wastes specified in Part B
A3150	Waste halogenated organic solvents
A3160	Waste halogenated or unhalogenated non-aqueous distillation residues arising from organic solvent recovery operations
A3170	Waste arising from the production of aliphatic halogenated hydrocarbons (such as chloromethane, dichloro-ethane, vinyl chloride, vinylidene chloride, allyl chloride and epichlorhydrin)
A3180	Wastes, substances and articles containing, consisting of or contaminated with polychlorinated biphenyl (PCB), polychlorinated terphenyl (PCT), polychlorinated naphthalene (PCN) or polybrominated biphenyl (PBB) or any other polybrominated analogues of these compounds
A3190	Waste tarry residues (excluding asphalt cements) arising from refining, distillation and any pyrolytic treatment of organic materials
A3200	Bituminous material (asphalt waste) from road construction and maintenance, containing tar (note the related entry in Part B, B2130)
A4	**Wastes which may contain either inorganic or organic constituents**
A4020	Clinical and related wastes; that is wastes arising from medical, nursing, dental, veterinary, or similar practices, and wastes generated in hospitals or other facilities during the investigation or treatment of patients, or research projects.
A4030	Waste from the production, formulation and use of biocide and phyto-pharmaceuticals, including waste pesticides and herbicides which are off-specification, out-dated (unused within the period recommended by the manufacturer), or unfit for their originally intended use,

(1)	(2)
A4050	Wastes that contain, consist of, or are contaminated with any of the following: - Inorganic cyanides, excepting precious-metal-bearing residues in solid form containing traces of inorganic cyanides. - Organic cyanides
A4060	Waste oils/water, hydrocarbons/water mixtures, emulsions
A4080	Wastes of an explosive nature (but excluding such wastes specified in Part B)
A4090	Waste acidic or basic solutions, other than those specified at B2120 of this Schedule
A4110	Wastes that contain, consist of or are contaminated with any of the following: - Any congenor of polychlorinated dibenzo-furan. - Any congenor of polychlorinated dibenzo-P-dioxin.
A4150	Waste chemical substances arising from research and development or teaching activities which are not identified and /or are new and whose effects on human health and /or the environment are not known
B1	**Metal and Metal bearing wastes**
B 1110	Used critical care medical equipment for re-use
B1115	Waste metal cables coated or insulated with plastics, not included in A1190 of this schedule, excluding those destined for operations which do not lead to resource recovery, recycling, reclamation, direct re-use or alternative uses or any other disposal operations involving, at any stage, uncontrolled thermal processes, such as open-burning.
B1250	Waste end-of-life motor vehicles, containing neither liquids nor other hazardous components
B2	**Wastes containing principally inorganic constituents, which may contain metals and organic materials**
B2050	Coal-fired power plant fly-ash, note the related entry at A2060 of this Schedule
B2110	Bauxite residue (red mud) (pH moderated to less than 11.5)
B2120	Waste acidic or basic solutions with a pH greater than 2 and less than 11.5, which are not corrosive or otherwise hazardous (note the related entry at A4090 of this schedule)
B3	**Wastes containing principally organic constituents, which may contain metals and inorganic materials**
B3010	Solid plastic waste The following plastic or mixed plastic waste, prepared to a specification: - Scrap plastic of non-halogenated polymers and co-polymers, including but not limited to the following: Ethylene, Styrene, Polypropylene, polyethylene terephthalate, Acrylonitrile, Butadiene, Polyacetals, Polyamides, polybutylene tere-phthalate, Polycarbonates, Polyethers, polyphenylene sulphides, acrylic polymers, alkanes C10-C13 (plasticiser), polyurethane (not containing CFC's), Polysiloxanes, polymethyl methacrylate, polyvinyl alcohol, polyvinyl butyral, Polyvinyl acetate - Cured waste resins or condensation products including the following: urea formaldehyde resins, phenol formaldehyde resins, melamine formaldehyde resins, epoxy resins, alkyd resins, polyamides - The following fluorinated polymer wastes (excluding post-consumer wastes):

(1)	(2)
	perfluoroethylene/ propylene, perfluoro alkoxy alkane, tetrafluoroethylene/per fluoro vinyl ether (PFA), tetrafluoroethylene/per fluoro methylvinyl ether (MFA), polyvinylfluoride , polyvinylidenefluoride
B3026	The following waste from the pre-treatment of composite packaging for liquids, not containing constituents mentioned in Schedule II in concentrations sufficient to exhibit Part C characteristics: - Non-separable plastic fraction - Non-separable plastic-aluminium fraction -
B3065	Waste edible fats and oils of animal or vegetable origin (e.g. frying oil)
B3140	Waste pneumatic tyres for direct reuse
Y 46	Wastes collected from household/municipal waste
Y 47	Residues arising from the incineration of household wastes

SCHEDULE VII

[*See rules 13 (6) and 21*]

List of authorities and corresponding duties

S. No.	Authority	Corresponding Duties
(1)	(2)	(3)
1.	Ministry of Environment, Forests and Climate Change under the Environment (Protection)Act, 1986	(i) Identification of hazardous and other wastes (ii) Permission to exporters of hazardous and other wastes (iii) Permission to importer of hazardous and other wastes (iv) Permission for transit of hazardous and other wastes through India. (v) Promote environmentally sound management of hazardous and other waste. (vi) Sponsoring of training and awareness programme on Hazardous and Other Waste Management related activities.
2.	Central Pollution Control Board constituted under the Water (Prevention and Control of Pollution) Act, 1974	(i) Co-ordination of activities of State Pollution Control Boards (ii) Conduct training courses for authorities dealing with management of hazardous and other wastes (iii) Recommend standards and specifications for treatment and disposal of wastes and leachates, recommend procedures for characterisation of hazardous wastes.

(1)	(2)	(3)
		(iv) Inspection of facilities handling hazardous waste as and when necessary. (v) Sector specific documentation to identify waste for inclusion in these rules. (vi) Prepare and update guidelines to prevent or minimise the generation and handling of hazardous and other wastes. (vii) Prepare and update guidelines/ Standard Operating Procedures (SoPs) for recycling, utilization, pre-processing, co-processing of hazardous and other wastes. (viii) To prepare annual review report on management of hazardous waste. (ix) Any other function assigned by the Ministry of Environment, Forest and Climate Change, from time to time.
3.	State Government/Union Territory Government/Administration	(i) Identification of site (s) for common Hazardous and Other Waste Treatment Storage and Disposal Facility (TSDF) (ii) Asses Environment Impact Assessment (EIA) reports and convey the decision of approval of site or otherwise Acquire the site or inform operator of facility or occupier or association of occupiers to acquire the site (iii) Notification of sites. (iv) Publish periodically an inventory of all potential or existing disposal sites in the State or Union Territory
4.	State Pollution Control Boards or Pollution Control Committees constituted under the Water (Prevention and Control of Pollution) Act, 1974	(i) Inventorisation of hazardous and other wastes (ii) Grant and renewal of authorisation (iii) Monitoring of compliance of various provisions and conditions of permission including conditions of permission for issued by Ministry of Environment, Forest and Climate Change for exports and imports (iv) Examining the applications for imports submitted by the importers and forwarding the same to Ministry of Environment, Forest and Climate Change (v) Implementation of programmes to prevent or reduce or minimise the generation of hazardous and other wastes. (vi) Action against violations of these rules. (vii) Any other function under these Rules assigned by Ministry of Environment, Forest and Climate Change from time to time.
5.	Directorate General of Foreign	(i) Grant of licence for import of hazardous

(1)	(2)	(3)
	Trade constituted under the Foreign Trade (Development and Regulation) Act, 1992	and other wastes (ii) Refusal of licence for hazardous and other wastes prohibited for imports and export
6.	Port authority under Indian Ports Act, 1908 (15 of 1908) and Customs Authority under the Customs Act, 1962 (52 of 1962)	(i) Verify the documents (ii) Inform the Ministry of Environment, Forests and Climate Change of any illegal traffic (iii) Analyse wastes permitted for imports and exports, wherever required. (iv) Train officials on the provisions of these rules and in the analysis of hazardous and other wastes (v) Take action against exporter or importer for violations under the Indian Ports Act, 1908 or Customs Act, 1962

SCHEDULE VIII

[*See rules 13(2) and 13 (4)*]

List of documents for verification by Customs for import of other wastes specified in Part D of Schedule III

S. No.	Basel No.	Description of other wastes	List of Documents
(1)	(2)	(3)	(4)
1	B1010	Metal and metal-alloy wastes in metallic, non-dispersible form: - Precious metals (gold, silver, platinum) - Iron and steel scrap - Nickel scrap - Aluminium scrap - Zinc scrap - Tin scrap - Tungsten scrap - Molybdenum scrap - Tantalum scrap - Cobalt scrap - Bismuth scrap - Titanium scrap - Zirconium scrap - Manganese scrap - Germanium scrap - Vanadium scrap - Hafnium scrap - Indium scrap - Niobium scrap - Rhenium scrap - Gallium scrap - Magnesium scrap - Copper scrap - Chromium scrap	(a) Duly filled up Form 6 - Movement document; (b) The import license from Directorate General of Foreign Trade, wherever applicable; (a) Pre-shipment inspection certificate issued by the inspection agency of the exporting country or the inspection and certification agency approved by Directorate General of Foreign Trade; (c) The valid consents to operate under the Air and Water Acts and the authorisation under these rules, for actual users. For traders, only valid one time authorisation from concerned SPCB is required; (d) The chemical analysis report of the waste being imported; (e) an acknowledged copy of the annual return filed with concerned State Pollution Control Board for import in the last financial year.

(1)	(2)	(3)	(4)
2	B1050	Mixed non-ferrous metal, heavy fraction scrap, containing metals other than specified in Part B1050 and not containing constituents mentioned in Schedule II in concentrations sufficient to exhibit Part C characteristics* *	(a) Duly filled up Form 6 - Movement document; (b) The import license from Directorate General of Foreign Trade, wherever applicable; (b) Pre-shipment inspection certificate issued by the inspection agency of the exporting country or the inspection and certification agency approved by Directorate General of Foreign Trade; (c) The valid consents to operate under the Air and Water Acts and the authorisation under these rules, for actual users. For traders, only valid authorisation from concerned SPCB is required; (d) The chemical analysis report of the waste being imported; (e) An acknowledged copy of the annual return filed with concerned SPCB for import in the last financial year.
3	B1100	Metal bearing wastes arising from melting, smelting and refining of metals: - Hard Zinc spelter - Zinc-containing drosses: ~ Galvanizing slab zinc top dross (>90% Zn) ~ Galvanizing slab zinc bottom dross (>92% Zn) ~Zinc die casting dross (>85% Zn) ~ Hot dip galvanizers slab zinc dross (batch) (>92% Zn) ~ Zinc skimmings − Aluminium skimmings (or skims) excluding salt slag	(c) Duly filled up Form 6 - Movement document; (d) The import license from Directorate General of Foreign Trade, wherever applicable; (e) Pre-shipment inspection certificate issued by the inspection agency of the exporting country or the inspection and certification agency approved by Directorate General of Foreign Trade; (f) The valid consents to operate under the Air and Water Acts and the authorisation under these rules, for actual users. For traders, only valid authorisation from concerned SPCB is required; (g) The chemical analysis report of the waste being imported; (h) An acknowledged copy of the annual return filed with concerned SPCB for import in the last financial year.
4	B1110	Electrical and electronic assemblies (including printed circuit boards, electronic components and wires) destined for direct reuse and not for recycling or final disposal	
(a)		Used electrical and electronic assemblies imported for repair and	(a) Duly filled up Form 6 - Movement document;

(1)	(2)	(3)	(4)
		to be re-exported after repair within one year of import	(b) Undertaking for re-export; (c) Details of previous import, if there has been any and confirmation regarding their re-export; (d) An acknowledged copy of the annual return filed with concerned SPCB for import in the last financial year (e) Certificate from exporting company for accepting the repaired and unrepairable electrical and electronic assemblies and the spares or part or component or consumables being re-exported.
(b)		Used electrical and electronic assemblies imported for rental purpose and re-exported back within one year of import	(a) Duly filled up Form 6 - Movement document; (b) Undertaking for re-export; (c) Details of previous import, if there has been any and confirmation regarding their re-export; (d) An acknowledged copy of the annual return filed with concerned SPCB for import in the last financial year
(c)		Used electrical and electronic assemblies exported for repair and to be re-imported after repair	(a) Duly filled up Form 6 - Movement document; (b) Proof of export of the defective electrical and electronic assemblies i.e. shipping or airway document authenticated by Customs
(d)		Used electrical and electronic assemblies imported for testing, research and development, project work purposes and to be re-exported back within a period of three years from the date of import	(a) Duly filled up Form 6 - Movement document; (b) Undertaking for re-export; (c) Details of previous import, if there has been any and confirmation regarding their re-export; (d) Chartered Engineer Certificate or certificate from accredited agency of exporting country indicating the functionality, manufacturing date, residual life and serial number; (e) an acknowledged copy of the annual return filed with concerned SPCB for import in the last financial year; (f) Certificate from exporting company for accepting the second hand functional or non-functional electrical and electronic assemblies and/or the spares or part or component or consumables being

(1)	(2)	(3)	(4)
			re-exported at the end of three years.
(e)		Spares imported for warranty replacements provided equal number of defective / non-functional parts are exported back within one year of the import.	(a) Duly filled up Form 6 - Movement document; (b) if refurbished components being imported as replacement to defective component then undertaking for export of equivalent numbers of defective components; (c) Details of previous import, if there has been any and confirmation regarding their re-export; (d) Certificate from exporting company for accepting the re-export of defective or non-functional spares or part or component or consumables being re-exported; (e) Documents on the declared policy regarding the use of second hand or refurbished spare parts for repair of electrical and electronic assemblies during warranty period.
(f)		Used electrical and electronic assemblies imported by Ministry of Defence, Department of Space and Department of Atomic Energy.	---
(g)		Used electrical and electronic assemblies (not in bulk; quantity less than or equal to three) imported by the individuals for their personal uses.	---
(h)		Used Laptop, Personal Computers, Mobile, Tablet up to 03 number each imported by organisations in a year.	---
(i)		Used electrical and electronic assemblies owned by individuals and imported on transfer of residence.	As per existing guidelines of Custom Authority
(j)		Used electrical and electronic assemblies, spares, imported by airlines for aircraft maintenance and remaining either on board or under the custodianship of the respective airlines warehouses located on the airside of the custom bonded areas.	----

(1)	(2)	(3)	(4)
(j)		Used multifunction print and copying machines (MFDs)*	(a) The country of Origin Certificate along with bill of lading and packaging; (b) The certificate issued by the inspection agency as certified by the exporting country or the inspection and certification agency approved by Directorate General Foreign Trade (DGFT) for functionality, having residual life of not less than five years and serial number; (c) Extended Producer Responsibility-Authorisation under e-waste (Management and Handling) Rules, 2011 as amended from time to time as Producer; (d) The MFDs shall be for printing A 3 size and above; (e) An acknowledged copy of the annual return filed with concerned SPCB for import in the last financial year.
5	B3020	Paper, paperboard and paper product wastes The following materials, provided they are not mixed with hazardous wastes: Waste and scrap of paper or paperboard of: - unbleached paper or paperboard or of corrugated paper or paperboard - other paper or paperboard, made mainly of bleached chemical pulp, not coloured in the mass - paper or paperboard made mainly of mechanical pulp (for example newspapers, journals and similar printed matter) - other, including but not limited to (1) laminated paperboard (2) unsorted scrap	(a) Duly filled up Form 6 – Movement document; (b) The import license from Directorate General of Foreign Trade, wherever applicable; (i) Pre-shipment inspection certificate issued by the inspection agency of the exporting country or the inspection and certification agency approved by Directorate General of Foreign Trade; (c) The valid consents to operate under the Air and Water Acts and the authorisation under these rules, for actual users. For traders, only valid authorisation from concerned SPCB is required; (d) The chemical analysis report of the waste being imported; (e) an acknowledged copy of the annual return filed with concerned State Pollution Control Board for import in the last financial year.
6.	B3140	Aircraft Tyres exported to Original Equipment Manufacturers for re-treading and re-imported after re-treading by airlines for aircraft	As per existing guidelines of Custom Authority

(1)	(2)	(3)	(4)
		maintenance and remaining either on board or under the custodianship of the respective airlines warehouses located on the airside of the custom bonded areas	

Note: * The policy for free trade for multifunction print and copying machine to be reviewed once the MFDs are domestically manufactured.

FORM 1

[See rule 6 (1)]

Application required for grant/renewal of authorisation for generation or collection or storage or transport or reception or recycling or reuse or recovery or pre-processing or co-processing or utilisation or treatment or disposal of hazardous and other waste

Part A: General (to be filled by all)

1. (a) Name and address of the unit and location of facility :
   (b) Name of the occupier of the facility or operator of disposal facility with designation, Tel, Fax and e-mail:
   (c) Authorisation required for (Please tick mark appropriate activity or activities:

(i) Generation	☐
(ii) Collection	☐
(iii) Storage	☐
(iv) Transportation	☐
(v) Reception	☐
(vi) Reuse	☐
(vii) Recycling	☐
(viii) Recovery	☐
(ix) Pre-processing	☐
(x) Co-processing	☐
(xi) Utilisation	☐
(xii) Treatment	☐
(xiii) Disposal	☐
(xiv) Incineration	☐

(d) In case of renewal of authorisation previous authorisation numbers and dates and provide copies of annual returns of last three years including the compliance reports with respect to the conditions of Prior Environmental Clearance, wherever applicable:

2. (a) Nature and quantity of waste handled per annum (in metric tonne or kilo litre)
   (b) Nature and quantity of waste stored at any time (in metric tonne or kilo litre)

3. (a) Year of commissioning and commencement of production:
   (b) Whether the industry works:

(i) 01 Shift	☐
(ii) 02 Shifts	☐
(iii) Round the clock	☐

4. Provide copy of the Emergency Response Plan (ERP) which should address procedures for dealing with emergency situations (viz. Spillage or release or fire) as specified in the guidelines of Central Pollution Control Board. Such ERP shall comprise the following, but not limited to:

- Containing and controlling incidents so as to minimise the effects and to limit danger to the persons, environment and property;
- Implementing the measures necessary to protect persons and the environment;
- Description of the actions which should be taken to control the conditions at events and to limit their consequences, including a description of the safety equipment and resources available;
- Arrangements for training staff in the duties which they are expected to perform;

- Arrangements for informing concerned authorities and emergency services; and
- Arrangements for providing assistance with off-site mitigatory action.

5. Provide undertaking or declaration to comply with all provisions including the scope of submitting bank guarantee in the event of spillage, leakage or fire while handling the hazardous and other waste.

Part B: To be filled by hazardous waste generators

1. (a) Products and by-products manufactured (names and product wise quantity per annum):
   (b) Process description including process flow sheet indicating inputs and outputs (raw materials, chemicals, products, by-products, wastes, emissions, waste water etc.) Please attach separate sheets:
   (c) Characteristics (waste-wise) and Quantity of waste generation per annum:
   (d) Mode of management of (c) above:
   i. Capacity and mode of secured storage within the plant;
   ii. Utilisation within the plant (provide details);
   iii. If not utilised within the plant, please provide details of what is done with this waste;
   iv. Arrangement for transportation to actual users/ TSDF;

   (e) Details of the environmental safeguards and environmental facilities provided for safe handling of all the wastes at point (c) above;

2. Hazardous and other wastes generated as per these rules from storage of hazardous chemicals as defined under the Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989

Part C: To be filled by Treatment, storage and disposal facility operators

1. Provide details of the facility including:
   (i) Location of site with layout map;
   (ii) Safe storage of the waste and storage capacity;
   (iii) The treatment processes and their capacities;
   (iv) Secured landfills;
   (v) Incineration, if any;
   (vi) Leachate collection and treatment system;
   (vii) Fire fighting systems;
   (viii) Environmental management plan including monitoring; and
   (ix) Arrangement for transportation of waste from generators.

2. Provide details of any other activities undertaken at the Treatment, storage and disposal facility site.

3. Attach a copy of prior Environmental Clearance.

Part D: To be filled by recyclers or pre-processors or co-processors or users of hazardous or other wastes

1. Nature and quantity of different wastes received per annum from domestic sources or imported or both:

2. Installed capacity as per registration issued by the District Industries Centre or any other authorised Government agency. Provide copy:

3. Provide details of secured storage of wastes including the storage capacity:

4. Process description including process flow sheet indicating equipment details, inputs and outputs (input wastes, chemicals, products, by-products, waste generated, emissions, waste water, etc.). Attach separate sheets:

5. Provide details of end users of products or by-products:

6. Provide details of pollution control systems such as Effluent Treatment Plant, scrubbers, etc. including mode of disposal of waste:

7. Provide details of occupational health and safety measures:

8. Has the facility been set up as per Central Pollution Control Board guidelines? If yes, provide a report on the compliance with the guidelines:

9. Arrangements for transportation of waste to the facility:

Signature of the Applicant
Designation

Date……..

Place…….

FORM 2

[See rule 6(2)]

FORM FOR GRANT OR RENEWAL OF AUTHORISATION BY STATE POLLUTION CONTROL BOARD TO THE OCCUPIERS, RECYCLERS, REPROCESSORS, REUSERS, USER AND OPERATORS OF DISPOSAL FACILITIES

1. Number of authorisation and date of issue :
2. Reference of application (No. and date) :
3. ……of …….is hereby granted an authorisation based on the enclosed signed inspection report for generation, collection, reception, storage, transport, reuse, recycling, recovery, pre-processing, co-processing, utilisation, treatment, disposal or any other use of hazardous or other wastes or both on the premises situated at……...

Details of Authorisation

Sl. No.	Category of Hazardous Waste as per the Schedules I, II and III of these rules	Authorised mode of disposal or recycling or utilisation or co-processing, etc.	Quantity (ton/annum)

(1) The authorisation shall be valid for a period of ……

(2) The authorisation is subject to the following general and specific conditions (Please specify any conditions that need to be imposed over and above general conditions, if any):

A. General conditions of authorisation:

1. The authorised person shall comply with the provisions of the Environment (Protection) Act, 1986, and the rules made there under.
2. The authorisation or its renewal shall be produced for inspection at the request of an officer authorised by the State Pollution Control Board.
3. The person authorised shall not rent, lend, sell, transfer or otherwise transport the hazardous and other wastes except what is permitted through this authorisation.
4. Any unauthorised change in personnel, equipment or working conditions as mentioned in the application by the person authorised shall constitute a breach of his authorisation.
5. The person authorised shall implement Emergency Response Procedure (ERP) for which this authorisation is being granted considering all site specific possible scenarios such as spillages, leakages, fire etc. and their possible impacts and also carry out mock drill in this regard at regular interval of time;
6. The person authorised shall comply with the provisions outlined in the Central Pollution Control Board guidelines on "Implementing Liabilities for Environmental Damages due to Handling and Disposal of Hazardous Waste and Penalty"
7. It is the duty of the authorised person to take prior permission of the State Pollution Control Board to close down the facility.
8. The imported hazardous and other wastes shall be fully insured for transit as well as for any accidental occurrence and its clean-up operation.

9. The record of consumption and fate of the imported hazardous and other wastes shall be maintained.
10. The hazardous and other waste which gets generated during recycling or reuse or recovery or pre-processing or utilisation of imported hazardous or other wastes shall be treated and disposed of as per specific conditions of authorisation.
11. The importer or exporter shall bear the cost of import or export and mitigation of damages if any.
12. An application for the renewal of an authorisation shall be made as laid down under these Rules.
13. Any other conditions for compliance as per the Guidelines issued by the Ministry of Environment, Forest and Climate Change or Central Pollution Control Board from time to time.
14. Annual return shall be filed by June 30th for the period ensuring 31st March of the year.

B. Specific conditions:

Date:

Signature of Issuing Authority
Designation and Seal

FORM 3

[See rules 6(5), 13(7), 14(6), 16(5) and 20 (1)]

FORMAT FOR MAINTAINING RECORDS OF HAZARDOUS AND OTHER WASTES

1. Name and address of the facility :
2. Date of issuance of authorisation and its reference number :
3. Description of hazardous and other wastes handled (Generated or Received)

Date	**Type of waste with category as per Schedules I, II and III of these rules**	**Total quantity (Metric Tonnes)**	**Method of Storage**	**Destined to or received from**

* *Fill up above table separately for indigenous and imported waste.*

4. Date wise description of management of hazardous and other wastes including products sent and to whom in case of recyclers or pre-processor or utiliser:
5. Date of environmental monitoring (as per authorisation or guidelines of Central Pollution Control Board):

Signature of occupier

Date……..

Place…….

FORM 4

[See rules 6(5), 13(8), 16(6) and 20 (2)]

FORM FOR FILING ANNUAL RETURNS

[To be submitted to State Pollution Control Board by 30th day of June of every year for the preceding period April to March]

1. Name and address of facility:

2. Authorisation No. and Date of issue:

3. Name of the authorised person and full address with telephone, fax number and e-mail:

4. Production during the year (product wise), wherever applicable

Part A. To be filled by hazardous waste generators

1. Total quantity of waste generated category wise

2. Quantity dispatched
   (i) to disposal facility
   (ii) to recycler or co-processors or pre-processor
   (iii) others

3. Quantity utilised in-house, if any -

4. Quantity in storage at the end of the year –

Part B. To be filled by Treatment, storage and disposal facility operators

1. Total quantity received -

2. Quantity in stock at the beginning of the year -

3. Quantity treated –

4. Quantity disposed in landfills as such and after treatment –

5. Quantity incinerated (if applicable) -

6. Quantity processed other than specified above -

7. Quantity in storage at the end of the year -

Part C. To be filled by recyclers or co-processors or other users

1. Quantity of waste received during the year –
   (i) domestic sources
   (ii) imported (if applicable)

2. Quantity in stock at the beginning of the year -

3. Quantity recycled or co-processed or used –

4. Quantity of products dispatched (wherever applicable) –

5. Quantity of waste generated -

6. Quantity of waste disposed -

7. Quantity re-exported (wherever applicable)-

8. Quantity in storage at the end of the year -

Signature of the Occupier or
Operator of the disposal facility

Date……..

Place…….

FORM 5

[See rules 13 (1) and 14 (1)]

APPLICATION FOR IMPORT OR EXPORT OF HAZARDOUS AND OTHER WASTE FOR REUSE OR RECYCLING OR RECOVERY OR CO-PROCESSING OR UTILISATION

TO BE FILLED IN BY APPLICANT

S. No.	Description	Details to be furnished by the importer or exporter
(1)	(2)	(3)
1.	Importer or Exporter (name and address) in India	
	Contact person	
	Tel, fax and e-mail	
	Facility location/address	
	Reason for import or export	
2.	Importer or exporter (name and address) outside of India	
3.	Details of waste to be imported or exported	
	(a) Quantity (b) Basel No. (c) Single/multiple movement (d) Chemical composition of waste (attach details), where applicable (e) Physical characteristics (f) Special handling requirements, if applicable	
4.	For Schedule III A hazardous waste whether Prior Informed Consent has been obtained	
5.	**For importer** (a) Process details along with environmental safeguard measures (attach separate sheet) (b) Capacity of recycling or co-processing or recovery or utilization **Enclose a copy each of valid authorisation and valid consent to operate from SPCB**	
6.	Details of import against the Ministry of Environment, Forest and Climate Change permission in the previous three years	
7.	Port of entry	

9. Undertaking :

I hereby solemnly undertake that:

(i) The information is complete and correct to the best of my knowledge and legally-enforceable written contractual obligations have been entered into and that my applicable insurance or other financial guarantees are or shall be in force covering the transboundary movement.

(ii) The waste permitted shall be fully insured for transit as well as for any accidental occurrence and its clean-up operation.

(iii) The record of consumption and fate of the imported waste shall be recorded and report sent to the SPCB every quarter.
(iv) The hazardous or other waste which gets generated in our premises by the use of imported hazardous or other wastes in the form of raw material shall be treated and disposed of as per conditions of authorisation.
(v) I agree to bear the cost of export and mitigation of damages if any.
(vi) I am aware that there are significant penalties for submitting a false certificate/ undertaking/ disobedience of the rules and lawful orders including the possibility of fine and imprisonment.
(vii) The exported wastes shall be taken back, if it is not acceptable to the importer.

Signature of the Applicant
Designation

Date……..

Place…….

FORM – 6

[See rules 13(2), 13 (10) and 14 (5)]

TRANSBOUNDARY MOVEMENT- MOVEMENT DOCUMENT

S.No	Description		Details to be furnished by the exporter or importer
(1)	(2)		(3)
1	Exporter (Name and Address) Contact Person Tele, Fax and email	: : :	
2.	Generator(s) of the waste (Name and Address)[1] Contact Person Tele, Fax and email	: : :	
	Site of generation	:	
3.	Importer or Actual user (Name and Address) Contact person Tele, Fax and email	: : :	
4.	Trader (Name and Address) Contact person Tele, Fax and email	: : :	
	Details of actual user (Name, Address, Telephone and email)	:	
5.	Corresponding to applicant Ref. No., If any	:	
6.	Bill of lading (attach copy)	:	
7.	Country of import/export	:	
8.	General description of waste	:	
	(a) Quantity (b) Physical characteristics (c) Chemical composition of waste (attach details), where applicable (d) Basel No. (e) UN Shipping name (f) UN Class (g) UN No (h) H Number (i) Y Number (j) ITC (HS) (k) Customs Code (H.S.) (l) Other (specify)		
9.	Type of packages	:	
	Number	:	
10.	Special handling requirements including emergency provision in case of accidents	:	
11.	Movement subject to single/multiple consignment		
	In case of multiple movement- (a) Expected dates of each shipment or expected frequency of the shipments (b) Estimated total quantity and quantities for each individual shipment	: :	

(1)	(2)		(3)
12.	Transporter of waste (Name and Address)[1] Contact Person Tele, Fax and email	:	
	Registration number	:	
	Means of transport (road, rail, inland waterway, sea, air)[2]	:	
	Date of Transfer	:	
	Signature of Carrier's representative	:	
13.	**Exporter's declaration for hazardous and other waste:**		
	I certify that the information in Sl. Nos. 1 to 12 above are complete and correct to my best knowledge. I also certify that legally-enforceable written contractual obligations have been entered into and are in force covering the transboundary movement regulations/rules. Date:..... Signature:..... Name:.....		
TO BE COMPLETED BY IMPORTER (ACTUAL USER OR TRADER)			
14.	Shipment received by importer/ actual user/trader[2 / 3]		
	Quantity received.....Kg/litres Date: Name: Signature:		
15.	Methods of recovery		
	R code*		
	Technology employed (Attached details if necessary)		
16.	I certify that nothing other than declared goods covered as per these rules is intended to be imported in the above referred consignment and will be recycled /utilized. Signature: Date:		
17.	SPECIFIC CONDITIONS ON CONSENTING TO THE MOVEMENT if applicable.		(attach details)
Notes:-(1) Attach list, if more than one; (2) Select appropriate option; (3) Immediately contact competent authority in case of any emergency; (4) If more than one transporter carriers, attach information as required in SL. No. 12.			

List of abbreviations used in the Movement Document

Recovery Operations (*)

R1 Use as a fuel (other than in direct incineration) or other means to generate energy.
R2 Solvent reclamation/regeneration.

R3 Recycling/reclamation of organic substances which are not used as solvents.
R4 Recycling/reclamation of metals and metal compounds.
R5 Recycling/reclamation of other inorganic materials.
R6 Regeneration of acids or bases.
R7 Recovery of components used for pollution abatement.
R8 Recovery of components from catalysts.
R9 Used oil re-refining or other reuses of previously used oil.
R10 Land treatment resulting in benefit to agriculture or ecological improvement
R11 Uses of residual materials obtained from any of the operations numbered R 1 to R 10

Date: **Signature:**

Place: **Designation:**

FORM 7

[See rule 13 (2) (c)]

APPLICATION FORM FOR ONE TIME AUTHORISATION OF TRADERS FOR PART- D OF SCHEDULE III, WASTE

[To be submitted by trader to the State Pollution Control Board]

1.	Name and address of trader with Telephone, Fax Number and e-mail	:	
2.	TIN/VAT Number/Import/ Export Code	:	
3.	Description and quantity of other waste to be imported	:	
4.	Details of storage, if any	:	
5.	Names and address of authorised actual user (s)	:	

Signature of the authorised person

Date:

Place:

FORM 8

[See rules 17 (1) and 18 (2)]

LABELLING OF CONTAINERS OF HAZARDOUS AND OTHER WASTE

Handle with care

Waste category and characteristics as per Part C of Schedules II and III of these rules …….	Incompatible wastes and substances …….
Total quantity …….	Date of storage
Physical State of the waste (Solid/Semi-solid/liquid):	
Sender's name and address	Receiver's name and address
Phone……	Phone……
E-mail……	E-mail…….
Tel. and Fax No…….	Tel. and Fax No…….
Contact person……	Contact person……
In case of emergency please Contact ……	

Note:

1. *Background colour of label - fluorescent yellow.*
2. *The word, 'HAZARDOUS WASTES' and 'HANDLE WITH CARE' to be prominent and written in red, in Hindi, English and in vernacular language.*
3. *The word 'OTHER WASTES' to be written prominently in orange, in Hindi, English and in vernacular language.*
4. *Label should be of non-washable material and weather proof.*

FORM 9

[See rule 18 (2)]

TRANSPORT EMERGENCY (TREM) CARD

[To be carried by the transporter during transportation of hazardous and other wastes, provided by the sender of waste]

1. Characteristics of hazardous and other wastes:

S. No.	Type of waste	Physical properties/	Chemical constituents	Exposure hazards	First Aid requirements

2. Procedure to be followed in case of fire :
3. Procedure to be followed in case of spillage/accident/explosion :
4. For expert services, please contact :
   (i) Name and Address :
   (ii) Telephone No. :

(Name, contact number and signature of sender)

Date……..

Place…….

FORM 10

[See rule 19 (1)]

MANIFEST FOR HAZARDOUS AND OTHER WASTE

1.	Sender's name and mailing address (including Phone No. and e-mail) :	
2.	Sender's authorisation No. :	
3.	Manifest Document No. :	
4.	Transporter's name and address: (including Phone No. and e-mail)	
5.	Type of vehicle :	(Truck/Tanker/Special Vehicle)
6.	Transporter's registration No. :	
7.	Vehicle registration No. :	
8.	Receiver's name and mailing address (including Phone No. and e-mail) :	
9.	Receiver's authorisation No. :	
10.	Waste description :	
11.	Total quantity : No. of Containers :	……..m^3 or MT ……..Nos.
12.	Physical form :	(Solid/Semi-Solid/Sludge/Oily/Tarry/Slurry/Liquid)
13.	Special handling instructions and additional information :	
14.	Sender's Certificate	I hereby declare that the contents of the consignment are fully and accurately described above by proper shipping name and are categorised, packed, marked, and labelled, and are in all respects in proper conditions for transport by road according to applicable national government regulations.
	Name and stamp: Signature: Month Day Year	
15.	Transporter acknowledgement of receipt of Wastes	
	Name and stamp: Signature: Month Day Year	
16.	Receiver's certification for receipt of hazardous and other waste	
	Name and stamp: Signature: Month Day Year	

FORM 11

[See rule 22]

FORMAT FOR REPORTING ACCIDENT

[To be submitted by the facility or sender or receiver or transporter to the State Pollution Control Board]

1. The date and time of the accident :
2. Sequence of events leading to accident :
3. Details of hazardous and other wastes involved in accident :
4. The date for assessing the effects of the accident on health or the environment :
5. The emergency measures taken :
6. The steps taken to alleviate the effects of accidents :
7. The steps take to prevent the recurrence of such an accident :

Date: **Signature:**

Place: **Designation:**

FORM 12

[See rule 24 (1)]

APPLICATION FOR FILING APPEAL
AGAINST THE ORDER PASSED BY STATE POLLUTION CONTROL BOARD

1.	Name and address of the person making the appeal	:	
2.	Number, date of order and address of the authority which passed the order, against which appeal is being made	:	(certified copy of the order be attached)
3.	Ground on which the appeal is being made	:	
4.	Relief sought for	:	
5.	List of enclosures other than the order referred in point 2 against which the appeal is being filed.	:	

Signature…….

Name and address…….

Date:

----------x----------x----------

[23-16/2009- HSMD]

(Bishwanath Sinha)
Joint Secretary to Government of India

रजिस्ट्री सं० डी० एल०-33004/99 REGD. NO. D. L.-33004/99

भारत का राजपत्र
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अधिसूचना

नई दिल्ली, 18 मार्च, 2016

सा.का.नि. 320(अ).—भारत सरकार, तत्कालीन पर्यावरण और वन मंत्रालय द्वारा अधिसूचना संख्या का.आ. 249(अ), तारीख 4 फरवरी, 2011 के *तहत* प्लास्टिक अपशिष्ट (प्रबंध और प्रहस्तन) नियम, 2011 प्रकाशित किए गए थे, जिन्हें समय-समय पर संशोधित किया गया। इन नियमों ने देश में जनित प्लास्टिक अपशिष्ट के प्रबंध के लिए एक नियामक ढ़ांचा उपलब्ध कराया;

और इन नियमों को अधिक कारगर ढंग से लागू करने और प्लास्टिक अपशिष्ट को न्यूनतम करने, स्रोत पर पृथक्करण, पुन: चक्रण पर बल देने के लिए घरों से अथवा इसके जनन के अन्य किसी स्रोत से अथवा मध्यवर्ती सामग्री पुन: प्राप्ति सुविधा से प्लास्टिक अपशिष्ट के टुकड़ों के संग्रहण में अपशिष्ट बीनने वालों, पुन: चक्रकों और अपशिष्ट संसाधकों को शामिल किया और अपशिष्ट प्रबंध प्रणाली की दीर्घकालिकता के लिए प्रदूषकों के भुगतान करने का सिद्धांत अपनाने के लिए केंद्रीय सरकार ने वर्तमान नियमों की समीक्षा की;

और पर्यावरण (संरक्षण) अधिनियम, 1986 (1986 का 29) की धारा 6, 8 और 25 द्वारा प्रदत्त शक्तियों का प्रयोग करते हुए भारत सरकार, पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय द्वारा मसौदा नियम अर्थात प्लास्टिक अपशिष्ट प्रबंध नियम, 2015 भारत के राजपत्र में सा.का.नि.423(अ), तारीख 25 मई, 2015 के तहत प्रकाशित कराए गए थे जिसमें जिस तारीख को उक्त अधिसूचना वाले राजपत्र की प्रतियां जनता को उपलब्ध कराई गई थीं उससे 60 दिन की अवधि समाप्त होने से पूर्व इनसे प्रभावित होने वाले संभावित सभी व्यक्तियों से आपत्तियां और सुझाव आमंत्रित किए गए थे;

और उक्त राजपत्र की प्रतियां 25 मई, 2015 को जनता को उपलब्ध करा दी गई थीं।

और उक्त मसौदा नियमों के संबंध में जनता से उक्त अवधि के अंदर प्राप्त आपत्तियों और सुझावों पर केंद्रीय सरकार द्वारा विधिवत विचार किया गया है;

अब, इसलिए, पर्यावरण (संरक्षण) अधिनियम, 1986 (1986 की 29) की धारा 3, 6 और 25 द्वारा प्रदत्त शक्तियों का प्रयोग करते हुए तथा प्लास्टिक अपशिष्ट (प्रबंध और प्रहस्तन) नियम, 2011 का अधिक्रमण करते हुए, उन बातों को छोड़कर जो उक्त अधिक्रमण से पूर्व की गई है अथवा जिनका विलोप किया गया है, केंद्रीय सरकार एतद्वारा निम्नलिखित नियम बनाती है, अर्थात् :-

1. संक्षिप्त नाम और प्रारंभ.- (1) इन नियमों का संक्षिप्त नाम अपशिष्ट प्लास्टिक नियम, 2016 है।

(2) इन नियमों में उपबंध के सिवाए वे राजपत्र में अपने प्रकाशन की तारीख से प्रवृत्त होंगे।

2. लागू होना.-

(1) ये नियम प्रत्येक अपशिष्ट उत्पादक, शहरी स्थानीय निकाय, ग्राम पंचायत विनिर्माता और उत्पादक को लागू होंगे।

(2) नियम 4 केंद्रीय सरकार द्वारा अधिसूचित निर्यात के आदेश के लिए अपने उत्पाद के विनिर्माण के लिए निर्यातोन्मुख इकाइयों या विशेष आर्थिक जोन की इकाइयों पर लागू नहीं होगा: परन्तु यह छूट गुटका, तम्बाकू और पान मसाला के पैकेजिंग में लगी इकाइयों और किसी अधिशेष या निराकृत, अवशेष और इसी प्रकार के अन्य उत्पादों पर भी लागू नहीं होगी।

3. परिभाषाएं.- इन नियमों में जब तक कि संदर्भ से अन्यथा अपेक्षित न हो.-

(क) **"अधिनियम"** से पर्यावरण (संरक्षण) अधिनियम, 1986 (1986 का 29) अभिप्रेत है;

(ख) **"ब्रांड स्वामी"** ऐसे व्यक्ति या कंपनी से अभिप्रेत है जो किसी पंजीकृत ब्रांड लेबल के तहत कोई वस्तु बेचता है।

(ग) **"कैरी बैग"** से प्लास्टिक सामग्री या कंपोस्ट योज्य प्लास्टिक सामग्री से बनाया गया, ले जाने या वस्तुएं तैयार करने के प्रयोजन के लिए प्रयुक्त बैग अभिप्रेत है जिसमें स्वत: ले जाने की विशिष्टता है किन्तु इसमें ऐसा बैग सम्मिलित नहीं है जो ऐसी पैकेजिंग गठित करता है या अभिन्न भाग बनता है जिसमें माल को उपयोग के पूर्व सील किया जाता है;

(घ) **"वस्तु से"** ऐसा मूर्त मद अभिप्रेत है जिसे खरीदा या बेचा जा सके और इसमें सभी पण्य माल या सौदा सम्मिलित है;

(ङ) **"कंपोस्ट योज्य प्लास्टिक"** से ऐसी प्लास्टिक अभिप्रेत है जो जैविकीय प्रक्रियाओं द्वारा विघटनीय होने के दौरान कार्बन-डाई-आक्साइड, जल, अकार्बनिक यौगिकों को कंपोस्ट करती है और अन्य ज्ञात कंपोस्ट योज्य सामग्रियों के साथ जैव भार की समरूप दर है और जो दृश्य, विशेषणीय या विषाक्त अपशिष्ट नहीं छोड़ती है;

(च) **"सहमति"** से जल (प्रदूषण निवारण तथा नियंत्रण) अधिनियम, 1974 (1974 का 6) और वायु (प्रदूषण निवारण या नियंत्रण) अधिनियम, 1981 (1981 का 14) के अधीन संबद्ध राज्य प्रदूषण नियुत्रण बोर्ड या प्रदूषण नियंनियंत्रण समिति से स्थापित करने की सहमति और उसे चलाने की सहमति अभिप्रेत है;

(छ) **"विघटन"** से किसी सामग्री का बहुत छोटे भागों में भौतिक रूपों में भंजन अभिप्रेत है;

(ज) **"विस्तारित उत्पादक दायित्व"** से इसके जीवन तक उत्पाद के पर्यावर्णीय रूप से सुदृढ़ के लिए उत्पादक का दायित्व अभिप्रेत है;

(झ) **"खाद्य पदार्थ"** से द्रव, चूर्ण, ठोस या अर्ध ठोस रूप में खाने के लिए तैयार खाद्य पदार्थ, फास्ट फूड, प्रसंस्कृत या पकाए हुए खाद्य पदार्थ अभिप्रेत हैं;

(ञ) **"सुविधा"** से प्लास्टिक अपशिष्ट के एकत्रण, भंडारण, पुन: चक्रीकरण, प्रसंस्करण और निपटान के लिए उपयोग किए जाने वाला परिसर अभिप्रेत है;

(ट) **"आयातकर्ता"** से ऐसा व्यक्ति अभिप्रेत है जो आयात करता है या करने का इरादा रखता है और जिसके पास आयात-निर्यात करने का लाइसेंस है, जब तक उसे अन्यथा विशेष रूप से छूट नहीं दी गई हो;

(ठ) **"संस्थागत अपशिष्ट जनित्र"** से केन्द्रीय सरकारी विभागी, राज्य सरकारी विभाग, पब्लिक या प्राइवेट सैक्टर कंपनियां, अस्पताल, स्कूल, महाविद्यालय, विश्वविद्यालय या शिक्षा के अन्य स्थल, संगठन, अकादमी, होटल, रेस्तरां, मॉल और शॅपिंग परिसरों द्वारा अधिकृत भवन जैसे संस्थागत भवनों का अधिभोगी अभिप्रेत है और सम्मिलित है;

(ड) **"विनिर्माता"** से उत्पादक द्वारा कच्ची सामग्री के रूप में प्रयुक्त की जाने वाली प्लास्टिक की कच्ची सामग्री के उत्पादन में लगा व्यक्ति या इकाई या अभिकरण अभिप्रेत है जो सम्मिलित है;

(ढ) **"बहुस्तरीय पैकेजिंग"** के लिए प्रयुक्त या प्रयुक्त की जाने वाली कोई सामग्री अभिप्रेत है और कागज, काज बोर्ड, बहुलक्ष्य सामग्रियां, धात्विक सतहों या एल्युमिनियम पन्नियां जो या तो लेमिनेट के रूप में या सह-बहिवेर्धन रूप में जैसे सामग्री के एक से अधिक सतह का संयोजन मुख्य संघटकों के रूप में प्लास्टिक का कम से एम स्तर रखती है;

(ण) **"प्लास्टिक"** से ऐसी सामग्री अभिप्रेत है जिसमें पोलीथाइलीन टेरेफेथेलेट, उच्च घनत्व पोलीथाइलीन, विनाइल, कम घनत्व पोलीथाइलीन, पोलीप्रोपीलीन, पोलीस्टाइरीन रेसिन, एक्रीलोनीट्रीइलीन बूटाडीन स्टाइरिन जैसी बहु सामग्री, पोलीफिनाइलीन आक्साइड, पोलीकार्बोनेट, पोलीबूटीलीन टेरेफिथालेट जैसी उच्च पालिमर के आवश्यक तत्व अनतर्विष्ट हों;

(त) **"प्लास्टिक चद्दर"** के प्लास्टिक चद्दर से अभिप्रेत है प्लास्टिक से बनी चद्दर;

(थ) **"प्लास्टिक अपशिष्ट"** से ऐसे किसी प्लास्टिक से अभिप्रेत है जिसे उपयोग के पश्चात या आशयित उपयोग के पश्चात फेंक दिया जाता है;

(द) **"विहित प्राधिकारी"** से नियम 12 में विनिर्दिष्ट प्राधिकारी अभिप्रेत है;

(ध) **"उत्पादक"** से कैरी बैग या बहुतस्तरीय पैकेजिंग या प्लास्टिक शीट या जैसे के विनिर्माण या आयात में लगा व्यक्ति अभिप्रेत है और प्लास्टिक शीट या जैसे या प्लास्टिक शीट के बनाए गए कवर या वस्तु की पैकेजिंग या ढ़कने के लिए बहुस्तरीय पैकेजिंग का उपयोग कर रहे उद्योग या व्यक्ति सम्मिलित हैं;

(न) **"पुन: चक्रीकरण"** नए उत्पाद उत्पादित करने के लिए पृथक्कृत प्लास्टिक अपशिष्ट को नए उत्पाद या कच्ची सामग्री में रूपान्तरित करने की प्रक्रिया से अभिप्रेत है;

(प) **"रजिस्ट्रीकरण"** से यथास्थिति, राज्य प्रदूषण नियंत्रण बोर्ड या संबद्ध प्रदूषण नियंत्रण समिति में रजिस्ट्रीकृत अभिप्रेत है;

(फ) **"पथ विक्रेता"** का वही अर्थ होगा जो पथ विक्रेता (आजीविका का संरक्षण और पथ विक्रय का विनियमन) अधिनियम, 2014 (2014 का 7) की धारा 2 की उपधारा (1) के खंड (1) में है;

(ब) **"शहरी स्थानीय निकाय"** से नगर निगम, म्युनिसिपलिटी, नगरपालिका, नगर निगम, नगर पंचायत, नगरपालिका परिषद जैसे विभिन्न नामों वाले शहरी स्थानीय निकाय अभिप्रेत हैं और जिसके अंतर्गत अधिसूचित क्षेत्र समिति (एनएसी) या सुसंगत कानूनों के अधीन गठित कोई अन्य स्थानीय निकाय और जहां प्लास्टिक अपशिष्ट का प्रबंध ऐसे अभिकरण को सौंपा गया है, सम्मिलित हैं;

(भ) **"अप्रयुक्त प्लास्टिक"** से ऐसी प्लास्टिक सामग्री अभिप्रेत है जिसका पहले उपयोग नहीं किया गया है या रद्दी या अपशिष्ट के साथ भी सम्मिश्रित नहीं किया गया है;

(म) **"अपशिष्ट जनित्र"** से प्रत्येक व्यक्ति या व्यक्तियों का समूह या संस्था, भारतीय रेल, विमानपत्तन, बंदरगाह और रक्षा कन्टून्मेंट जो अपशिष्ट प्लास्टिक पैदा करते हैं, सहित रिहायसी और वाणिज्यिक स्थापना अभिप्रेत है और सम्मिलित है;

(य) **"अपशिष्ट प्रबंध"** से प्लास्टिक अपशिष्ट का पर्यावरण की दृष्टि से सुरक्षित पद्धति से एकत्रण, भंडारण, परिवहन, पुन: उपयोग, पुन: प्राप्ति, पुन:चक्रण, कंपोस्टिंग या व्ययन अभिप्रेत है;

(र) **"अपशिष्ट चुनने वाले"** से पुन:चक्रण योग्य प्लास्टिक अपशिष्ट के चुनने में स्वैच्छिक रूप से लगे या प्राधिकृत किए गए व्यक्ति या एजेंसियां, व्यक्तियों का समूह अभिप्रेत है;

4. शर्तें.-

(1) कैरी बैग, प्लास्टिक शीट या इसी प्रकार या प्लास्टिक शीट या बहुस्तरीय पैकेजिंग के बने आवरण का विनिर्माण, आयात, भंडारण, वितरण, विक्रय और उपयोग के अनुक्रम दौरान निम्नलिखित शर्तें पूरी की जाएंगी, अर्थात :-

(क) कैरी बैग और प्लास्टिक पैकेजिंग या तो प्राकृतिक रंग में होंगे जो किसी मिलाए गए रंजक से रहित है या केवल उन्हीं रंजकों और रंगकों का उपयोग कर बनाए गए हैं जो समय-समय पर यथा-संशोधित "खाद्य पदार्थों, भेषजीय

पदार्थों और पीने के पानी के संपर्क में आने वाली प्लास्टिकों के उपयोग के लिए रंजकों और रंगकों की सूची" नामक शीर्षक से भारतीय मानक: आईएस 9833:1981 के अनुरूप हैं ;

(ख) पुन:चक्रित प्लास्टिक से बने कैरी बैग या पुन:चक्रित प्लास्टिक से बने उत्पादों का उपयोग खाने या पीने के लिए तैयार खाद्य सामग्री का भंडार करने, वहन करने, वितरण करने या पैकेजिंग करने के लिए नहीं किया जाएगा;

(ग) अप्रयुक्त या पुन:चक्रित प्लास्टिक के बने किसी कैरी बैग की मोटाई में पचास माइक्रोन्स से कम नहीं होगी;

(घ) प्लास्टिक शीट या इसी प्रकार, जो बहुस्तरीय पैकेजिंग और वस्तु की पैकेजिंग या लपेटने के लिए प्रयुक्त प्लास्टिक शीट के बने कवर का अभिन्न भाग नहीं है, की मोटाई पचास माइक्रोन्स से कम नहीं होगी, वहां छोड़कर जहां ऐसी प्लास्टिक शीट उत्पाद के कार्यरण में बाधक हो;

(ङ) विनिर्माता संबद्ध राज्य प्रदूषण नियंत्रण बोर्ड या प्रदूषण नियंत्रण समिति से विधिमान्य रजिस्ट्रीकरण न रखने वाले उत्पादक को कच्ची सामग्री के रूप में प्रयुक्त होने वाली प्लास्टिक को न बेचेगा या न उपलब्ध कराएगा या न व्यवस्था करेगा;

(च) गुटखा, तम्बाकू और पान मसाला के भंडारण, पैकिंग या बिक्री हेतु प्लास्टिक सामग्री युक्त सैशे का उपयोग नहीं किया जाएगा;

(छ) प्लास्टिक अपशिष्ट का पुन: चक्रण समय-समय पर यथा संशोधित भारतीय मानक के प्लास्टिक के पुन:चक्रण के लिए मार्गदर्शन नामक विनिर्देश भा.मा.14539:1998 के अनुरूप होगा;

(ज) मोटाई का प्रावधान कंपोस्ट योज्य प्लास्टिक से बने कैरी बैग पर लागू नहीं होगा। कंपोस्ट योज्य प्लास्टिक से बने कैरी बैग समय-समय यथा संशोधित कंपोस्ट योज्य प्लास्टिक के लिए विनिर्देश नामक भारतीय मानक आईएस या आईएसओ 17088:2008 के अनुरूप होंगे। कंपोस्ट योज्य कैरी बैग के विनिर्माता या विक्रेता विपणन या बिक्री करने से पूर्व केन्द्रीय प्रदूषण नियंत्रण बोर्ड से प्रमाण पत्र प्राप्त करेंगे;

(झ) विनायल एसिटेट-मलेइक एसिड-विनायल क्लोराइड कोपॉलिमर सहित किसी भी प्रकार की प्लास्टिक सामग्री का उपयोग किसी पैकेज में सभी प्रकार के गुटका, पान मसाला और तम्बाकू के पैकेजिंग के लिए नहीं किया जाएगा।

5. प्लास्टिक अपशिष्ट प्रबंध.-

(1) शहरी स्थानीय निकायों द्वारा अपने संबद्ध अधिकारिता में प्लास्टिक अपशिष्ट प्रबंध इस प्रकार होगा :-

(क) ऐसा प्लास्टिक अपशिष्ट जिसे पुन:चक्रित किया जा सकता हो, को रजिस्ट्रीकृत प्लास्टिक अपशिष्टि पुन:चक्रक को पहुंचाया जाएगा और प्लास्टिक का पुन:चक्रण समय-समय पर यथा-संशोधित पुन:चक्रण के लिए दिशा-निर्देश नामक भारतीय मानक : आईएस 14534:1998 के अनुसार किया जाएगा;

(ख) शहरी स्थानीय निकाय प्लास्टिक अपशिष्ट (प्रधानत: ऐसे प्लास्टिक अपशिष्ट का जिसका पुन:चक्रीकरण नहीं किया जा सकता) के उपयोग को भारतीय रोड कांग्रेस दिशा-निर्देशों के अनुसार सड़क निर्माण करने या ऊर्जा पुन: प्राप्त करने या वेस्ट टु ऑयल आदि हेतु करने को प्रोत्साहित करेंगी। इन प्रौद्योगिकियों के लिए निर्धारित प्राधिकरण द्वारा विनिर्दिष्ट मानकों और प्रदूषण नियंत्रण मानदंडों का पालन किया जाएगा।

(ग) तापस्थायी प्लास्टिक अपशिष्ट का प्रसंस्करण और व्ययन केन्द्रीय प्रदूषण नियंत्रण बोर्ड द्वारा समय-समय पर जारी मार्गदर्शक सिद्धांतों के अनुसार किया जाएगा;

(घ) प्लास्टिक अपशिष्ट के पुन:चक्रण या प्रसंस्करण की सुविधाओं के अक्रिय का व्ययन ठोस अपशिष्ट प्रबंध नियम, 2000 के अनुपालन में या समय-समय पर संशोधन के अनुसार किया जाएगा।

6. स्थानीय निकाय का दायित्व.-

(1) प्रत्येक स्थानीय निकाय स्वयं या अभिकरण या उत्पादक लगाकर प्लास्टिक अपशिष्ट के पृथक्करण या संग्रहण, भंडारण, परिवहन, प्रसंस्करण और व्ययन की अवसंरचना को विकसित करने और स्थापना के लिए उत्तरदायी होगा;

(2) स्थानीय निकाय अपशिष्ट प्रबंध प्रणाली की स्थापना, प्रचालन और समन्वय के लिए तथा सहयोजित कृत्यों के निर्वहन के लिए उत्तरदायी होगा, अर्थात्;

(क) प्लास्टिक अपशिष्ट के संग्रहण, भंडारण, पृथक्करण, परिवहन, प्रसंस्करण और व्ययन को सुनिश्चित करना;

(ख) यह सुनिश्चित करना कि इस प्रक्रिया के दौरान पर्यावरण को कोई हानि न हो;

(ग) पुन:चक्रण करने वाले लोगों के प्रति पुन:चक्रण योग्य प्लास्टिक अपशिष्ट भाग के सरणीकरण को सुनिश्चित करना;

(घ) केन्द्रीय प्रदूषण नियंत्रण बोर्ड द्वारा जारी मार्ग निर्देशक सिद्धांतों के अनुसार प्लास्टिक अपशिष्ट के गैर पुन:चक्रण योग्य भाग के प्रसंस्करण और व्ययन को सुनिश्चित करना;

(ङ) सभी पणधारियों में उनके उत्तरदायित्व के लिए जागृति पैदा करना;

(च) अपशिष्ट चुनने वालों के साथ कार्य कर रहे सिविल सोसायटी या समूहों को लगाना; और

(छ) यह सुनिश्चित करना कि प्लास्टिक अपशिष्ट को खुले में न जलाया जाए।

(3) प्लास्टिक अपशिष्ट प्रबंध के लिए प्रणाली के गठन के लिए स्थानीय निकाय उत्पादकों की सहायता लेगा और इन नियमों को भारत के राजपत्र में अंतिम प्रकाशन की तारीख से एक वर्ष के भीतर ऐसी प्रणाली का गठन किया जाएगा।

(4) स्थानीय निकाय इन नियमों के प्रावधानों को शामिल करते हुए उप-नियम बनाएगा।

7. ग्राम पंचायतों का दायित्व.-

(1) प्रत्येक ग्राम पंचायत स्वयं या अभिकरण के माध्यम से अपने नियंत्रण के अधीन ग्रामीण क्षेत्र में अपशिष्ट प्रबंधन के लिए और सहयोजित कृत्यों के अनुपालन के लिए स्थापना, प्रचालन और समन्वय करेगा अर्थात.-

(क) प्लास्टिक अपशिष्ट का संग्रहण, भंडारण, पृथक्करण, परिवहन और विधिमान्य रजिस्ट्रीकरण रखने वाले पुन:चक्रण करने वाले लोगों के प्रति पुन:चक्रण योग्य प्लास्टिक अपशिष्ट का सरणीकरण सुनिश्चित करना; यह सुनिश्चित करना कि इस प्रक्रिया के दौरान पर्यावरण को कोई हानि न हो;

(ख) सभी पणधारियों में उनके उत्तरदायित्व के लिए जागृति पैदा करना;

(ग) यह सुनिश्चित करना कि प्लास्टिक अपशिष्ट को खुले में न जलाया जाए।

8. अपशिष्ट जनक का उत्तरदायित्व.-

(1) अपशिष्ट जनक.-

(क) समय-समय पर यथा संशोधित ठोस अपशिष्ट प्रबंध नियम, 2000 के अनुसार प्लास्टिक अपशिष्ट के जनन को कम करने और स्त्रोत पर प्लास्टिक अपशिष्ट को पृथक करने के कदम उठाएगा।

(ख) प्लास्टिक अपशिष्ट को न बिखरने देगा और स्त्रोत पर अपशिष्ट का पृथक भंडारण सुनिश्चित करेगा तथा पृथक अपशिष्ट को शहरी स्थायी निकायों या ग्राम पंचायत या उनके द्वारा नियुक्त एजेंसियों या अपशिष्ट चुनने वालों, रजिस्ट्रीकृत पुन:चक्रणकर्ताओं या अपशिष्ट संग्रहण अभिकरणों को सौंपेगा;

(2) प्लास्टिक अपशिष्ट के सभी संस्थागत जनक उनके द्वारा जनित अपशिष्ट का पृथक्करण और भंडारण इस अधिनियम या इसके बाद संशोधित अधिनियम के तहत का.आ.908(अ) तारीख 25 सितंबर, 2000 द्वारा अधिसूचित म्युनिसिपल ठोस अपशिष्ट (प्रबंधन और प्रहस्तन) नियम, 2000 के अनुसार करेंगे और पृथक्कृत अपशिष्टकों को स्वयं के या प्राधिकृत अपशिष्ट अभिकरण के माध्यम से प्राधिकृत अपशिष्ट प्रसंस्करण या व्ययन सुविधा या निक्षेपण केन्द्रों को सौंपेंगे।

(3) सभी अपशिष्ट जनक ऐसी उपयोक्ता फीस या प्रभार अदा करेंगे जो अपशिष्ट संग्रहण या उसकी सुविधा के प्रचालन आदि जैसे प्लास्टिक अपशिष्ट प्रबंध के लिए स्थानीय निकायों की उपविधियों में विनिर्दिष्ट हो;

(4) खुली जगह में आयोजन की व्यवस्था करने वाला प्रत्येक उत्तरदायी व्यक्ति जिसमें प्लास्टिक या बहुस्तरीय पैकेजिंग में खाद्य सामग्री की सेवा अंतर्वलित है, ऐसे आयोजनों के दौरान जनित अपशिष्ट का पृथक्करण और प्रबंधन इस अधिनियम या इसके बाद संशोधित अधिनियम के तहत का.आ.908(अ) तारीख 25 सितंबर, 2000 द्वारा अधिसूचित म्युनिसिपल ठोस अपशिष्ट (प्रबंधन और प्रहस्तन) नियम, 2000 के अनुसार करेगा।

9. उत्पादकों, आयातकर्ताओं और ब्रांड स्वामियों का दायित्व.-

(1) उत्पादक इन नियमों के प्रकाशन की तारीख से छह मास की अवधि के भीतर व्यक्तिगत या समूहिक रूप से अपने निजी वितरण चैनल या संबद्ध स्थानीय निकाय के माध्यम से विस्तारित उत्पादक दायित्व पर आधारित अपशिष्ट संग्रहण प्रणाली के लिए राज्य शहरी विकास विभाग को सम्मिलित करते हुए रूपरेखा तैयार करेगा।

(2) उपयोग में लाए गए बहुस्तरीय प्लास्टिक शैशे या पाउचों या पैकेजिंग के संग्रहण का प्रमुख दायित्व उन उत्पादकों, आयातकर्ताओं और ब्राउंड स्वामियों का होगा जो बाजार में उत्पाद को पेश करते हैं। उन्हें अपने उत्पादों के कारण जनित प्लास्टिक अपशिष्ट को वापस संग्रह करने की प्रणाली स्थापित करने की जरूरत है। संग्रह करने की यह योजना स्थापित करने या प्रचालन या नवीकरण के लिए सहमति हेतु आवेदन करते समय राज्य प्रदूषण नियंत्रण बोर्ड को प्रस्तुत करनी होगी। जिन ब्रांड स्वामियों की सहमति का नवीकरण इन नियमों की अधिसूचना से पहले कर दिया गया है वे इन नियमों की अधिसूचना की तारीख से एक वर्ष के अंदर उक्त योजना प्रस्तुत कर देंगे और उसके दो वर्ष बाद लागू कर देंगे।

(3) पुन:चक्रीकरण न की जा सकने योग्य बहुस्तरीय पैकेजिंग का विनिर्माण एवं उपयोग, यदि कोई हो, दो वर्ष में बंद कर दिया जाएगा।

(4) उत्पादक राजपत्र में इन नियमों के अंतिम प्रकाशन की तारीख से तीन मास की अवधि के भीतर रजिस्ट्रीकरण की मंजूरी के लिए राज्यों या संबद्ध संघ राज्य क्षेत्रों के प्रशासन के यथास्थिति प्रदूषण नियंत्रण बोर्ड या प्रदूषण नियंत्रण समिति को आवेदन करेगा।

(5) कोई उत्पादक राजपत्र में इन नियमों के अंतिम प्रकाशन की तारीख से एक वर्ष की अवधि की समाप्ति पर या इसके पश्चात संबद्ध राज्य प्रदूषण नियंत्रण बोर्ड या प्रदूषण नियंत्रण समितियों से रजिस्ट्रीकरण के बिना वस्तुओं के पैकेजिंग के लिए किसी प्लास्टिक या बहुस्तरीय पैकेजिंग का विनिर्माण या उपयोग नहीं करेगा।

(6) प्रत्येक उत्पादक कैरी बैग या प्लास्टिक शीट या इसी प्रकार या प्लास्टिक शीट या बहुस्तरीय पैकेजिंग के बने कवर के विनिर्माण के लिए कच्ची सामग्री के रूप में प्रयुक्त प्लास्टिक की आपूर्ति में लगे व्यक्ति के ब्यौरों के अभिलेख बनाए रखेगा।

10. कंपोस्ट योज्य प्लास्टिक सामग्रियों के लिए नयाचार.- प्लास्टिक सामग्री के अविक्रमित की डिग्री और विघटन की डिग्री का निर्धारण, इन नियमों की अनुसूची-1 में सूचीबद्ध भारतीय मानकों के नयाचारों के अनुसार होगा।

11. मार्का या लेबल लगाना.- (1) प्रत्येक प्लास्टिक कैरी बैग और बहुस्तरीय पैकेजिंग पर अंग्रेजी में निम्नलिखित जानकारी मुद्रित की जाएगी, अर्थात् :-

(क) कैरी बैग की दशा में विनिर्माणकर्ता का नाम, उसका रजिस्ट्रीकरण संख्या और मोटाई; और

(ख) बहुस्तरीय पैकेजिंग की दशा में विनिर्माणकर्ता का नाम और उसका रजिस्ट्रीकरण संख्या।

(ग) कंपोस्ट योज्य प्लास्टिक से बने कैरी बैग की दशा में नाम और प्रमाणपत्र सं. [नियम 4(ज)]।

(2) प्रत्येक पुन:चक्रित कैरी बैग पर निम्नलिखित रूप में यथादर्शित "पुन:चक्रित" लेबल या चिन्ह होगा और भारतीय मानके के समय-समय पर यथा संशोधित पुन:चक्रित प्लास्टिक के लिए मार्गदर्शक नामक विनिर्देश भा.मा.14534:1998 के अनुसार होगा;

टिप्पण : पैट-पोलीथाइलिन टेरीफैथेलेट, एचडीईपी-उच्च डेंसिटी पोलीथाइलिन, वी-विनाइल (पीवीसी), एलडीपीई - निम्न डेंसिटी पोलीथाइलिन, पीपी-पोलीप्रोपिलिन, पीएस पोलीस्टायरिन और अन्य से अभिप्रेत सभी अन्य राल और बहुसामग्रियां हैं जैसे एबीएस (एक्रीलोनिट्राइल बूटाडिन स्टायरिन), पीपीओ (पोलीफेननाइलिन आक्साइड), पीपी (पोलीकार्बोनेट), पीवीटी (पोलीबूटीलेन पेरीफेलेट) आदि।

(3) कंपोस्ट योज्य प्लास्टिकों से बने प्रत्येक कैरी बैग पर कंपोस्ट योज्य का लेबल लगा होगा और भारतीय मानक के कंपोस्ट योज्य प्लास्टिक के लिए विनिर्देश नामक विनिर्देश भा.मा./भा.मा.स.17088:2008 के अनुरूप होगा।

12. विहित प्राधिकारी.- (1) किसी संघ राज्य क्षेत्र की बाबत राज्य प्रदूषण नियंत्रण बोर्ड या प्रदूषण नियंत्रण समिति रजिस्ट्रीकरण, प्लास्टिक उत्पादों और बहुस्तरीय पैकेजिंग के विनिर्माण, अपशिष्ट प्लास्टिक के प्रसंस्करण और व्ययन से संबंधित इन नियमों के उपबंधों को प्रवृत्त करने के लिए प्राधिकारी होगा;

(2) राज्य या संघ राज्य क्षेत्र के शहरी विभाग का संबद्ध भारसाधक सचिव अपशिष्ट जनक द्वारा अपशिष्ट प्रबंधन, प्लास्टिक कैरी बैग, प्लास्टिक शीट या इसी प्रकार के प्लास्टिक शीटों और बहुस्तरीय पैकेजिंग से बने कवर के उपयाग से संबंधित इन नियमों के उपबंधों को प्रवृत्त करने के लिए प्राधिकारी होगा;

(3) संबद्ध ग्राम पंचायत राज्य सा संघ राज्य क्षेत्र के ग्रामीण क्षेत्रों में अपशिष्ट जनक द्वारा अपशिष्ट प्रबंधन, प्लास्टिक कैरी बैग, प्लास्टिक शीट या इसी प्रकार के प्लास्टिक शीटों और बहुस्तरीय पैकेजिंग से बने कवर के उपयोग से संबंधित इन नियमों के उपबंधों को प्रवृत्त करने के लिए प्राधिकारी होगा;

(4) उप-नियम (1) से (3) में निर्दिष्ट प्राधिकारी इन नियमों के उपबंधों के प्रवर्तन में संबद्ध जिले की अधिकारिता की राज्य क्षेत्र की सीमाओं के भीतर जिला मजिस्ट्रेट या उपायुक्त की सहायता लेगा।

13. उत्पादक, पुन:चक्रणकर्ता और विनिर्माणकर्ता का रजिस्ट्रीकरण.- (1) कोई व्यक्ति कैरी बैगों या पुन:चक्रित प्लास्टिक बैगों और बहुस्तरीय प्लास्टिकों का विनिर्माण तब तक नहीं करेगा जब तक कि उसने उत्पादन के प्रारंभ से पूर्व यथास्थिति राज्य प्रदूषण नियंत्रण बोर्ड या संघ राज्य क्षेत्र की प्रदूषण नियंत्रण समिति से रजिस्ट्रीकरण प्रमाणपत्र अभिप्राप्त न हो गया हो;

(2) प्रत्येक उत्पादनकर्ता रजिस्ट्रीकरण के लिए या रजिस्ट्रीकरण के नवीकरण के लिए राज्य प्रदूषण नियंत्रण बोर्ड या संघ राज्य क्षेत्र की प्रदूषण नियंत्रण समिति को उपाबद्ध प्ररूप 1 का प्रयोग करते हुए आवेदन करेगा।

(3) ऐसा कोई व्यक्ति जो कैरी बैग और बहुस्तरीय प्लास्टिकों या प्लास्टिक अपशिष्ट का पुन:चक्रण करता है या पुन:चक्रण करने के लिए प्रस्ताव करता है, उपाबद्ध प्ररूप 2 का प्रयोग करते हुए पुन:चक्रण यूनिट के लिए रजिस्ट्रीकरण प्रदान करने के लिए या रजिस्ट्रीकरण का नवीकरण करने के लिए राज्य प्रदूषण नियंत्रण बोर्ड या प्रदूषण नियंत्रण समिति को आवेदन करेगा।

(4) उत्पादक द्वारा कच्ची सामग्री के रूप में प्रयुक्त की जाने वाली प्लास्टिक के विनिर्माण में लगे प्रत्येक विनिर्माता प्ररूप 3 में रजिस्ट्रीकरण की मंजूरी या रजिस्ट्रीकरण के नवीकरण के लिए राज्य प्रदूषण नियंत्रण बोर्ड या संबद्ध संघ राज्य क्षेत्र की प्रदूषण नियंत्रण समिति को आवेदन करेगा।

(5) राज्य प्रदूषण नियंत्रण बोर्ड और प्रदूषण नियंत्रण समिति विनिर्माण या पुन:चक्रण यूनिटों के लिए कोई रजिस्ट्रीकरण तब तक जारी नहीं करेगी या उसका नवीकरण नहीं करेगी जब तक कि यूनिट, जल (प्रदूषण निवारण तथा नियंत्रण) अधिनियम, 1974 (1974 का 6) और वायु (प्रदूषण निवारण तथा नियंत्रण) अधिनियम, 1981 (1981 का 14) के अधीन कोई विधिमान्य सहमति नहीं रखती हो और जिला उद्योग केन्द्र या इस संबंध में प्राधिकृत किसी अन्य सरकारी अभिकरण द्वारा जारी रजिस्ट्रीकरण का प्रमाणपत्र न रखती हो।

(6) राज्य प्रदूषण नियंत्रण बोर्ड और प्रदूषण नियंत्रण समिति उत्पादक के रजिस्ट्रीकरण का नवीकरण तब नहीं करेगा जब तक उत्पादक प्लास्टिक अपशिष्ट प्रणाली की स्थापना के लिए संबद्ध राज्य या संघ राज्य क्षेत्र के शहरी विकास के भारसाधक सचिव द्वारा पृष्ठांकित कार्य योजना न रखता हो।

(7) उपनियम (3) के अंतर्गत प्लास्टिक अपशिष्ट के पुन:चक्रण या प्रसंस्करण के रजिस्ट्रीकरण के लिए सभी प्रकार से पूर्ण आवेदन की प्राप्ति पर राज्य प्रदूषण नियंत्रण बोर्ड ऐसी जांच करने के पश्चात जो वह आवश्यक समझे और यह समाधान हो जाने पर कि आवेदक के पास समुचित सुविधाएं तकनीकी योग्यताएं और प्लास्टिक अपशिष्ट से

सुक्षित रूप से निपटने के लिए उपकरण हैं, ऐसी शर्तों के पूरा होने पर आवेदक को रजिस्ट्रीकरण मंजूर कर सकेगा जो रजिस्ट्रीकरण के निबंधनों में अभिकथित की जाएं।

(8) प्रत्येक राज्य प्रदूषण नियंत्रण बोर्ड या प्रदूषण नियंत्रण समिति, सभी प्रकार से पूर्ण आवेदन की प्राप्ति के नब्बे दिनों के भीतर रजिस्ट्रीकरण प्रदान करने हेतु विनिश्चय करेगा।

(9) इस नियम के अधीन अनुदत्त रजिस्ट्रीकरण जब तक कि वह विखंडित, निलंबित या रद्द नहीं कर दिया जाता है एक वर्ष की अवधि के लिए विधिमान्य होगा और बाद में उसे तीन वर्ष तक बढ़ाया जा सकता है।

(10) राज्य प्रदूषण नियंत्रण बोर्ड या प्रदूषण नियंत्रण समिति, रजिस्ट्रीकरण को उत्पादक या प्लास्टिक अपशिष्ट के पुन:चक्रण या प्रसंस्करण में लगे हुए व्यक्ति को सुनवाई का अवसर दिए बिना विखंडित, निलंबित या रद्द नहीं करेगी।

(11) रजिस्ट्रीकरण के नवीकरण के लिए प्रत्यक आवेदन, रजिस्ट्रीकरण प्रमाणपत्र की विधिमान्यता की समाप्ति से कम से कम एक सौ बीस दिन पूर्व किया जाएगा।

14. खुदरा विक्रेताओं और पथ विक्रेताओं का दायित्व.- (1) खुदरा विक्रेता या पथ विक्रेता उपभोक्ता को ऐसे कैरी बैग या प्लास्टिक शीट या बहुस्तरीय पैकेजिंग में वस्तु नहीं बेचेगा या उपलब्ध कराएगा जो इन नियमों के अधीन विहितानुसार विनिर्मित या लेबल लगे या चिन्हित नहीं है।

(2) प्लास्टिक कैरी बैग या बहुस्तरीय पैकेजिंग या प्लास्टिक शीट या इसी प्रकार या ऐसे प्लास्टिक शीट से बने जो इन नियमों के अनुसार विनिर्मित या लेबलित या चिन्हित नहीं है, में वस्तुओं को बेचने या उपलब्ध कराने वाला प्रत्येक खुदरा विक्रेता या पथ विक्रेता ऐसा जुर्माना देने का दायी होगा जो स्थानीय निकायों की विधियों में विनिर्दिष्ट हो।

15. कैरी बैगों की कीमत सुनिश्चित करना.- (1) जो दुकानदार और पथ विक्रेता किसी वस्तु को वितरित करने के लिए प्लास्टिक के कैरी बैग उपलब्ध कराना चाहते हैं उन्हें स्थानीय निकाय के पास पंजीकरण करना होगा। स्थानीय निकाय, भारत के राजपत्र में इन नियमों के प्रकाशित होने की तारीख से छह माह की अवधि के अंदर, चार हजार रुपये प्रतिमाह की दर से न्यूनतम अड़तालीस हजार रुपये का प्लास्टिक प्रबंधन शुल्क का भुगतान करने के बाद ऐसे पंजीकरण के लिए अपने राज्य के उपयुक्त कानून या उपनियमों के तहत अधिसूचना या आदेश के द्वारा प्रावधान करेगा। संबंधित स्थानीय निकाय उत्पादन या बिक्री क्षमता को ध्यान में रखते हुए अधिक प्लास्टिक अपशिष्ट प्रबंधन शुल्क निर्धारित कर सकता है। पंजीकृत दुकानदार प्रमुख स्थान पर प्रदर्शित करेगा कि प्लास्टिक कैरी बैग भुगतान करने पर दिए जाते हैं।

(2) वस्तुओं का वितरण करने के लिए प्लास्टिक कैरी बैग उपलब्ध कराने के लिए केवल पंजीकृत दुकानदार या पथ विक्रेता पात्र होंगे।

(3) शहरी स्थानीय निकाय कैरी बैगों के लिए उपभोक्ताओं द्वारा संदत रकम का अनन्यत: उपयोग अपनी अधिकारिताओं के भीतर अपशिष्ट प्रबंधन प्रणाली की संधार्यता के लिए करेगा।

16. राज्य स्तरीय मॉनीटरिंग समिति.- (1) राज्य सरकार या संघ राज्य क्षेत्र, इन नियमों के क्रियान्वयन के प्रभावी मॉनीटरिंग करने के प्रयोजन के लिए राज्य स्तरीय सलाहकार समिति का गठन करेगा जिसमें निम्नलिखित व्यक्ति होंगे, अर्थात :-

(क)	सचिव, शहरी विकास विभाग	-	अध्यक्ष
(ख)	राज्य पर्यावरण विभाग से निदेशक	-	सदस्य
(ग)	राज्य प्रदूषण नियंत्रण बोर्ड या प्रदूषण नियंत्रण समिति से सदस्य सचिव	-	सदस्य
(घ)	म्युनिसिपल कमीशनर	-	सदस्य
(ङ)	स्थानीय निकाय से एक विशेषज्ञ		सदस्य
(च)	गैर सरकारी संगठन से एक विशेषज्ञ जो अपशिष्ट प्रबंधन में शामिल हो	-	सदस्य
(छ)	कमीशनर वैल्यु ऐडेड टैक्स या उसका प्रतिनिधि	-	सदस्य
(ज)	बिक्री कर कमीशनर या अधिकारी	-	सदस्य
(झ)	प्लास्टिक संघ, ड्रग मॅन्युफैक्चरर एसोसिएशन, केमिकल मॅन्युफैक्चरर	-	सदस्य

एसोसिएशन का प्रतिनिधि

(ञ) उद्योग क्षेत्र से एक विशेषज्ञ - सदस्य

(ट) शिक्षा संस्था के क्षेत्र से एक विशेषज्ञ - सदस्य

(ठ) निदेशक, म्युनिसिवल प्रशासन - संयोजक

राज्य स्तरीय सलाहकार निकाय छह माह में कम से कम एक बार बैठक करेगा और यदि वह आवश्यक समझता है तो विशेषज्ञों को आमंत्रित कर सकेगा।

17. वार्षिक रिपोर्टें.- (1) प्लास्टिक अपशिष्ट के पुन:चक्रण या प्रसंस्करण में लगा प्रत्येक व्यक्ति प्ररूप 4 में वार्षिक रिपोर्ट्स तैयार करेगा और प्रत्येक वर्ष के 30 अप्रैल तक संबद्ध राज्य प्रदूषण नियंत्रण बोर्ड प्रदूषण नियंत्रण समिति की सूचना के अधीन संबद्ध शहरी स्थानीय निकाय को प्रस्तुत करेगा।

(2) प्रत्येक शहरी स्थानीय निकाय प्रत्येक वर्ष की 30 जून संबद्ध राज्य प्रदूषण नियंत्रण बोर्ड प्रदूषण नियंत्रण समिति की सूचना के अधीन शहरी विकास के संबद्ध भारसाधक सचिव को प्ररूप-5 में वार्षिक रिपोर्ट तैयार करेगा और प्रस्तुत करेगा।

(3) प्रत्येक राज्य प्रदूषण नियंत्रण बोर्ड या प्रदूषण समिति, प्रत्येक वर्ष 31 जुलाई तक इन नियमों के क्रियान्वयन पर प्ररूप-VI में वार्षिक रिपोर्ट तैयार करेगा और केन्द्रीय प्रदूषण नियंत्रण बोर्ड को प्रस्तुत करेगा।

(4) केन्द्रीय प्रदूषण नियंत्रण बोर्ड, प्लास्टिक अपशिष्टों के उपयोग और प्रबंधन पर समेकित एक वार्षिक रिपोर्ट तैयार करेगा और उसको प्रत्येक वर्ष 31 अगस्त से पूर्व अपनी सिफारिशों के साथ केन्द्रीय सरकार को अग्रेषित करेगा।

अनुसूची-I

(नियम 10 देखें)

1.	भा.मा./भा.मा.स.14851:1999 जलीय माध्यम से प्लास्टिक सामग्री की अंतिम (अल्टीमेट) ऑक्सी जैव विघटनीयता ज्ञात करना - बंद रेसपीरोमीटर में ऑक्सीजन की आवश्यकता मापन द्वारा पद्धति
2.	भा.मा./भा.मा.स.14852:1999 जलीय माध्यम में प्लास्टिक सामग्री की अंतिम (अल्टीमेट) ऑक्सी विघटनीयता ज्ञात करना - उत्पन्न कार्बन डाइऑक्साइड के विश्लेषण द्वारा पद्धति
3.	भा.मा./भा.मा.स.14853:2005 प्लास्टिक - जलीय तंत्र में प्लास्टिक सामग्री की अंतिम (अल्टीमेट) ऑक्सी जैव विघटनीयता ज्ञात करना - बायोगैस उत्पादन के मापन द्वारा पद्धति
4.	भा.मा./भा.मा.स.14855-1:2005 नियंत्रिक संघटक स्थितियों में प्लास्टिक सामग्री की अंतिम (अल्टीमेट) ऑक्सी जैव विघटनीयता ज्ञात करना - उत्पन्न कार्बन डाईऑक्साइड के विश्लेषण द्वारा पद्धति (भाग-1 सामान्य पद्धति)
5.	भा.मा./भा.मा.स.14855-2:2007 नियंत्रिक संघटक स्थितियों में प्लास्टिक सामग्री की अंतिम (अल्टीमेट) ऑक्सी जैव विघटनीयता ज्ञात करना - उत्पन्न कार्बन डाइऑक्साइड के विश्लेषण द्वारा पद्धति (भाग-2; प्रयोगशाला-स्केल परीक्षण में उत्पन्न कार्बन डाइऑक्साइड का भारात्मक मापन)
6.	भा.मा./भा.मा.स.15985:2004 प्लास्टिक - 4उच्च ठोसता की अनॉक्सी (एनोरोबिक) डाइजेशन स्थितियों में अंतिम (अल्टीमेट) अनॉक्सी (एनोरोबिक) जैव विघटनीयता एवं विघटन ज्ञात करना - निकली बायोगैस की विश्लेषण पद्धति
7.	भा.मा./भा.मा.स.16929:2002 प्लास्टिक - पायलट मापन परीक्षण में परिभाषित संघटक स्थितियों में प्लास्टिक सामग्री के विघटन का स्तर ज्ञात करना
8.	भा.मा./भा.मा.स.17556:2003 प्लास्टिक - रेसपीरोमीटर में ऑक्सीजन की आवश्यकता अथवा उत्पन्न कार्बन डाइऑक्साइड के मापन द्वारा मृदा में अंतिम (अल्टीमेट) ऑक्सी जैव विघटनीयता ज्ञात करना
9.	भा.मा./भा.मा.स.20200:2004 प्लास्टिक - प्रयोगशाला में अनुरूपी कंपोस्टिंग स्थितियों में प्लास्टिक सामग्रियों के विघटन का स्तर ज्ञात करना - स्केल परीक्षण

प्ररूप-I

[नियम 13(2) देखें]

उत्पादकों या ब्रांड स्वामियों के रजिस्ट्रीकरण के लिए आवेदन

प्रेषक .....

.....

..... (अधिष्ठाता का नाम और पूरा पता)

सेवा में,

सदस्य सचिव,

..... प्रदूषण नियंत्रण बोर्ड/प्रदूषण नियंत्रण समिति

.....

.....

महोदय,

मैं/हम प्लास्टिक अपशिष्ट (प्रबंधन) नियम, 2015 के नियम 9 के अधीन पंजीकरण के लिए आवेदन करता हूं/करते हैं।

I. उत्पादक

	भाग-क साधारण	
1. (क)	इकाई का नाम और अवस्थिति	
(ख)	इकाई का नाम	
(ग)	निम्नलिखित के विनिर्माण के लिए अपेक्षित पंजीकरण : (i) कैरी बैग [(क) पैट्रो आधारित, (ख) कंपोस्ट योज्य] (ii) बहुस्तरीय प्लास्टिक	
(घ)	विनिर्माण क्षमता	
(ड.)	नवीकरण की दशा में, पूर्व रजिस्ट्रीकरण संख्या और रजिस्ट्रीकरण की तारीख	
2.	क्या इकाई, राज्य सरकार/संघ राज्य क्षेत्र प्रशासन में जिला उद्योग केन्द्र में रजिस्ट्रीकरण है? यदि हां, तो प्रति संलग्न करें।	
3. (क)	परियोजना पर निवेशित कुल पूंजी	
(ख)	उत्पादन आरंभ करने का वर्ष	
4. (क)	उत्पादों और उप उत्पादों की सूची और मात्रा	
(ख)	प्रयुक्त कच्ची सामग्री की सूची और मात्रा	
5.	उत्पादों और उत्पादित अपशिष्ट निबंधनों में जिसके अधीन केप्टिव विद्युत उत्पादन और जल भी है, निवेश और उत्पादन को दर्शित करते हुए विनिर्माणकारी प्रक्रिया का एक प्रवाहित डायग्राम प्रस्तुत करें।	
6.	इन नियमों के अनुपालन की प्रास्थिति - मोटाई - पचास माइक्रोन (हां/नहीं)	
	भाग-ख द्रव बहिस्राव और गैसीय उत्सर्जन से संबंधित	
7.	(क) क्या इकाई, जल (प्रदूषण निवारण और नियंत्रण) अधिनियम, 1974 (1974 का 6) के अधीन विधिमान्य सहमति रखती है? यदि हां, तो प्रति संलग्न करें।	
	(ख) क्या इकाई, वायु (प्रदूषण निवारण और नियंत्रण) अधिनियम, 1981 (1981 का 14) के अधीन विधिमान्य सहमति रखती है? यदि हां, तो प्रति संलग्न करें।	
	भाग-ग	

अपशिष्ट से संबंधित		
8.	ठोस अपशिष्ट : (क) उत्पादित अपशिष्ट की कुल मात्रा (ख) संयंत्र के भीतर भंडारण की पद्धति (ग) अपशिष्टों के व्ययन के लिए किए गए अपबंध	
9.	कैरी बैग अथवा समान प्रकार की प्लास्टिक शीट अथवा बहुस्तरीय पैकेजिंग के विनिर्माण के लिए कच्ची सामग्री के रूप में प्रयुक्त किए जाने के लिए प्लास्टिक की आपूर्ति करने वाले व्यक्तियों की सूची संलग्न करें/उपलब्ध कराएं।	
10.	उन कार्मिकों या ब्रांड स्वामियों की सूची संलग्न करें/उपलब्ध कराएं जिन्हें उत्पादों की आपूर्ति की जाएगी	
11.	प्लास्टिक अपशिष्ट का वापस संग्रहण करने की कार्य योजना	
		नाम और हस्ताक्षर पदनाम
तारीख : स्थान :		

II ब्रांड स्वामी

भाग-क सामान्य		
1.	नाम, पता और संपर्क नम्बर	
2.	नवीकरण की दशा में पिछला रजिस्ट्रीकरण नम्बर और रजिस्ट्रीकरण की तारीख	
3.	क्या इकाई राज्य सरकार या संघ राज्य क्षेत्र के जिला उद्योग केन्द्र या डीसीएसएसआई में रजिस्ट्रीकृत है? यदि हां, तो प्रति संलग्न करें।	
4.(क)	परियोजना में निवेशित कुल पूंजी	
(ख)	उत्पादन प्रारंभ करने का वर्ष	
5.(क)	उत्पादों और उप उत्पादों की सूची और मात्रा	
(ख)	प्रयुक्त कच्ची सामग्री की सूची और मात्रा	
भाग - ख द्रव बहिस्राव और गैसीय उत्सर्जन से संबंधित		
5.	(क) क्या इकाई, जल (प्रदूषण निवारण और नियंत्रण) अधिनियम, 1974 (1974 का 6) के अधीन विधिमान्य सहमति रखती है? यदि हां, तो प्रति संलग्न करें।	
6.	(ख) क्या इकाई, वायु (प्रदूषण निवारण और नियंत्रण) अधिनियम, 1981 (1981 का 14) के अधीन विधिमान्य सहमति रखती है? यदि हां, तो प्रति संलग्न करें।	

भाग-ग अपशिष्ट से संबंधित		
7.	ठोस अपशिष्ट : (क) उत्पादित अपशिष्ट की कुल मात्रा (ख) संयंत्र के भीतर भंडारण की पद्धति (ग) अपशिष्टों के व्ययन के लिए किए गए अपबंध	

8.	उन कार्मिकों या ब्रांड स्वामियों की सूची संलग्न करें/उपलब्ध कराएं जिन्हें उत्पादों की आपूर्ति की जाएगी	
9.	प्लास्टिक अपशिष्ट का वापस संग्रहण करने की कार्य योजना	
		नाम और हस्ताक्षर पदनाम
तारीख : स्थान :		

प्रपत्र - II

[नियम 13 (3) देखें)]

प्लास्टिक अपशिष्ट के प्रसंस्करण एवं पुनर्चक्रण में संलग्न इकाइयों के पंजीकरण हेतु आवेदन-प्रपत्र

1.	इकाई का नाम और पता				
2.	संपर्क व्यक्ति, पदनाम, टेलीफोन/फैक्स/ई-मेल सहित				
3.	प्रारंभ किए जाने की तारीख				
4.	कर्मकारों की संख्या (संविदा श्रम सहित)				
5.	सहमति विधिमान्यता	क. जल (प्रदूषण निवारण तथा नियंत्रण) अधिनियम, 1974 ..... तक विधिमान्य ख. वायु (प्रदूषण निवारण तथा नियंत्रण) अधिनियम, 1981 ..... तक विधिमान्य ग. प्राधिकरण ; ..... तक विधिमान्य			
6.	विनिर्माण प्रक्रिया	कृपया विनिर्माण, प्रक्रिया का प्रवाहित डायग्राम संलगन करें प्रत्येक उत्पाद के लिए प्रवाहित डायग्राम।			
7.	उत्पाद और उत्पादन की संस्थित क्षमता (एमटीए)	उत्पाद		संस्थित क्षमता	
8.	अपशिष्ट प्रबंधन	क्रम सं.	किस्म	श्रेणी	मात्रा
	क. प्लास्टिक अपशिष्ट में अपशिष्ट जनन	(i)			
		(ii)			
		(iii)			
	ख. अपशिष्ट संग्रह और परिवहन (विवरण संलगन करें)				
	ग. अपशिष्ट निपटान का विवरण	क्रम सं.	किस्म	श्रेणी	मात्रा
		(i)			
		(ii)			
	घ. निपटान सुविधा का ब्यौरा उपलब्ध कराएं, क्या सुविधा एसपीसीबी या पीसीसी द्वारा प्राधिकृत है				
	ड. कृपया जनित अपशिष्ट के वर्गीकरण की विश्लेषण रिपोर्ट संलग्न करें (यदि लागू हो तो लीचेट परीक्षण सहित)				
9.	कच्ची सामग्री के रूप में उपयोग के लिए, यथा स्थिति, बिक्री, नीलामी, संविदा या आयात के जरिए अर्जित होने वाले प्रस्तावित प्लास्टिक अपशिष्ट का ब्यौरा	(i) नाम (ii) प्रति वर्ष अपेक्षित मात्रा			
10.	व्यावसायिक सुरक्षा और स्वास्थ्य संबंधी पहलू	कृपया सुविधाओं का ब्यौरा दें			
11.	प्रदूषण नियंत्रण के उपाय				
	क्या उत्सर्जन या बहि:स्राव के मानकों को पूरा करने के				

	लिए इकाई के पास पर्याप्त प्रदूषण नियंत्रण प्रणालियां या उपस्कर है।	
	क्या इकाई उक्त नियमों में निर्धारित शर्तों का अनुपालन करती है।	
	क्या हथालन अथवा प्रसंस्कृत की जारी सामग्री के पर्यावरण पर पड़ने वाले तत्काल या विलंब से पड़ने वाले प्रतिकूल प्रभाव के लिए परिस्थितियां विद्यमान हैं या विद्यमान होने की संभावना है।	
	क्या हथालन अथवा प्रसंस्कृत की जा रही सामग्री किसी भी साधन से अन्य सामग्री (अर्थात् लीचेट) उत्पन्न करने में सक्षम है, उसके लिए परिस्थितियां विद्यमान हैं (या विद्यमान होने की संभावना है जिसमें विषाक्तता हो सकती है)	
12.	कोई अन्य प्रासंगिक सूचना, जिसमें अग्नि या दुर्घटना प्रशमनकारी उपाय शामिल है	
13.	नियमानुसार संलग्नों की सूची	

नाम और हस्ताक्षर

पदनाम

तारीख :

स्थान :

प्ररूप-III

[नियम 13(4) देखें]

अपरिष्कृत प्लास्टिक विनिर्माताओं के लिए पंजीकरण हेतु आवेदन पत्र

प्रेषक .....

.....

..... (अधिष्ठाता का नाम और पूरा पता)

सेवा में,

सदस्य सचिव,

..... प्रदूषण नियंत्रण बोर्ड/प्रदूषण नियंत्रण समिति

.....

.....

महोदय,

मैं/हम प्लास्टिक अपशिष्ट प्रबंधन नियम, 2011 के अंतर्गत पंजीकरण हेतु आवेदन करता हूं/करते हैं।

भाग-क सामान्य		
1. (क)	इकाई का नाम और अवस्थिति	
(ख)	इकाई का पता	
(ग)	नवीकरण के मामले में, पिछली रजिस्ट्रीकरण संख्या और रजिस्ट्रीकरण की तारीख	
2.	क्या यह इकाई राज्य सरकार/संघ राज्य क्षेत्र की डीआईसी/डीसीएसएसआई में रजिस्ट्रीकृत है? यदि हो, तो	

	रजिस्ट्रीकरण की प्रति संलग्न करें।	
3. (क)	परियोजना पर निवेश की गई कुल पूंजी	
(ख)	उत्पादन शुरू करने का वर्ष	
(ग)	उत्पादकों की सूची और उत्पादकों को आपूर्ति किए गए कच्चे माल की प्रमात्रा	
		नाम और हस्ताक्षर पदनाम
तारीख : स्थान :		

प्ररूप-IV

(नियम 17(1) देखें)

स्थानीय निकाय को प्लास्टिक प्रसंस्करण या पुन:चक्रण सुविधा के प्रचालनकर्ता द्वारा प्रस्तुत की जाने वाली वार्षिक रिपोर्ट का प्रपत्र

रिपोर्टिंग की अवधि :

(1)	सुविधा के प्रचालकर्ता का नाम और पता	
(2)	सुविधा के प्रभारी अधिकारी का नाम (दूरभाष/फैक्स/मोबाइल/ई-मेल)	
(3)	क्षमता :	
(4)	प्लास्टिक अपिशष्ट के प्रबंधन हेतु प्रयुक्त प्रौद्योगिकियां :	
(5)	प्रस्तुत रिपोर्ट के वर्ष के दौरान प्राप्त प्लास्टिक अपशिष्ट की प्रमात्रा तथा उसका स्रोत	
(6)	प्रसंस्कृत प्लास्टिक अपशिष्ट की प्रमात्रा (टनों में) : - पुनर्चक्रित पलास्टिक अपशिष्ट (टन में) - प्रसंस्कृत प्लास्टिक अपशिष्ट (टन में) - उपयोग में लाया गया (टन में)	
(7)	खत्ता स्थलों में अंतिम निपटान हेतु भेजे गए बेकार/अस्वीकृत अपशिष्टों की प्रमात्रा :	
(8)	उस खत्ता सुविधा का ब्यौरा जहां बेकार/अस्वीकृत अपशिष्टों को अंतिम निपटान हेतु भेजा गया है : - पता - दूरभाष	
(9)	सहमति प्रदान करने या पंजीकरण के दौरान यदि कोई पर्यावरणीय शर्त विनिर्दिष्ट की गई हो तो उसके अनुपालन की स्थिति संलग्न करें।	

प्रचालनकर्ता के हस्ताक्षर

तारीख :

स्थान :

प्ररूप-V

(नियम 17(2) देखें)

स्थानीय निकाय द्वारा प्रस्तुत की जाने वाली प्लास्टिक अपशिष्ट प्रबंधन संबंधी वार्षिक रिपोर्ट का प्रपत्र

रिपोर्ट प्रस्तुत करने की अवधि :

(1)	शहर/नगर और राज्य का नाम	
(2)	जनसंख्या	
(3)	वर्ग किलोमीटर में क्षेत्र	
(4)	स्थानीय निकाय का नाम और पता टेलीफोन सं. फैक्स सं. ई-मेल :	
(5)	क्षेत्राधिकार के अंतर्गत क्षेत्र में वार्डों की कुल संख्या	
(6)	क्षेत्राधिकार के अंतर्गत क्षेत्र में घरों की कुल संख्या	
(7)	घर-घर जाकर किए गए एकत्र करने में शामिल घरों की संख्या	
(8)	क्षेत्राधिकार के अंतर्गत क्षेत्र में वाणिज्यिक संस्थाओं और संस्थानों की कुल संख्या - वाणिज्यिक संस्थाएं - संस्थान	
(9)	प्रत्येक संस्थान/संस्थान में जाकर एकत्र करने के लिए सम्मिलित वाणिज्यिक संस्थाओं और संस्थानों की संख्या - वाणिज्यिक संस्थाएं - संस्थान	
(10)	घर-घर जाकर एकत्रण में शामिल एजेंसियों के ब्यौरे सहित क्षेत्राधिकार के अंतर्गत क्षेत्र में प्लास्टिक अपशिष्ट के प्रबंधन हेतु तैयार किए गए तंत्रों का सारांश	
(11)	क्षेत्राधिकार के अंतर्गत क्षेत्र में उत्पन्न प्लास्टिक अपशिष्ट के प्रबंधन हेतु तैयार की गई अवसंरचना का ब्यौरा संलग्न करें	
(12)	अपेक्षित अवसंरचना, यदि कोई हो, के औचित्य सहित उसका ब्यौरा संलग्न करें	
(13)	क्षेत्राधिकार के अंतर्गत वर्ष के दौरान उत्पन्न प्लास्टिक अपशिष्ट की मात्रा (टन में)	
(14)	क्षेत्राधिकार के अंतर्गत क्षेत्र से वर्ष के दौरान एकत्रित किए गए प्लास्टिक अपशिष्ट की मात्रा (टन में)	
(15)	वर्ष के दौरान पुनर्चक्रण हेतु भेजे गए प्लास्टिक अपशिष्ट की मात्रा (टन में)	
(16)	वर्ष के दौरान उपयोग हेतु भेजे गए प्लास्टिक अपशिष्ट की मात्रा (टन में)	
(17)	वर्ष के दौरान भू-भराव स्थलों को भेजे गए बेकार/अस्वीकृत प्लास्टिक अपशिष्ट की मात्रा (टन में)	
(18)	प्लास्टिक अपशिष्ट के प्रसंस्करण और निपटान हेतु प्रयुक्त प्रत्येक सुविधा का ब्यौरा **सुविधा-1** i) प्रचालक का नाम ii) टेलीफोन नंबर/मोबाइल नंबर सहित पता iii) क्षमता iv) प्रयुक्त प्रौद्योगिकी v) पंजीकरण संख्या	

	vi) पंजीकरण की वैधता (तक) **सुविधा-2** i) प्रचालक का नाम ii) टेलीफोन नंबर/मोबाइल नंबर सहित पता iii) क्षमता iv) प्रयुक्त प्रौद्योगिकी v) पंजीकरण संख्या vi) पंजीकरण की वैधता (तक)	
(19)	ब्यौरा दें : गली की सफाई, अपशिष्ट के द्वितीयक भंडारण, परिवहन, प्रसंस्करण और निपटान सहित एकत्रण हेतु तैनात की गई स्थानीय निकायों की निजी जनशक्ति।	
(20)	ब्यौरा दें : गली की सफाई, अपशिष्ट के द्वितीयक भंडारण, परिवहन, प्रसंस्करण और निपटान सहित एकत्रण हेतु तैनात की गई ठेकेदार/ग्रहियों की जनशक्ति।	
(21)	वित्तीय बाध्यताओं, सहित इन नियमों के उपबंधों के अनुपालन में शहरी स्थानीय निकाय द्वारा अनुभव की जा रही कठिनाइयों, यदि कोई हों, का उल्लेख करें	
(22)	क्या शहर में ठोस अपशिष्ट प्रबंधन पद्धतियों में सुधार करने के लिए कार्य योजना तैयार की गई है? यदि हो तो (प्रति संलग्न करें) संशोधन की तारीख :	

मुख्य कार्यकारी अधिकारी/नगर आयुक्त/कार्यकारी अधिकारी/

मुख्य अधिकारी के हस्ताक्षर

तारीख :

स्थान :

<u>प्ररूप-</u>VI

<u>प्लास्टिक अपशिष्ट प्रबंधन नियम, 2016 के कार्यान्वयन की वर्ष ..... की राज्यवार स्थिति</u>

राज्य प्रदूषण नियंत्रण बोर्ड अथवा प्रदूषण नियंत्रण समिति का नाम	अनुमानित प्लास्टिक अपशिष्ट जनन टन प्रति वर्ष (टीपीए)	रजिस्ट्रीकृत प्लास्टिक विनिर्माता या पुन: चक्रण इकाइयों की संख्या (प्रवर्धक, कंपोस्ट योज्य सहित) (नियम 9)			गैर-रजिस्ट्रीकृत प्लास्टिक विनिर्माता या पुन:चक्रण इकाईयों की संख्या (आवासीय या अनधिकृत क्षेत्रों में)	प्लास्टिक अपशिष्ट प्रबंधन का विवरण (पीडब्ल्यूएम) अर्थात संग्रहण, पृथक्करण, निपटान (सह-प्रसंस्करण सड़क निर्माण आदि) (नियम 6) (अलग पृष्ठ संलग्न करें)	प्लास्टिक कैरी बैग के उपयोग पर आंशिक अथवा पूर्ण प्रतिबंध (कार्यकारी आदेश के जरिए) (अधिसूचना या कार्यकारी आदेश की प्रति संलग्न करें)	कैरी बैग पर मार्क करने, लेबल लगाने की स्थिति (नियम 8) (अनुपालन करने/अनुपालन नहीं करने वाली इकाइयों की संख्या का उल्लेख करें)	कैरी बैगों का स्पष्ट मूल्य निर्धारण करना (नियम 10)	राज्य स्तरीय सलाहकार संस्था (एसएलए) की बैठकों तथा साथ ही कार्यान्वियन के संबंध में इसकी सिफारिशों का विवरण (नियम 11)	उल्लंघनों की संख्या और इन नियमों के प्रावधानों का पालन नहीं करने पर की गई कारवाई	क्षेत्राधिकार के अधीन म्यूनिसिपल प्राधिकरणों या ग्राम पंचायतों की संख्या और केन्द्रीय प्रदूषण नियंत्रण बोर्ड को वार्षिक रिपोर्ट प्रस्तुत करना (नियम 12)
		प्लास्टिक इकाई	कंपोस्ट योज्य प्लास्टिक इकाई	बहुस्तरीय प्लास्टिक इकाई								
(1)	(2)	(3)			(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)

[फा. सं. 17—2/2001—एचएसएमडी]

विश्वनाथ सिन्हा, संयुक्त सचिव

MINISTRY OF ENVIRONMENT, FOREST AND CLIMATE CHANGE

NOTIFICATION

New Delhi, the 18th March, 2016

G.S.R. 320(E).—Whereas the Plastic Waste (Management and Handling) Rules, 2011 published vide notification number S.O 249(E), dated 4th February, 2011 by the Government of India in the erstwhile Ministry of Environment and Forests, as amended from time to time, provided a regulatory frame work for management of plastic waste generated in the country;

And whereas, to implement these rules more effectively and to give thrust on plastic waste minimization, source segregation, recycling, involving waste pickers, recyclers and waste processors in collection of plastic waste fraction either from households or any other source of its generation or intermediate material recovery facility and adopt polluter's pay principle for the sustainability of the waste management system, the Central Government reviewed the existing rules;

And whereas, in exercise of the powers conferred by sections 6, 8 and 25 of the Environment (Protection) Act, 1986 (29 of 1986), the draft rules, namely, the Plastic Waste Management, Rules, 2015 were published by the Government of India in the Ministry of Environment, Forest and Climate Change *vide* number G.S.R. 423(E), dated the 25th May, 2015 in the Gazette of India, inviting objections and suggestions from all persons likely to be affected thereby, before the expiry of a period of sixty days from the date on which copies of the Gazette containing the said notification were made available to the public;

And Whereas copies of the said Gazette were made available to the public on the 25th May, 2015;

And Whereas the objections and suggestions received within the said period from the public in respect of the said draft rules have been duly considered by the Central Government**;**

NOW, Therefore, in exercise of the powers conferred by sections 3, 6 and 25 of the Environment (Protection) Act, 1986 (29 of 1986), and in supersession of the Plastic Waste (Management and Handling) Rules, 2011, except as respects things done or omitted to be done before such supersession, the Central Government hereby makes the following rules, namely:-

1. Short title and commencement.- (1) These rules shall be called the Plastic Waste Management Rules, 2016.

(1) Save as otherwise provided in these rules, they shall come into force on the date of their publication in the Official Gazette.

2. Application.-(1) These rules shall apply to every waste generator, local body, Gram Panchayat, manufacturer, Importers and producer.

(2) The rule 4 shall not apply to the export oriented units or units in special economic zones, notified by the Central Government, manufacturing their products against an order for export: Provide this exemption shall not apply to units engaged in packaging of gutkha, tobacco and pan masala and also to any surplus or rejects, left over products and the like.

3. Definitions.- In these rules, unless the context otherwise requires.-

(a) **"Act"** means the Environment (Protection) Act, 1986 (29 of 1986);

(b) **"brand owner"** means a person or company who sells any commodity under a registered brand

label.

(c) **"carry bags"** mean bags made from plastic material or compostable plastic material, used for the purpose of carrying or dispensing commodities which have a self carrying feature but do not include bags that constitute or form an integral part of the packaging in which goods are sealed prior to use.

(d) **"commodity"** means tangible item that may be bought or sold and includes all marketable goods or wares;

(e) "**compostable plastics**" mean plastic that undergoes degradation by biological processes during composting to yield CO_2, water, inorganic compounds and biomass at a rate consistent with other known compostable materials, excluding conventional petro-based plastics, and does not leave visible, distinguishable or toxic residue;

(f) **"consent"** means the consent to establish and operate from the concerned State Pollution Control Board or Pollution Control Committee granted under the Water (Prevention and Control of Pollution) Act, 1974 (6 of 1974), and the Air (Prevention and Control of Pollution) Act, 1981 (14 of 1981);

(g) "**disintegration**" means the physical breakdown of a material into very small fragments;

(h) **"extended producer's responsibility "** means the responsibility of a producer for the environmentally sound management of the product until the end of its life;

(i) **"food-stuffs"** mean ready to eat food products, fast food, processed or cooked food in liquid, powder, solid or semi-solid form;

(j) **"facility"** means the premises used for collection, Storage, recycling, processing and disposal of plastic waste;

(k) **"importer"** means a person who imports or intends to import and holds an Importer -Exporter Code number, unless otherwise specifically exempted.

(l) **"institutional waste generator"** means and includes occupier of the institutional buildings such as building occupied by Central Government Departments, State Government Departments, public or private sector companies, hospitals, schools, colleges, universities or other places of education, organisation, academy, hotels, restaurants, malls and shopping complexes;

(m) "**manufacturer"** means and include a person or unit or agency engaged in production of plastic raw material to be used as raw material by the producer.

(n) **"multilayered packaging"** means any material used or to be used for packaging and having at least one layer of plastic as the main ingredients in combination with one or more layers of materials such aspaper, paper board, polymeric materials, metalised layers or aluminium foil, either in the form of a laminate or co-extruded structure;

(o) **"plastic"** means material which contains as an essential ingredient a high polymer such as polyethylene terephthalate, high density polyethylene, Vinyl, low density polyethylene, polypropylene, polystyrene resins, multi-materials like acrylonitrile butadiene styrene, polyphenylene oxide, polycarbonate, Polybutylene terephthalate;

(p) **"plastic sheet"** means Plastic sheet is the sheet made of plastic;

(q) **"plastic waste"**means any plastic discardedafter use or after their intended use is over;

(r) **"prescribed authority"** means the authorities specified in rule 12;

(s) **"producer"** means persons engaged in manufacture or import of carry bags or multilayered packaging or plastic sheets or like, and includes industries or individuals using plastic sheets or like or covers made of plastic sheets or multilayered packaging for packaging or wrapping the commodity;

(t) **"recycling"** means the process of transforming segregated plastic waste into a new product or raw material for producing new products;

(u) **"registration"** means registration with the State Pollution Control Board or Pollution Control Committee concerned, as the case may be;

(v) **"street vendor"** shall have the same meaning as assigned to it in clause (l) of sub-section (1) of Section 2 of the Street Vendors (Protection of Livelihood and Regulation of Street Vending) Act, 2014 (7 of 2014);

(w) **"local body"** means urban local body with different nomenclature such as municipal corporation, municipality, nagarpalika, nagarnigam, nagarpanchayat, municipal council including notified area committee (NAC) and not limited to or any other local body constituted under the relevant statutes such as gram panchayat, where the management of plastic waste is entrusted to such agency;

(x) **"virgin plastic"** means plastic material which has not been subjected to use earlier and has also not been blended with scrap or waste;

(y) **"waste generator"** means and includes every person or group of persons or institution, residential and commercial establishments including Indian Railways, Airport, Port and Harbour and Defense establishments which generate plastic waste;

(z) **"waste management"** means the collection, storage, transportation reduction, re-use, recovery, recycling, composting or disposal of plastic waste in an environmentally safe manner;

(aa) **"waste pickers"** mean individuals or agencies, groups of individuals voluntarily engaged or authorised for picking of recyclable plastic waste.

4. Conditions.- (1) The manufacture, importer stocking, distribution, sale and use of carry bags, plastic sheets or like, or cover made of plastic sheet and multilayered packaging, shall be subject to the following conditions, namely:-

a) carry bags and plastic packaging shall either be in natural shade which is without any added pigments or made using only those pigments and colourants which are in conformity with Indian Standard : IS 9833:1981 titled as "List of pigments and colourants for use in plastics in contact with foodstuffs, pharmaceuticals and drinking water", as amended from time to time;

b) Carry bags made of recycled plastic or products made of recycled plastic shall not be used for storing, carrying, dispensing or packaging ready to eat or drink food stuff';

c) carry bag made of virgin or recycled plastic, shall not be less than fifty microns in thickness;

d) plastic sheet or like, which is not an integral part of multilayered packaging and cover made of plastic sheet used for packaging, wrapping the commodity shall not be less than fifty microns in thickness except where the thickness of such plastic sheets impair the functionality of the product;

e) the manufacturer shall not sell or provide or arrange plastic to be used as raw material to a producer, not having valid registration from the concerned State Pollution Control Boards or Pollution Control Committee;

f) sachets using plastic material shall not be used for storing, packing or selling gutkha, tobacco and pan masala;

g) recycling of plastic waste shall conform to the Indian Standard: IS 14534:1998 titled as Guidelines for Recycling of Plastics, as amended from time to time;

h) The provision of thickness shall not be applicable to carry bags made up of compostable plastic. Carry bags made from compostable plastics shall conform to the Indian Standard: IS 17088:2008 titled as Specifications for Compostable Plastics, as amended from time to time. The manufacturers or seller of compostable plastic carry bags shall obtain a certificate from the Central Pollution Control Board before marketing or selling; and

i) plastic material, in any form including Vinyl Acetate - Maleic Acid - Vinyl Chloride Copolymer, shall not be used in any package for packaging gutkha, pan masala and tobacco in all forms.

5. Plastic waste management.- (1) The plastic waste management by the urban local bodies in their respective jurisdiction shall be as under:-

(a) plastic waste, which can be recycled, shall be channelized to registered plastic waste recycler and recycling of plastic shall conform to the Indian Standard: IS 14534:1998 titled as Guidelines for Recycling of Plastics, as amended from time to time.

(b) local bodies shall encourage the use of plastic waste (preferably the plastic waste which cannot be further recycled) for road construction as per Indian Road Congress guidelines or energy recovery or waste to oil etc. The standards and pollution control norms specified by the prescribed authority for these technologies shall be complied with.

(c) Thermo set plastic waste shall be processed and disposed off as per the guidelines issued from time to time by the Central Pollution Control Board.

(d) The inert from recycling or processing facilities of plastic waste shall be disposed of in compliance with the Solid Waste Management Rules, 2000 or as amended from time to time.

6. Responsibility of local body.- (1) Every local body shall be responsible for development and setting up of infrastructure for segregation, collection, storage, transportation, processing and disposal of the plastic waste either on its own or by engaging agencies or producers.

(2) The local body shall be responsible for setting up, operationalisation and co-ordination of the waste management system and for performing the associated functions, namely:-

(a) Ensuring segregation, collection, storage, transportation, processing and disposal of plastic waste;

(b) ensuring that no damage is caused to the environment during this process;

(c) ensuring channelization of recyclable plastic waste fraction to recyclers;

(d) ensuring processing and disposal on non-recyclable fraction of plastic waste in accordance with the guidelines issued by the Central Pollution Control Board;

(e) creating awareness among all stakeholders about their responsibilities;

(f) engaging civil societies or groups working with waste pickers; and

(g) ensuring that open burning of plastic waste does not take place.

(3) The local body for setting up of system for plastic waste management shall seek assistance of producers and such system shall be set up within one year from the date of final publication of these rules in the Official Gazaette of India.

(4) The local body to frame bye-laws incorporating the provisions of these rules.

7. Responsibility of Gram Panchayat.- (1) Every gram panchayat either on its own or by engaging an agency shall set up, operationalise and co-ordinate for waste management in the rural area under their control and for performing the associated functions, namely,-

(a) ensuring segregation, collection, storage, transportation, plastic waste and channelization of recyclable plastic waste fraction to recyclers having valid registration; ensuring that no damage is caused to the environment during this process;

(b) creating awareness among all stakeholders about their responsibilities; and

(c) ensuring that open burning of plastic waste does not take place

8. Responsibility of waste generator.- (1) The waste generator shall.-

(a) take steps to minimize generation of plastic waste and segregate plastic waste at source in accordance with the Solid Waste Management Rules, 2000 or as amended from time to time.

(b) not litter the plastic waste and ensure segregated storage of waste at source and handover segregated waste to urban local body or gram panchayat or agencies appointed by them or registered waste pickers', registered recyclers or waste collection agencies;

(2) All institutional generators of plastic waste, shall segregate and store the waste generated by them in accordance with the Municipal Solid Waste (Management and Handling) Rules, 2000 notified vide S.O. 908(E) dated the 25th September, 2000 under the Act or amendment from time to time and handover

segregated wastes to authorized waste processing or disposal facilities or deposition centers either on its own or through the authorized waste collection agency.

(3) All waste generators shall pay such user fee or charge as may be specified in the bye-laws of the local bodies for plastic waste management such as waste collection or operation of the facility thereof, etc.;

(4) Every person responsible for organising an event in open space, which involves service of food stuff in plastic or multilayered packaging shall segregate and manage the waste generated during such events in accordance with the Municipal Solid Waste (Management and Handling) Rules, 2000 notified vide
S.O. 908(E) dated the 25th September, 2000 under the Act or amendment from time to time.

9. Responsibility of producers, **Importers and Brand Owners.-** (1) The producers, within a period of six months from the date of publication of these rules, shall work out modalities for waste collection system based on Extended Producers Responsibility and involving State Urban Development Departments, either individually or collectively, through their own distribution channel or through the local body concerned.

(2) Primary responsibility for collection of used multi-layered plastic sachet or pouches or packaging is of Producers, Importers and Brand Owners who introduce the products in the market. They need to establish a system for collecting back the plastic waste generated due to their products. This plan of collection to be submitted to the State Pollution Control Boards while applying for Consent to Establish or Operate or Renewal. The Brand Owners whose consent has been renewed before the notification of these rules shall submit such plan within one year from the date of notification of these rules and implement with two years thereafter.

(3) manufacture and use of non- recyclable multilayered plastic if any should be phased out in Two years time.

(4) The producer, within a period of three months from the date of final publication of these rules in the Official Gazette shall apply to the Pollution Control Board or the Pollution Control Committee, as the case may be, of the States or the Union Territories administration concerned, for grant of registration.

(5) No producer shall on and after the expiry of a period of Six Months from the date of final publication of these rules in the Official Gazette manufacture or use any plastic or multilayered packaging for packaging of commodities without registration from the concerned State Pollution Control Board or the Pollution Control Committees.

(6) Every producer shall maintain a record of details of the person engaged in supply of plastic used as raw material to manufacture carry bags or plastic sheet or like or cover made of plastic sheet or multilayered packaging.

10. Protocols for compostable plastic materials.-Determination of the degree of degradability and degree of disintegration of plastic material shall be as per the protocols of the Indian Standards listed in Schedule-I to these rules.

11. Marking or labelling.-(1) Each plastic carry bag and multilayered packaging shall have the following information printed in English namely,-

(a) name, registration number of the manufacturer and thickness in case of carry bag;

(b) name and registration number of the manufacturer in case of multilayered packaging; and

(c) name and certificate number [Rule 4(h)] in case of carry bags made from compostable plastic

(2) Each recycled carry bag shall bear a label or a mark "recycled" as shown below and shall conform to the Indian Standard: IS 14534: 1998 titled as "Guidelines for Recycling of Plastics", as amended from time to time;

NOTE: PET-Polyethylene terephthalate, HDPE-High density polyethylene, V-Vinyl (PVC), LDPE- Low density polyethylene, PP-Polypropylene, PS-Polystyrene and Other means all other resins and multi-materials like ABS (Acrylonitrile butadiene styrene), PPO (Polyphenylene oxide), PC (Polycarbonate), PBT (Polybutylene terephalate) etc.

Each carry bag made from compostable plastics shall bear a label "compostable" and shall conform to the Indian Standard : IS or ISO 17088:2008 titled as Specifications for "Compostable Plastics".

12. Prescribed authority.- (1) The State Pollution Control Board and Pollution Control Committee in respect of a Union territory shall be the authority for enforcement of the provisions of these rules relating to registration, manufacture of plastic products and multilayered packaging, processing and disposal of plastic wastes.

(2) The concerned Secretary-in-charge of Urban Development of the State or a Union Territory shall be the authority for enforcement of the provisions of these rules relating to waste management by waste generator, use of plastic carry bags, plastic sheets or like, covers made of plastic sheets and multilayered packaging.

(3) The concerned Gram Panchayat shall be the authority for enforcement of the provisions of these rules relating to waste management by the waste generator, use of plastic carry bags, plastic sheets or like, covers made of plastic sheets and multilayered packaging in the rural area of the State or a Union Territory.

(4) The authorities referred to in sub-rules (1) to (3) shall take the assistance of the District Magistrate or the Deputy Commissioner within the territorial limits of the jurisdiction of the concerned district in the enforcement of the provisions of these rules.

13. Registration of producer, recyclers and manufacturer,- (1) No person shall manufacture carry bags or recycle plastic bags or multilayered packaging unless the person has obtained a registration from the State Pollution Control Board or the Pollution Control Committee of the Union Territory concerned, as the case may be, prior to the commencement of production;

(2) Every producer shall, for the purpose of registration or for renewal of registration, make an application to the State Pollution Control Board or the Pollution Control Committee of the Union territory concerned, in Form I

(3) Every person recycling or processing waste or proposing to recycle or process plastic waste shall make an application to the State Pollution Control Board or the Pollution Control Committee, for grant of registration or renewal of registration for the recycling unit, in Form II.

(4) Every manufacturer engaged in manufacturer of plastic to be used as raw material by the producer shall make an application to the State Pollution Control Board or the Pollution Control Committee of the Union territory concerned, for the grant of registration or for the renewal of registration, in Form III.

(5) The State Pollution Control Board or the Pollution Control Committee shall not issue or renew registration to plastic waste recycling or processing units unless the unit possesses a valid consent under the Water (Prevention and Control of Pollution) Act, 1974 (6 of 1974) and the Air (Prevention and Control of Pollution) Act, 1981 (14 of 1981) along with a certificate of registration issued by the District Industries Centre or any other Government agency authorised in this regard.

(6) The State Pollution Control Board or the Pollution Control Committee shall not renew registration of producer unless the producer possesses and action plan endorsed by the Secretary in charge of Urban Development of the concerned State or Union Territory for setting of plastic waste management system.

(7) On receipt of the application complete in all respects for the registration for recycling or processing of plastic waste under sub-rule (3), the State Pollution Control Board may, after such inquiry as it considers necessary and on being satisfied that the applicant possesses appropriate facilities, technical capabilities and equipment to handle plastic waste safely, may grant registration to the applicant on fulfilment of the conditions as may be laid down in terms of registration.

(8) Every State Pollution Control Board or Pollution Control Committee shall take a decision on the grant of registration within ninety days of receipt of an application which is complete in all respects.

(9) The registration granted under this rule shall initially be valid for a period of one year, unless revoked, suspended or cancelled and shall subsequently be granted for three years.

(10) State Pollution Control Board or the Pollution Control Committees shall not revoke, suspend or cancel registration without providing the opportunity of a hearing to the producer or person engaged in recycling or processing of plastic wastes.

(11) Every application for renewal of registration shall be made at least one hundred twenty days before the expiry of the validity of the registration certificate.

14. Responsibility of retailers and street vendors- (1) Retailers or street vendors shall not sell or provide commodities to consumer in carry bags or plastic sheet or multilayered packaging, which are not manufactured and labelled or marked, as per prescribed under these rules.

(2) Every retailers or street vendors selling or providing commodities in, plastic carry bags or multilayered packaging or plastic sheets or like or covers made of plastic sheets which are not manufactured or labelled or marked in accordance with these rules shall be liable to pay such fines as specified under the bye-laws of the local bodies.

15. Explicit pricing of carry bags.- (1) The shopkeepers and street vendors willing to provide plastic carry bags for dispensing any commodity shall register with local body. The local body shall, within a period of six months from the date of final publication of these rules ion the Official Gazette of India notification of these rules, by notification or an order under their appropriate state statute or byelaws shall make provisions for such registration on payment of plastic waste management fee of minimum rupees forty eight thousand @ rupees four thousand per month. The concerned local body may prescribe higher plastic waste management fee, depending upon the sale capacity. The registered shop keepers shall display at prominent place that plastic carry bags are given on payment.

(2) Only the registered shopkeepers or street vendors shall be eligible to provide plastic carry bags for dispensing the commodities.

(3) The local body shall utilize the amount paid by the customers for the carry bags exclusively for the sustainability of the waste management system within their jurisdictions.

16. State Level Monitoring Committee.- (1) The State government or the union Territory shall, for the purpose of effective monitoring of implementation of these rules, constitute a State Level Advisory Committee consisting of the following persons, namely;-

(a)	the Secretary, Department of Urban Development	- Chairman
(b)	Director from State Department of Environment	- Member
(c)	Member Secretary from State Pollution Control Board or Pollution Control Committee	- Member
(d)	Municipal Commissioner	- Member
(e)	one expert from Local Body	- Member
(f)	one expert from Non-Governmental involved in Waste Management	- Member

(g) Commissioner, Value Added Tax or his nominee, - Member

(h) Sales Tax Commissioner or Officer - Member

(i) representative of Plastic Association,
Drug Manufacturers Association,
Chemical Manufacturers Association - Member

(j) one expert from the field of Industry - Member and

(k) one expert from the field of academic institution - Member

(l) Director , Municipal Administration - Convener

The State Level Advisory Body shall meet at least once in Six Month and may invite experts, if it considers necessary.

17. Annual reports.- (1) Every person engaged in recycling or processing of plastic waste shall prepare and submit an annual report in Form-IV to the local body concerned under intimation to the concerned State Pollution Control Board or Pollution Control Committee by the 30th April, of every year.

(2) Every local body shall prepare and submit an annual report in Form –V to the concerned Secretary-in-charge of the Urban Development Department under intimation to the concerned State Pollution Control Board or Pollution Control Committee by the 30th June, every year.

(3) Each State Pollution Control Board or Pollution Control Committee shall prepare and submit an annual report in Form VI to the CPCB on the implementation of these rules by the 31st July, of every year.

(4) The CPCB shall prepare a consolidated annual report on the use and management of plastic waste and forward it to the Central Government along with its recommendations before the 31st August of every year.

SCHEDULE-I

[See rule 10]

1.	IS / ISO 14851: 1999 Determination of the ultimate aerobic biodegradability of plastic materials in an aqueous medium-Method by measuring the oxygen demand in a closed Respirometer
2.	IS / ISO 14852: 1999 Determination of the ultimate aerobic biodegradability of plastic materials in an aqueous medium-Method by analysis of evolved carbon dioxide
3.	IS / ISO 14853: 2005 Plastics- Determination of the ultimate anaerobic biodegradation of plastic materials in an aqueous system-Method by measurement of biogas production
4.	IS /ISO 14855-1: 2005 Determination of the ultimate aerobic biodegradability of plastic materials under controlled composting conditions-Method by analysis of evolved carbon dioxide (Part-1 General method)
5.	IS / ISO 14855-2: 2007 Determination of the ultimate aerobic biodegradability of plastic materials under controlled composting conditions-Method by analysis of evolved carbon dioxide (Part-2: Gravimetric measurement of carbon dioxide evolved in a laboratory- scale test)
6.	IS / ISO 15985: 2004 Plastics- Determination of the ultimate anaerobic biodegradation and disintegration under high-solids anaerobic digestion conditions- Methods by analysis of released biogas
7.	IS /ISO 16929: 2002 Plastics- Determination of degree of disintegration of plastic materials under defined composting conditions in a pilot - scale test
8.	IS / ISO 17556: 2003 Plastics- Determination of ultimate aerobic biodegradability in soil by measuring the oxygen demand in a Respirometer or the amount of carbon dioxide evolved
9.	IS / ISO 20200:2004 Plastics- Determination of degree of disintegration of plastic materials under simulated composting conditions in a laboratory - scale test

FORM - I

[See rules 13 (2)]

APPLICATION FOR REGISTRATION FOR PRODUCERS or Brand Owners

From: .....

……

…….(Name and full address of the occupier)

To

The Member Secretary,

.....……. Pollution Control Board or Pollution Control Committee

…….

…….

Sir,

I /We hereby apply for registration under rule 9 of the Plastic Waste Management Rules, 2015

1. Producers

	PART – A GENERAL	
1.(a)	Name and location of the unit	
(b)	Address of the unit	
(c)	Registration required for manufacturing of: (i) Carry bags; (a) petro- based, (b) Compostable (ii) Multilayered plastics	
(d)	Manufacturing capacity	
(e)	In case of renewal, previous registration number and date of registration	
2.	Is the unit registered with the District Industries Centre of the State Government or Union Territory? If yes, attach a copy.	
3.(a)	Total capital invested on the project	
(b)	Year of commencement of production	
4. (a)	List and quantum of products and by-products	
(b)	List and quantum of raw materials used	
5.	Furnish a flow diagram of manufacturing process showing input and output in terms of products and waste generated including for captive power generation and water.	
6.	Status of compliance with these rules- Thickness – fifty micron (Yes/No)	
	PART – B PERTAINING TO LIQUID EFFLUENT AND GASEOUS EMISSIONS	
7.	(a) Does the unit have a valid consent under the Water (Prevention and control of Pollution) Act, 1974 (6 of 1974)? If yes, attach a copy	
	(b) Does the unit have a valid consent under the Air (Prevention and Control of Pollution) Act, 1981 (14 of 1981)? If yes, attach a copy	
	PART – C PERTAINING TO WASTE	
8.	Solid Wastes or rejects: (a) Total quantum of waste generated (b) Mode of storage within the plant (c) Provision made for disposal of wastes	
9.	Attach or Provide list of person supplying plastic to be used as raw material to manufacture carry bags or plastic sheet of like or multilayered packaging	

10.	Attach or provide list of personnel or Brand Owners to whom the products will be supplied	
11.	Action plan on collecting back the plastic wastes	

Name and Signature

Designation

Date :
Place :

II Brand Owners:

	PART – A GENERAL	
1.	Name, Address and Contact number	
2	In case of renewal, previous registration number and date of registration	
3	Is the unit registered with the District Industries Centre of the State Government or Union Territory? If yes, attach a copy.	
4.(a)	Total capital invested on the project	
(b)	Year of commencement of production	
5. (a)	List and quantum of products and by-products	
(b)	List and quantum of raw materials used	
	PART – B PERTAINING TO LIQUID EFFLUENT AND GASEOUS EMISSIONS	
5	Does the unit have a valid consent under the Water (Prevention and control of Pollution) Act, 1974 (6 of 1974)? If yes, attach a copy	
6	Does the unit have a valid consent under the Air (Prevention and Control of Pollution) Act, 1981 (14 of 1981)? If yes, attach a copy	
	PART – C PERTAINING TO WASTE	
7.	Solid Wastes or rejects: (c) Total quantum of waste generated (d) Mode of storage within the plant (d) Provision made for disposal of wastes	
8.	Attach or Provide list of person supplying plastic material	
9	Action plan on collecting back the plastic wastes	

Name and Signature
Designation

Date :

Place :

FORM - II

[see rule 13 (3)]

APPLICATION FORM FOR REGISTRATION OF UNITS ENGAGED IN PROCESSING OR RECYCLING OF PLASTIC WASTE

1.	Name and Address of the unit	
2.	Contact person with designation, Tel./Fax /email	

3.	Date of commencement					
4.	No. of workers (including contract labour)					
5.	Consents Validity	a. Water (Prevention & Control of Pollution) Act, 1974; Valid up to _____ b. Air (Prevention & Control of Pollution) Act, 1981; Valid up to_____ c. Authorization ; valid up to ….				
6.	Manufacturing Process	Please attach a flow diagram of the manufacturing process flow diagram for each product.				
7.	Products and installed capacity of production (MTA)	Products		Installed capacity		
8.	Waste Management:	S. No.	Type	Category	Qty.	
	a. Waste generation in processing plastic-waste	(i)				
		(ii)				
		(iii)				
	b. Waste Collection and transportation (attach details)					
	c. Waste Disposal details	S. No.	Type	Category	Qty	
		(i)				
		(ii)				
	d. Provide details of the disposal facility, whether the facility is authorized by SPCB or PCC					
	e. Please attach analysis report of characterization of waste generated (including leachate test if applicable)					
9.	Details of plastic waste proposed to be acquired through sale, auction, contract or import, as the case may be, for use as raw material	(i) Name (ii) Quantity required /year				
10.	Occupational safety and health aspects	Please provide details of facilities				
11.	Pollution Control Measures					
	Whether the unit has adequate pollution control systems or equipment to meet the standards of emission or effluent.	If Yes, please furnish details				
	Whether unit is in compliance with conditions laid down in the said rules.	Yes/No				
	Whether conditions exist or are likely to exist of the material being handled or processed posing adverse immediate or delayed impacts on the environment.	Yes/No				
	Whether conditions exist (or are likely to exist) of the material being handled or processed by any means capable of yielding another material (e.g. leachate) which may possess eco-toxicity.	Yes/No				
12.	Any other relevant information including fire or accident mitigative measures					
13.	List of enclosures as per rule					

Name and Signature

Designation

Date :

Place :

FORM - III

[See rules 13(4)]

APPLICATION FOR REGISTRATION FOR MANUFACTURERS OF PLASTIC RAW MATERIALS

From: .....

……

…….(Name and full address of the occupier)

To

The Member Secretary,

.....……. Pollution Control Board or Pollution Control Committee

…….

…….

Sir,

I/We hereby apply for registration under the Plastic Waste Management Rules, 2011

PART – A GENERAL		
1.(a)	Name and location of the unit	
(b)	Address of the unit	
(c)	In case of renewal, previous registration number and date of registration	
2.	Is the unit registered with the DIC or DCSSI of the State Government or Union Territory? If yes, attach a copy.	
3.(a)	Total capital invested on the project	
(b)	Year of commencement of production	
(c)	List of producers and quantum of raw materials supplied to producers	
		Name and Signature Designation
Date : Place :		

Form - IV

[See rules 17 (1)]

FORMAT OF ANNUAL REPORT BY OPERATOR OF PLASTIC WASTE PROCESSING OR RECYCLING FACILITY TO THE LOCAL BODY

Period of Reporting:

(1)	Name and Address of operator of the facility	
(2)	Name of officer in-charge of the facility (Telephone/Fax/Mobile/ E-mail)	
(3)	Capacity:	
(4)	Technologies used for management of plastic waste:	
(5)	Quantity of plastic waste received during the year being reported upon along with the source	
(6)	Quantity of plastic waste processed (in tons): - Plastic waste recycled(in tons) - Plastic waste processed (in tons) - Used (in tons)	
(7)	Quantity of inert or rejects sent for final disposal to landfill sites:	
(8)	Details of land fill facility to which inert or rejects were sent	

	for final disposal: - Address -Telephone	
(9)	Attach status of compliance to environmental conditions, if any specified during grant of Consent or registration	

Signature of Operator

Dated :

Place:

Form - V

[See rules 17(2)]

FORMAT FOR ANNUAL REPORT ON PLASTIC WASTE MANAGEMENT TO BE SUBMITTED BY THE LOCAL BODY

Period of Reporting:

(1)	Name of the City or Town and State:	
(2)	Population	
(3)	Area in sq. kilometers	
(4)	Name & Address of Local body Telephone No. Fax No. E-mail:	
(5)	Total Numbers of the wards in the area under jurisdiction	
(6)	Total Numbers of Households in the area under jurisdiction	
(7)	Number of households covered by door to door collection	
(8)	Total number of commercial establishments and Institutions in the area under jurisdiction -Commercial establishments - Institutions	
(9)	Number of commercial establishments and Institutions covered by door to door collection -Commercial establishments - Institutions	
(10)	Summary of the mechanisms put in place for management of plastic waste in the area under jurisdiction along with the details of agencies involved in door to door collection	
(11)	Attach details of infrastructure put in place for management of plastic waste generated in the area under jurisdiction	
(12)	Attach details of infrastructure required, if any along with justification	
(13)	Quantity of Plastic Waste generated during the year from area under jurisdiction (in tons)	
(14)	Quantity of Plastic Waste collected during the year from area under jurisdiction (in tons)	
(15)	Quantity of plastic waste channelized for recycling during the year (in tons)	
(16)	Quantity of plastic waste channelized for use during the year (in tons)	
(17)	Quantity of inert or rejects sent to landfill sites during the year (in tons)	
(18)	Details of each of facilities used for processing and disposal of plastic waste **Facility-I** i) Name of operator ii) Address with Telephone Number or Mobile iii) Capacity iv) Technology Used v) Registration Number vi) Validity of Registration (up to)	

Name of the SPCB or PCC	Estimated Plastic Waste generation Tons Per Annum (TPA)	No. of registered Plastic Manufacturing or Recycling (including multilayer, compostable) units. (Rule 9)			No. of Unregistered plastic manufacturing Recycling units. (in residential or unapproved areas)	Details of Plastic Waste Management (PWM) e.g. Collection, Segregation, Disposal (Co-processing road construction etc.) (Rules 6) (Attach separate	Partial or complete ban on usages of Plastic Carry Bags (through Executive Order) (Attach copy of notification or executive order)	Status of Marking Labelling on carry bags (Rule 8) [Specify the number of units or not complied)complied	Explicit Pricing of carry bags (Rule 10)	Details of the meeting of State Level Advisory Body (SLA) along with its recommend-dations on Implemen-tation (Rule 11)	No. of violations and action taken on non-compliance of provisions of these Rules	Number of Municipal Authority or Gram Panchayat-under jurisdiction and Submission of Annual Report to CPCB (Rule 12)
		Plastic units	Compostable Plastic Units	Multilayer Plastic units								

	Facility-II i) Name of operator ii) Address with Telephone Number or Mobile iii) Capacity iv) Technology Used v) Registration Number Validity of Registration (up to)	
(19)	Give details of: Local body's own manpower deployed for collection including street sweeping, secondary storage, transportation, processing and disposal of waste.	
(20)	Give details of: Contractor or concessionaire's manpower deployed for collection including street sweeping, secondary storage, transportation, processing and disposal of waste.	
(21)	Mention briefly, the difficulties being experienced by the local body in complying with provisions of these rules including the financial constrains, if any	
(22)	Whether an Action Plan has been prepared for improving solid waste management practices in the city? If yes (attach copy) Date of revision:	

Signature of CEO or Municipal Commissioner or

Executive Officer or Chief Officer

Date:

Place:

Form-VI

STATE-WISE STATUS OF IMPLEMENTATION OF PLASTIC WASTE MANAGEMENT RULES, 2016 FOR THE YEAR … ANNUAL REPORT Format

						sheet)						
(1)	(2)	(3)			(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)

[F. No. 17-2/2001-HSMD]

BISHWANATH SINHA, Jt. Secy.

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Ministry of Environment and Forests

Notification

New Delhi, the 25th September, 2000

S.O. 908(E).- Whereas the draft of the Municipal Solid Wastes (Management and Handling) Rules, 1999 were published under the notification of the Government of India in the Ministry of Environment and Forests number S.O. 783(E), dated, the 27th September, 1999 in the Gazette of India, Part II, Section 3, Sub-section (ii) of the same date inviting objections and suggestions from the persons likely to be affected thereby, before the expiry of the period of sixty days from the date on which the copies of the Gazette containing the said notification are made available to the public;

And whereas copies of the said Gazette were made available to the public on the 5th October, 1999;

And whereas the objections and suggestions received from the public in respect of the said draft rules have been duly considered by the Central Government;

Now, therefore, in exercise of the powers conferred by section 3, 6 and 25 of the Environment (Protection) Act, 1986 (29 of 1986), the Central Government hereby makes the following rules to regulate the management and handling of the municipal solid wastes, namely :-

1. Short title and commencement .--

1. These rules may be called the Municipal Solid Wastes (Management and Handling) Rules, 2000.
2. Save as otherwise provided in these rules, they shall come into force on the date of their publication in the Official Gazette.

2. Application .-- These rules shall apply to every municipal authority responsible for collection, segregation, storage, transportation,, processing and disposal of municipal solid wastes .

3. Definitions.-- In these rules, unless the context otherwise requires ,--

i. "**anaerobic digestion"** means a controlled process involving microbial decomposition of organic matter in the absence of oxygen;

ii. **"authorization"** means the consent given by the Board or Committee to the "operator of a facility" ;

iii. "**biodegradable substance"** means a substance that can be degraded by micro-organisms;

iv. **"biomethanation"** means a process which entails enzymatic decomposition of the organic matter by microbial action to produce methane rich biogas;

v. "**collection"** means lifting and removal of solid wastes from collection points or any other location;

vi. "**composting"** means a controlled process involving microbial decomposition of organic matter;

vii. "**demolition and construction waste"** means wastes from building materials debris and rubble resulting from construction, re-modelling, repair and demolition operation;

viii. "**disposal"** means final disposal of municipal solid wastes in terms of the specified measures to prevent contamination of ground-water, surface water and ambient air quality;

ix. **"Form"** means a Form appended to these rules;

x. **"generator of wastes"** means persons or establishments generating municipal solid wastes;

xi. "**landfilling"** means disposal of residual solid wastes on land in a facility designed with protective measures against pollution of ground water, surface water and air fugitive dust, wind-blown litter, bad odour, fire hazard, bird menace, pests or rodents, greenhouse gas emissions, slope instability and erosion;

xii. "**leachate"** means liquid that seeps through solid wastes or other medium and has extracts of dissolved or suspended material from it;

xiii. "**lysimeter"** is a device used to measure rate of movement of water through or from a soil layer or is used to collect percolated water for quality analysis;

xiv. **"municipal authority"** means Municipal Corporation, Municipality, Nagar Palika, Nagar Nigam, Nagar Panchayat, Municipal Council including notified area committee (NAC) or any other local body constituted under the relevant statutes and, where the management and handling of municipal solid waste is entrusted to such agency;

xv. **"municipal solid waste"** includes commercial and residential wastes generated in a municipal or notified areas in either solid or semi-solid form excluding industrial hazardous wastes but including treated bio-medical wastes;

xvi. **"operator of a facility"** means a person who owns or operates a facility for collection, segregation, storage, transportation, processing and disposal of municipal solid wastes and also includes any other agency appointed as such by the municipal authority for the management and handling of municipal solid wastes in the respective areas;

xvii. **"pelletisation"** means a process whereby pellets are prepared which are small cubes or cylindrical pieces made out of solid wastes and includes fuel pellets which are also referred as refuse derived fuel;

xviii. "**processing"** means the process by which solid wastes are transformed into new or recycled products;

xix. "r**ecycling"** means the process of transforming segregated solid wastes into raw materials for producing new products, which may or may not be similar to the original products;

xx. **"Schedule"** means a Schedule appended to these rules;

xxi. **"segregation"** means to separate the municipal solid wastes into the groups of organic, inorganic, recyclables and hazardous wastes;

xxii. **"State Board or the Committee"** means the State Pollution Control Board of a State, or as the case may be, the Pollution Control Committee of a Union territory;

xxiii. **"storage"** means the temporary containment of municipal solid wastes in a manner so as to prevent littering, attraction to vectors, stray animals and excessive foul odour;

xxiv. **"transportation "** means conveyance of municipal solid wastes from place to place hygienically through specially designed transport system so as to prevent foul odour, littering, unsightly conditions and accessibility to vectors;

xxv. "**vadose water"** water which occurs between the ground, surface and the water table that is the unsaturated zone;

xxvi. "**vermicomposting"** is a process of using earthworms for conversion of bio-degradable wastes into compost.

4. Responsibility of municipal authority .-

1. Every municipal authority shall, within the territorial area of the municipality, be responsible for the implementation of the provisions of these rules, and for any infrastructure development for collection, storage, segregation, transportation, processing and disposal of municipal solid wastes.
2. The municipal authority or an operator of a facility shall make an application in **Form-I,** for grant of authorization for setting up waste processing and disposal facility including landfills from the State Board or the Committee in order to comply with the implementation programme laid down in **Schedule I**.
3. The municipal authority shall comply with these rules as per the implementation schedule laid down in **Schedule I.**

(4) The municipal authority shall furnish its annual report in **Form-II**,-

a. to the Secretary-incharge of the Department of Urban Development of the concerned State or as the case may be of the Union territory, in case of a metropolitan city; or
b. to the District Magistrate or the Deputy Commissioner concerned in case of all other towns and cities,

with a copy to the State Board or the Committee on or before the 30th day of June every year.

5. Responsibility of the State Government and the Union territory Administrations .--

(1) The Secretary-incharge of the Department of Urban Development of the concerned State or the Union territory, as the case may be, shall have the overall responsibility for the enforcement of the provisions of these rules in the metropolitan cities.

(2) The District Magistrate or the Deputy Commissioner of the concerned district shall have the overall responsibility for the enforcement of the provisions of these rules within the territorial limits of their jurisdiction.

6. Responsibility of the Central Pollution Control Board and the State Board or the Committees .—

1. The State Board or the Committee shall monitor the compliance of the standards regarding ground water, ambient air, leachate quality and the compost quality including incineration standards as specified under **Schedules II, III** and **IV**.
2. The State Board or the Committee, after the receipt of application from the municipal authority or the operator of a facility in **Form I,** for grant of authorization for setting up waste processing and disposal facility including landfills, shall examine the proposal taking into consideration the views of other agencies like the State Urban Development Department, the Town and Country Planning Department, Air Port or Air Base Authority, the Ground Water Board or any such other agency prior to issuing the authorization.
3. The State Board or the Committee shall issue the authorization in **Form-III** to the municipal authority or an operator of a facility within forty-five days stipulating compliance criteria and standards as specified in **Schedules II, III** and **IV** including such other conditions, as may be necessary.
4. The authorization shall be valid for a given period and after the validity is over, a fresh authorization shall be required.

(5) The Central Pollution Control Board shall co-ordinate with the State Boards and the Committees with particular reference to implementation and review of standards and guidelines and compilation of monitoring data.

7. Management of municipal solid wastes .--

1. Any municipal solid waste generated in a city or a town, shall be managed and handled in accordance with the compliance criteria and the procedure laid down in **Schedule-II.**

(2) The waste processing and disposal facilities to be set up by the municipal authority on their own or through an operator of a facility shall meet the specifications and standards as specified in **Schedules III** and **IV.**

8. Annual Reports .—

1. The State Boards and the Committees shall prepare and submit to the Central Pollution Control Board an annual report with regard to the implementation of these rules by the 15th of September every year in **Form-IV**.
2. The Central Pollution Control Board shall prepare the consolidated annual review report on management of municipal solid wastes and forward it to the Central

Government alongwith its recommendations before the 15th of December every year.

9. Accident Reporting .-- When an accident occurs at any municipal solid wastes collection, segregation, storage, processing, treatment and dispoosal facility or landfill site or during the transportation of such wastes, the municipal authority shall forthwith report the accident in **Form-V** to the Secretary in-charge of the Urban Development Department in metropolitan cities, and to District Collector or Deputy Commissioner in all other cases.

Schedule I

[see rules4(2) and (3)]

Implementation Schedule

Serial No.	**Compliance Criteria**	**Schedule**
1.	Setting up of waste processing and disposal facilities	By 31.12.2003 or earlier
2.	Monitoring the performance of waste processing and disposal facilities	Once in six months
3.	Improvement of existing landfill sites as per provisions of these rules	By 31.12.2001 or earlier
4.	Identification of landfill sites for future use and making site (s) ready for operation	By 31.12.2002 or earlier

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Schedule -II

[see rules 6(1) and (3), 7(1)]

Management of Municipal Solid Wastes

S.no	**Parameters**	**Compliance criteria**
1.	**Collection of municipal solid**	1. Littering of municipal solid waste shall be prohibited in cities, towns and in urban areas notified by the State Governments. To

	wastes	prohibit littering and facilitate compliance, the following steps shall be taken by the municipal authority, namely :- i. Organising house-to-house collection of municipal solid wastes through any of the methods, like community bin collection (central bin), house-to-house collection, collection on regular pre-informed timings and scheduling by using bell ringing of musical vehicle (without exceeding permissible noise levels); ii. Devising collection of waste from slums and squatter areas or localities including hotels, restaurants, office complexes and commercial areas; iii. Wastes from slaughter houses, meat and fish markets, fruits and vegetable markets, which are biodegradable in nature, shall be managed to make use of such wastes; iv. Bio-medical wastes and industrial wastes shall not be mixed with municipal solid wastes and such wastes shall follow the rules separately specified for the purpose; v. Collected waste from residential and other areas shall be transferred to community bin by hand-driven containerised carts or other small vehicles; vi. Horticlutural and construction or demolition wastes or debris shall be separately collected and disposed off following proper norms. Similarly, wastes generated at dairies shall be regulated in accordance with the State laws; vii. Waste (garbage, dry leaves) shall not be burnt; viii. Stray animals shall not be allowed to move around waste storage facilities or at any other place in the city or town and shall be managed in accordance with the State laws. 2. The municipal authority shall notify waste collection schedule and the likely method to be adopted for public benefit in a city or town. 3. It shall be the responsibility of generator of wastes to avoid littering and ensure delivery of wastes in accordance with the collection and segregation system to be notified by the municipal authority as per para 1(2) of this Schedule.
2.	Segregation of municipal solid wastes	In order to encourage the citizens, municipal authority shall organise awareness programmes for segregation of wastes and shall promote recycling or reuse of segregated materials. The municipal authority shall undertake phased programme to

		ensure community participation in waste segregation. For this purpose, regular meetings at quarterly intervals shall be arranged by the municipal authorities with representatives of local resident welfare associations and non-governmental organizations.
3.	**Storage of municipal solid wastes**	Municipal authorities shall establish and maintain storage facilities in such a manner as they do not create unhygienic and insanitary conditions around it. Following criteria shall be taken into account while establishing and maintaining storage facilities, namely :- i. Storage facilities shall be created and established by taking into account quantities of waste generation in a given area and the population densities. A storage facility shall be so placed that it is accessible to users; ii. Storage facilities to be set up by municipal authorities or any other agency shall be so designed that wastes stored are not exposed to open atmosphere and shall be aesthetically acceptable and user-friendly; iii. Storage facilities or 'bins' shall have 'easy to operate' design for handling, transfer and transportation of waste. Bins for storage of bio-degradable wastes shall be painted green, those for storage of recyclable wastes shall be printed white and those for storage of other wastes shall be printed black; iv. Manual handling of waste shall be prohibited. If unavoidable due to constraints, manual handling shall be carried out under proper precaution with due care for safety of workers.
4.	**Transportation of municipal solid wastes**	Vehicles used for transportation of wastes shall be covered. Waste should not be visible to public, nor exposed to open environment preventing their scattering. The following criteria shall be met, namely:- i. The storage facilities set up by municipal authorities shall be daily attended for clearing of wastes. The bins or containers wherever placed shall be cleaned before they start overflowing; ii. Transportation vehicles shall be so designed that multiple handling of wastes, prior to final disposal, is avoided.
5.	**Processing of municipal solid**	Municipal authorities shall adopt suitable technology or combination of such technologies to make use of wastes so as to

	wastes	minimize burden on landfill. Following criteria shall be adopted, namely:- (i) The biodegradable wastes shall be processed by composting, vermicomposting, anaerobic digestion or any other appropriate biological processing for stabilization of wastes. It shall be ensured that compost or any other end product shall comply with standards as specified in Schedule-IV; ii. Mixed waste containing recoverable resources shall follow the route of recycling. Incineration with or without energy recovery including pelletisation can also be used for processing wastes in specific cases. Municipal authority or the operator of a facility wishing to use other state-of-the-art technologies shall approach the Central Pollution Control Board to get the standards laid down before applying for grant of authorisation.
6.	**Disposal of municipal solid wastes**	Land filling shall be restricted to non-biodegradable, inert waste and other waste that are not suitable either for recycling or for biological processing. Land filling shall also be carried out for residues of waste processing facilities as well as pre-processing rejects from waste processing facilities. Land filling of mixed waste shall be avoided unless the same is found unsuitable for waste processing. Under unavoidable circumstances or till installation of alternate facilities, land-filling shall be done following proper norms. Landfill sites shall meet the specifications as given in Schedule –III.

Schedule III

[see rules 6(1) and (3), 7(2)]

Specifications for Landfill Sites

Site Selection

1. In areas falling under the jurisdiction of 'Development Authorities' it shall be the responsibility of such Development Authorities to identify the landfill sites and hand over the sites to the concerned municipal authority for development, operation and maintenance. Elsewhere, this responsibility shall lie with the concerned municipal authority.

2. Selection of landfill sites shall be based on examination of environmental issues. The Department of Urban Development of the State or the Union territory shall co-ordinate with the concerned organisations for obtaining the necessary approvals and clearances.
3. The landfill site shall be planned and designed with proper documentation of a phased construction plan as well as a closure plan.
4. he landfill sites shall be selected to make use of nearby wastes processing facility. Otherwise, wastes processing facility shall be planned as an integral part of the landfill site.
5. The existing landfill sites which continue to be used for more than five years, shall be improved in accordance of the specifications given in this Schedule.
6. Biomedical wastes shall be disposed off in accordance with the Bio-medical Wastes (Management and Handling) Rules, 1998 and hazardous wastes shall be managed in accordance with the Hazardous Wastes (Management and Handling) Rules, 1989, as amended from time to time.
7. The landfill site shall be large enough to last for 20-25 years.
8. The landfill site shall be away from habitation clusters, forest areas, water bodies monuments, National Parks, Wetlands and places of important cultural, historical or religious interest.
9. A buffer zone of no-development shall be maintained around landfill site and shall be incorporated in the Town Planning Department's land-use plans.
10. Landfill site shall be away from airport including airbase. Necessary approval of airport or airbase authorities prior to the setting up of the landfill site shall be obtained in cases where the site is to be located within 20 km of an airport or airbase..

Facilities at the Site

11. Landfill site shall be fenced or hedged and provided with proper gate to monitor incoming vehicles or other modes of transportation.
12. The landfill site shall be well protected to prevent entry of unauthorised persons and stray animals.
13. Approach and other internal roads for free movement of vehicles and other machinery shall exist at the landfill site.
14. The landfill site shall have wastes inspection facility to monitor wastes brought in for landfill, office facility for record keeping and shelter for keeping equipment and machinery including pollution monitoring equipments.
15. Provisions like weigh bridge to measure quantity of waste brought at landfill site, fire protection equipments and other facilities as may be required shall be provided.
16. Utilities such as drinking water (preferably bathing facilities for workers) and lighting arrangements for easy landfill operations when carried out in night hours shall be provided.
17. Safety provisions including health inspections of workers at landfill site shall be periodically made.

Specifications for land filling

18. Wastes subjected to land filling shall be compacted in thin layers using landfill compactors to achieve high density of the wastes. In high rainfall areas where heavy compactors cannot be used alternative measures shall be adopted.
19. Wastes shall be covered immediately or at the end of each working day with minimum 10 cm of soil, inert debris or construction material till such time waste processing facilities for composting or recycling or energy recovery are set up as per Schedule I.
20. Prior to the commencement of monsoon season, an intermediate cover of 40-65 cm thickness of soil shall be placed on the landfill with proper compaction and grading to prevent infiltration during monsoon. Proper drainage berms shall be constructed to divert run-off away from the active cell of the landfill.
21. After completion of landfill, a final cover shall be designed to minimize infiltration and erosion. The final cover shall meet the following specifications, namely :--

a. The final cover shall have a barrier soil layer comprising of 60 cms of clay or amended soil with permeability coefficient less that 1×10^{-7} cm/sec.
b. On top of the barrier soil layer there shall be a drainage layer of 15 cm.
c. On top of the drainage layer there shall be a vegetative layer of 45 cm to support natural plant growth and to minimize erosion.

Pollution prevention

22. In order to prevent pollution problems from landfill operations, the following provisions shall be made, namely :-

a. Diversion of storm water drains to minimize leachate generation and prevent pollution of surface water and also for avoiding flooding and creation of marshy conditions;
b. Construction of a non-permeable lining system at the base and walls of waste disposal area. For landfill receiving residues of waste processing facilities or mixed waste or waste having contamination of hazardous materials (such as aerosols, bleaches, polishes, batteries, waste oils, paint products and pesticides) minimum liner specifications shall be a composite barrier having 1.5 mm high density polyethylene (HDPE) geomembrane, or equivalent, overlying 90 cm of soil (clay or amended soil) having permeability coefficient not greater than 1×10^{-7} cm/sec. The highest level of water table shall be at least two meter below the base of clay or amended soil barrier layer;
c. Provisions for management of leachates collection and treatment shall be made. The treated leachates shall meet the standards specified in Schedule- IV;
d. Prevention of run-off from landfill area entering any stream, river, lake or pond.

Water Quality Monitoring

23. Before establishing any landfill site, baseline data of ground water quality in the area shall be collected and kept in record for future reference. The ground water quality within 50 metres of the periphery of landfill site shall be periodically monitored to ensure that the ground water is not contaminated beyond acceptable limit as decided by the Ground Water Board or the State Board or the Committee. Such monitoring shall be carried out to cover different seasons in a year that is, summer, monsoon and post-monsoon period.
24. Usage of groundwater in and around landfill sites for any purpose (including drinking and irrigation) is to be considered after ensuring its quality. The following specifications for drinking water quality shall apply for monitoring purpose, namely :-

S.No.	**Parameters**	**IS 10500: 1991 Desirable limit (mg/l except for pH)**
1.	Arsenic	0.05
2.	Cadmium	0.01
3	Chromium	0.05
4.	Copper	0.05
5.	Cyanide	0.05
6.	Lead	0.05
7.	Mercury	0.001
8.	Nickel	-
9.	Nitrate as NO_3	45.0
10	PH	6.5-8.5
11.	Iron	0.3
12.	Total hardness (as $CaCO_3$)	300.0
13.	Chlorides	250
14.	Dissolved solids	500
15.	Phenolic compounds (as C_6H_5OH)	0.001

16.	Zinc	5.0
17.	Sulphate (as SO_4)	200

25. **Ambient Air Quality Monitoring**
26. Installation of landfill gas control system including gas collection system shall be made at landfill site to minimize odour generation, prevent off-site migration of gases and to protect vegetation planted on the rehabilitated landfill surface.
27. The concentration of methane gas generated at landfill site shall not exceed 25 per cent of the lower explosive limit (LEL).
28. The landfill gas from the collection facility at a landfill site shall be utilized for either direct thermal applications or power generation, as per viability. Otherwise, landfill gas shall be burnt (flared) and shall not be allowed to directly escape to the atmosphere or for illegal tapping. Passive venting shall be allowed if its utiliztion or flaring is not possible.
29. Ambient air quality at the landfill site and at the vicinity shall be monitored to meet the following specified standards, namely :-

S.No.	**Parameters**	**Acceptable levels**
(i)	Sulphur dioxide	120 μ γ/μ^3 (24 ηουρσ)
(ii)	Suspended Particulate Matter	500 μ γ/μ^3 (24 ηουρσ)
(iii)	Methane	Not to exceed 25 per cent of the lower explosive limit (equivalent to 650 mg/m^3)
(iv)	Ammonia daily average	
	(Sample duration 24 hrs)	0.4 mg/m^3 (400 μ γ/μ^3)
(v)	Carbon monoxide	1 hour average : 2 mg/m^3 8 hour average : 1 mg/m^3

29. The ambient air quality monitoring shall be carried out by the concerned authority as per the following schedule, namely:-

(a) Six times in a year for cities having population of more than fifty lakhs;

(b) Four times in a year for cities having population between ten and fifty lakhs;

(c) Two times in a year for town or cities having population between one and ten lakhs.

Plantation at Landfill Site

30. A vegetative cover shall be provided over the completed site in accordance with the and following specifications, namely :-

(a) Selection of locally adopted non-edible perennial plants that are resistant to drought and extreme temperatures shall be allowed to grow;

(b) The plants grown be such that their roots do not penetrate more than 30 cms. This condition shall apply till the landfill is stabilised;

(c) Selected plants shall have ability to thrive on low-nutrient soil with minimum nutrient addition;

(d) Plantation to be made in sufficient density to minimize soil erosion.

Closure of Landfill Site and Post-care

31. The post-closure care of landfill site shall be conducted for at least fifteen years and long term monitoring or care plan shall consist of the following, namely :-

(a) Maintaining the integrity and effectiveness of final cover, making repairs and preventing run-on and run-off from eroding or otherwise damaging the final cover;

(b) Monitoring leachate collection system in accordance with the requirement;

(c) Monitoring of ground water in accordance with requirements and maintaining ground water quality;

(d) Maintaining and operating the landfill gas collection system to meet the standards.

32. Use of closed landfill sites after fifteen years of post-closure monitoring can be considered for human settlement or otherwise only after ensuring that gaseous and leachate analysis comply with the specified standards.

Special provisions for hilly areas

33. Cities and towns located on hills shall have location-specific methods evolved for final disposal of solid wastes by the municipal authority with the approval of the concerned State Board or the Committee. The municipal authority shall set up processing facilities for utilization of biodegradable organic wastes. The inert and non-biodegradable waste shall be used for building roads or filling-up of appropriate areas on hills. Because of constraints in finding adequate land in hilly areas, wastes not suitable for road-laying or filling up shall be disposed of in specially designed landfills.

Schedule IV

[see rules 6(1) and (3), 7(2)]

Standards for Composting, Treated Leachates and Incineration

1. The waste processing or disposal facilities shall include composting, incineration, pelletisation, energy recovery or any other facility based on state-of-the-art technology duly approved by the Central Pollution Control Board
2. In case of engagement of private agency by the municipal authority, a specific agreement between the municipal authority and the private agency shall be made particularly, for supply of solid waste and other relevant terms and conditions.
3. In order to prevent pollution problems from compost plant and other processing facilities, the following shall be complied with, namely :-

i. The incoming wastes at site shall be maintained prior to further processing. To the extent possible, the waste storage area should be covered. If, such storage is done in an open area, it shall be provided with impermeable base with facility for collection of leachate and surface water run-off into lined drains leading to a leachate treatment and disposal facility;
ii. Necessary precautions shall be taken to minimise nuisance of odour, flies, rodents, bird menace and fire hazard;
iii. In case of breakdown or maintenance of plant, waste intake shall be stopped and arrangements be worked out for diversion of wastes to the landfill site;
iv. Pre-process and post-process rejects shall be removed from the processing facility on regular basis and shall not be allowed to pile at the site. Recyclables shall be routed through appropriate vendors. The non-recyclables shall be sent for well designed landfill site(s).
v. In case of compost plant, the windrow area shall be provided with impermeable base. Such a base shall be made of concrete or compacted clay, 50 cm thick, having permeability coefficient less than 10^{-7} cm/sec. The base shall be provided with 1 to 2 per cent slope and circled by lined drains for collection of leachate or surface run-off;
vi. Ambient air quality monitoring shall be regularly carried out particularly for checking odour nuisance at down-wind direction on the boundary of processing plant.

- In order to ensure safe application of compost, the following specifications for compost quality shall be met, namely:-

Parameters	**Concentration not to exceed * (mg/kg dry basis , except pH value and C/N ratio)**

Arsenic	10.00
Cadmium	5.00
Chromium	50.00
Copper	300.00
Lead	100.00
Mercury	0.15
Nickel	50.00
Zinc	1000.00
C/N ratio	20-40
PH	5.5-8.5

* Compost (final product) exceeding the above stated concentration limits shall not be used for food crops. However, it may be utilized for purposes other than growing food crops.

4. The disposal of treated leachates shall follow the following standards, namely:-

S.No	**Parameter**	**Standards (Mode of Disposal)**		
		Inland surface water	**Public sewers**	**Land disposal**
1.	Suspended solids, mg/l, max	100	600	200
2.	Dissolved solids (inorganic) mg/l, max.	2100	2100	2100
3	PH value	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0
4	Ammonical nitrogen (as N), mg/l, max.	50	50	-
5	Total Kjeldahl nitrogen (as N)	100	-	-

	mg/l, max.			
6	Biochemical oxygen demand (3 days at 27^0 C) max.(mg/l)	30	350	100
7	Chemical oxygen demand, mg/l, max.	250	-	-
8	Arsenic (as As), mg/l, max	0.2	0.2	0.2
9	Mercury (as Hg), mg/l, max	0.01	0.01	-
10	Lead (as Pb), mg/l, max	0.1	1.0	-
11	Cadmium (as Cd), mg/l, max	2.0	1.0	-
12	Total Chromium (as Cr), mg/l, max.	2.0	2.0	-
13	Copper (as Cu), mg/l, max.	3.0	3.0	-
14	Zinc (as Zn), mg/l, max.	5.0	15	-
15	Nickel (as Ni), mg/l, max	3.0	3.0	-
16	Cyanide (as CN), mg/l, max.	0.2	2.0	0.2
17	Chloride (as Cl), mg/l, max.	1000	1000	600
18	Fluoride (as F), mg/l, max	2.0	1.5	-
19	Phenolic compounds (as C_6H_5OH) mg/l, max.	1.0	5.0	-

Note : While discharging treated leachates into inland surface waters, quantity of leachates being discharged and the quantity of dilution water available in the receiving water body shall be given due consideration.

The incinerators shall meet the following operating and emission standards, namely:-

A. Operating Standards

(1) The combustion efficiency (CE) shall be at least 99.00%.

(2) The combustion efficiency is computed as follows :

$$\%CO_2$$

$$C.E. = \frac{}{\%CO_2 + \%CO} \times 100$$

1. **Emission Standards**

Parameters	Concentration mg/Nm^3 at (12% CO_2 correction)
(1) Particulate matter	
(2) Nitrogen Oxides	450
(3) HCl	
(4) Minimum stack height shall be 30 metres above ground.	
(5) Volatile organic compounds in ash shall not be more than 0.01%.	

Note :

1. Suitably designed pollution control devices shall be installed or retrofitted with the incinerator to achieve the above emission limits, if necessary.
2. astes to be incinerated shall not be chemically treated with any chlorinated disinfectants
3. Chlorinated plastics shall not be incinerated.
4. Toxic metals in incineration ash shall be limited within the regulatory quantities as specified in the Hazardous Wastes (Management and Handling) Rules, 1989 as amended from time to time.
5. Only low sulphur fuel like l.d.o., l.s.h.s or Diesel shall be used as fuel in the incinerator.

Form –I

[see rules 4(2) & 6(2)]

Application for obtaining authorization

To,
The Member Secretary

1.	Name of the municipal authority/Name of the agency appointed by the municipal authority	:	
2.	Correspondence address Telephone No.	:	

	Fax No.		
3.	Nodal Officer & designation(Officer authorised by the municipal authority or agency responsible for operation of processing or disposal facility)	:	
4.	Authorization applied for (Please tick mark)	:	(a) Setting up & operation of waste rocessing facility (b)Setting up & operation of disposal facility
5.	Detailed proposal of waste processing/disposal facility (to be attached) to include	:	
5.1	**Processing of Waste** i. Location of site ii. Name of waste processing technology iii. Details of processing technology iv. Quanitty of waste to be processed per day v. Site clearance (from local authority) vi. Details of agreement between municipal authority and operating agency vii. Utilization programme for waste processed (Product utilization) viii. Methodology for disposal of waste processing rejects (quantity and quality) ix. Measures to be taken for prevention and control of environmental pollution x. Investment on Project and expected returns xi. Measures to be taken for safety of workers working in the plant	:	
5.2	**Disposal of Waste** i. Number of sites indentified ii. Layout maps of site iii. Quantity of waste to be disposed per day iv. Nature and composition of waste v. Details of methodology or criteria followed for site selection vi. Details of existing site under operation vii. Methodology and operational details of landfilling	:	

	viii. Measures taken to check enviornmental pollution		

Date	Signature of Nodal Officer

Form - II

[See rule 4(4)]

Format of Annual Report to be submitted by the Municipal Authority

i. Name of City/Town:……
ii. Population ……
iii. Name of municipal body:……..…… and Address ……
……

Telephone No. : …….

Fax : ……

iv. Name of Incharge dealing with municipal solid wastes ……
……..…… with designation ……..

1. **Quantity and composition of solid wastes**

(i) Total quantity of wastes generated per day

(ii) Total quantity of wastes collected per day

(iii)Total quantity of wastes processed for :

a. Composting: ……
b. Vermiculture: ……
c. Pellets: ……
d. Others, if any, please specify
…….

(iv) Total quantity of waste disposed by landfilling:
…….

a. no. of landfill sites used :
……
b. Area used: ……
c. Whether Weigh bridge facilities available : Yes/No

a. Whether area is fenced : Yes/No

a. Lighting facility on site : Yes/No

(f) Whether equipment like Bulldozer, Compacters etc.available. (Please specify) :---------- ----------

a. Total Manpower available on site: ----------

a. Whether covering is done on daily basis : Yes/No

i. Whether covering material is used and whether it is adequately available : ----------

a. Provisions for gas venting provided : Available (Yes/No) /Not available

a. Provision for leachate collection : Provisions made/ Provisions not made

2. Storage facilities

(i) Area covered for collection of wastes	:	----------
(ii) no. of houses covered	:	----------
(iii)Whether house-to-house collection is practised (if yes, whether done by Municipality or through Private Agency or Non-Governmental Organisation)	:	----------
(iv) Bins	:	----------
		Specifications Existing Proposed
		(Shape & Size) Numbers for future
		----------

a. RCC Bins (Capacity) :

b. Trolleys (Capacity) :

(c) Containers (Capacity) :

d. Dumper Placers :

e. Others, please specify :

(v)Whether all bins/collection spots are attended for daily lifting of garbage : Yes/No

(vi)Whether lifting of garbage from dustbins is manual or mechanical i.e. for example by using of front-end loaders (Please tick mark) : Manual/Loader/Others, please specify

3. Transportation

	Existing number	Actually Required/Proposed
(i) Truck :		
(ii) Truck-Tipper :		
(iii) Tractor-Trailer :		
(iv) Refuse-collector :		
(v) Dumper-placers :		
(vi) Animal Cart :		
(vii) Tricycle :		
(viii) Others (please specify) :		

4. Whether any proposal has been made to improve solid wastes management practices

4. Are any efforts made to call for private firms etc. to attempt for processing of waste utilising technologies like :

Waste Utilisation Technology	Proposals	Steps taken (Quantity to be processed)

i. Composting :

ii. Vermiculture :

iii. Pelletisation :

iv. Others if any, Please specify :

6. What provisions are available and how these are implemented to check unhygienic operations of :

i. Dairy related activities :

ii. Slaughter houses and unauthorised slaughtering :

iii. Malba (cnstruction debris) lifting :

iv. Encroachment in Parks, Footpaths etc. :

7. How many slums are identified and whether these are provided with sanitation facilities :

8. **Are municipal magistrates appointed for Taking penal action :** Yes/No

[If yes, how many cases registered & settled during last three years (give year-wise details)]

9. Hospital waste management

i. How many Hospitals/Clinics under the control of the Corporation:

ii. What methods are followed for disposal of bio-medical wastes ?:

iii. Do you have any proposal for setting up of common treatment facility for disposal of bio-medical wastes :

iv. How many private Nursing Homes, Clinics etc. are operating in the city/town

and what steps have been taken to check disposal of their wastes :

Signature of Municipal Commissioner

Dated :

Form –III

[See-rule 6(2)]

Format for Issue of Authorisation

File No.: _____

Date:_____

To,
_____
_____
_____

Ref: Your application number _____dt. _____

The _____State Pollution Control Board/Pollution Control Committee after examining the proposal hereby authorises_____having their administrative office at _____to set up and operate waste processing/waste disposal facility at_____on the terms and conditions (including the standards to comply) attached to this authorization letter.

1. The validity of this authorization is till_____. After the validity, renewal of authorization is to be sought.
2. The _____State Pollution Control Board/Pollution Control Committees may, at any time, revoke any of the conditions applicable under the authorization and shall communicate the same in writing.
3. Any violation of the provision of the Municipal Solid Wastes (Managemeant and Handling) Rules, 2000 will attract the penal provision of the Environment (Protection) Act, 1986 (29 of1986).

(Member Secretary)

State Pollution Control Board/
Pollution Control Committee

Date :
Place :

Form - IV

[see rule 8(1)]

Format of Annual Review Report to be submitted by the State Pollution Control Board/Committees to the Central Pollution Control Board

To,
The Chairman,
Central Pollution Control Board,
(Ministry of Environment and Forests)
Government of India,
'Parivesh Bhawan', East Arjun Nagar,
DELHI- 110 0032.

1.	Name of the State/Union territory	:	
2.	Name & address of the State Pollution Control	:	
3.	Board/Pollution Control Committee Number of municipal authorities responsible for management of municipal solid wastes in the State/Union territory under these rules	:	
4.	A Summary Statement on progress made by municipal authorities in respect of implementation of Schedule I [rule 4(3)]	:	Please attach as Annexure-I
5.	A Summary Statement on progress made by municipal authorities in respect of implementation of Schedule II [rules 6(1) and (3), 7(1)]	:	Please attach as Annexure-II
6.	A Summary Statement on progress made by municipal authorities in respect of implementation of Schedule III [rules 6(1) and (3), 7(2)]	:	Please attach as Annexure-III
7.	A summary statement on progress made by municipal authorities in respect of implementation	:	Please attach as Annexure-IV

	of Schedule IV [rules 6(1) and (3), 7(2)]		

Date: _____	Chairman or the Member Secretary
Place : _____	State Pollution Control Board/
	Pollution Control Committee

Form - V

[see rule 9]

Accident reporting

1.	Date and time of accident	:	
2.	Sequence of events leading to accident	:	
3.	The waste involved in accident	:	
4.	Assessment of the effects of the accidents on human health and the environment	:	
5.	Emergency measures taken	:	
6.	Steps taken to alleviate the effects of accidents	:	
7.	Steps taken to prevent the recurrence of such an accident	:	

Date : ……	Signature : ……
Place : ……	Designation : ……

V. Rajagopalan, Jt. Secy.
[F.No.17-2/95-HSMD]

Solid Waste Management Rules, 2016- Major changes and likely implications

Municipal Solid Waste (Management and Handling) rules, 2000	Solid Waste Management Rules, 2016	Reasons and likely implications
Title		
Municipal Solid Wastes (Management and Handling) rules, 2000	Solid Waste Management Rules, 2016	Thejurisdiction of the rules have been extended beyond Municipal area hence the word 'Municipal' has been removed.
Application		
apply to every municipal authority.	The jurisdiction of the rules have been extended beyond Municipal area to cover, outgrowths in urban agglomerations, census towns, notified industrial townships, areas under the control of Indian Railways, airports, airbase, Port and harbour, defense establishments, special economic zones, State and Central government organizations, places of pilgrims, religious & historical importance .	To ensure effective implementation of the Rules and achieve objectives of the Swachh Bharat.
Duties of Waste generator		
..Nil...	Every waste generator shall segregate and store the waste generated by them in three separate streams namely bio-degradable, non-bio-degradable and domestic hazardous wastes in suitable bins and handover segregated wastes to authorized rag-pickers or waste collectors	The SWM rules, 2016 emphasises source segregation of waste, a basic need for channelizing the waste to wealth by recovery, reuse and recycle. In line

	Event organizer of more than 100 persons shall intimate the local authority, at least three working days in advance. Such person or the organizer of such event shall ensure segregation of waste at source and handing over of segregated waste to waste collector or agencyas specified by local authority. All Resident Welfare and Market Associations, Gated communities and institution with an area >5,000 sq m and all hotels and restaurant shall, within one year from the date of notification of these rules and in partnership with the local authority by the generators as prescribed in these rules, ensure segregation of waste at source, facilitate collection of segregated waste in separate streams, handover recyclable material to either the authorized waste pickers or the authorized recyclers. The bio-degradable waste shall be processed, treated and disposed of through composting or bio-methanation within the premises as far as possible. The residual waste shall be given to the waste collectors or agency as directed by the local authority. The developers of Special Economic Zone, Industrial Estate, Industrial park to earmark at least 5% of the total area of the plot or minimum 5 plots/ sheds for recovery and recycling facility.	with the above, the event organizers, Resident Welfare and Market Associations, Gated communities, institution and SEZ have been assigned responsibility. This will improve the waste segregation and utilization, less waste or only inert to landfill.
Collection and disposal of sanitary waste like diapers, sanitary pads and other disposal items		
…NIL..	The manufacturers or Brand owners of sanitary napkins and diapers shall provide a pouch or wrapper for disposal of each napkin or diapers along with the packet of their sanitary products.	The issue of collection and disposal of sanitary waste like diapers, sanitary pads

	All such manufacturers, brand owners or marketing companies shall educate the masses for wrapping and disposal of their products. All waste generators shall wrap securely the used sanitary waste like diapers, sanitary pads etc., in the pouches provided by the manufacturers or brand owners of these products or in a suitable wrapping material and shall place the same in the bin meant for dry waste / non- bio-degradable waste. The manufacturers or Brand owners of disposable products such as tin, glass, plastics packaging etc. or brand ownerswho introduce such products in the market and sale or market their products in such packaging material shall provide necessary financial assistance to local authorities for establishment of waste management system.	and other disposal items have been addressed. This will improve the other waste utilisation and management namely organic waste for composting, high calorific waste to energy recovery etc.
Duties of Ministry of Urban Development		
….Nil….	MoUD shall formulate National Policy and Strategy on Solid Waste Management including policy on Waste to Energy in consultation with stakeholders within 6 months from the date of notification of these Rules; review of the measures taken by the States and local bodies, undertake training and capacity building of local bodies and other stakeholders;	Being the nodal Ministry on the subject Solid Waste Management, more responsibilities have been assigned to MoUD. The national policy on SWM, will be guiding tool for the States/ local authorities in SWM.

	providing technical guidelines and project finance to States, UTs and local bodies on solid waste management to facilitate meeting timelines and standards.	The technical and financial support will improve the SWM .
Promotion of marketing and utilization of compost		
..NlL..	The Department of Fertilisers, Ministry of Chemicals and Fertilizers shall provide market development assistance on city compost and ensure promotion of co-marketing of compost with chemical fertilizers in the ratio of 3 to 4 bags: 6 to 7 bags by the fertilizer companies to the extent compost is made available for marketing to the companies. The Ministry of Agriculture shall provide flexibility in Fertiliser Control Order for manufacturing and sale of compost , propagate utlisation of compost on farm land set up laboratories to test quality of compost produced by local authorities or their authorized agencies and issue suitable guidelines for maintaining the quality of compost and ratio of use of compost visa-a-vis chemical fertilizers while applying compost to farmland.	This will make the compost plants economically viable and improve the gainful utilization of waste.
Promotion of waste to energy plant		
….Nil..	Ministry of Power shall fix tariff or charges for the power generated from the Waste to Energy plants based on solid waste and ensure compulsory purchase of power generated from such Waste to Energy plants by DISCOMs .	This will make the waste to energy plants economically viable and improve the gainful utilization of waste.

	The Ministry of New and Renewable Energy Sources shall facilitate infrastructure creation for Waste to Energy plants and provide appropriate subsidy or incentives for such Waste to Energy plants. All industrial units using fuel and located within 100 km from an solid waste based RDF plant shall make arrangements within six months from the date of notification of these rules to replace at least 5 % of their fuel requirement by RDF so produced. Non recyclable waste having calorific value of 1500 K/cal/kg or more shall not be disposed of on landfills and shall only be utilized for generating energy either or through refuse derived fuel or by giving away as feed stock for preparing refuse derived fuel.	The incentives and mandatory provision to utilize 5 % of RDF by the nearby industries will support the waste to energy plants, and reduce the consumption of fossil fuel.
Duties of Secretary, State Urban Development Department, the Commissioner Municipal Administration, Director of Local Bodies, local authorities and village Panchayats		
The Secretary-in-charge of the Department of Urban Development of the concerned State or the Union territory, as the case may be, shall have the overall responsibility for the enforcement of the provisions of these rules in	Detailed duties and responsibilities have been assigned to the Secretary, State Urban Development Department, the Commissioner Municipal Administration, Director of Local Bodies, local authorities and village Panchayats of census towns and urban agglomerations: They are responsible for preparation of state policy and solid waste management strategy in consultation with stakeholders including representative of waste pickers, self-help group and similar groups working in the field of waste management.	Integration of Waste pickers/ Shelf Help Groups in waste management will improve the collection, segregation and recovery of reusable etc. Imposition of user charge and fine will improve waste collection and management

the metropolitan cities. The District Magistrate or the Deputy Commissioner of the concerned district shall have the overall responsibility for the enforcement of the provisions of these rules within the territorial limits of their jurisdiction.	User fee for solid waste management, spot fine for littering / have been introduced which shall be as specified in the bye-laws of the local bodies.	and strengthen the financial position of local authority.
Criteria and standards for Waste treatment facility and pollution Control		
	The SWM Rules 2016 provide for detailed criteria for setting-up solid waste processing and treatment facility, solid waste management in hilly areas, for waste to energy process, for Sanitary Landfills,for site selection, development of facilities at the sanitary landfills, specifications for land filling operations and closure on completion of landfilling, pollution prevention, Closure and Rehabilitation of Old Dumps etc. Notify buffer zone for the solid waste processing and disposal facilities of more than 5 tons per day in consultation with the State Pollution Control Board and Buffer zone to be provided.	The criteria and buffer zone for waste treatment and landfill facility and stringent standards will facilitate smooth functioning of the facility without any pollution issues.

	The landfill site shall be 100 meter away from river, 200 meter from a pond, 500, 200 meter from Highways, Habitations, Public Parks and water supply wells and 20 km away from Airports or Airbase Emission Standards are completely amended and includes parameters for dioxins, furans, reduced limits for particulate matters FROM 150 TO 100 AND NOW 50 . Compost Standards have been amended to align with Fertiliser Control Order.	

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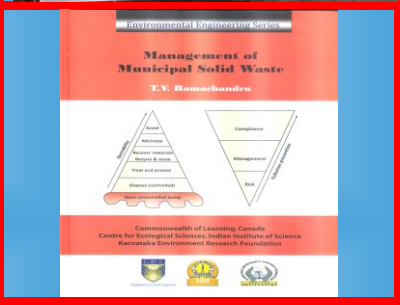

ENVIS Resource Partner: Sahyadri ENVIS, CES, IISc, Bengaluru

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