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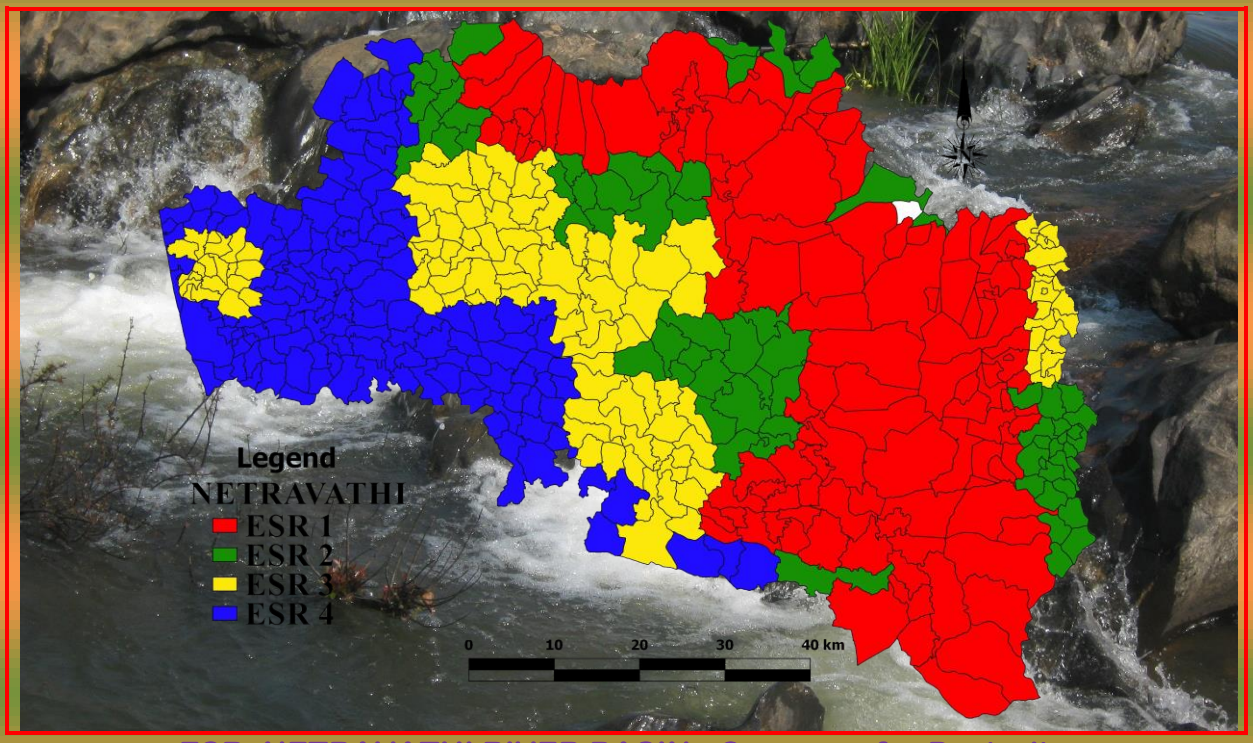
CARRYING CAPACITY OF NETRAVATHI RIVER BASIN BASED ON THE ECOLOGICAL SENSITIVENESS



ESR: NETRAVATHI RIVER BASIN - Conserve for Posterity

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In fond memory

Dr. Harish R Bhat

1973 ~ 2017

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CARRYING CAPACITY OF NETRAVATHI RIVER BASIN BASED ON THE ECOLOGICAL SENSITIVENESS

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Research Highlights

- Ecosystem carrying capacity is defined as 'the maximum number of a species that can be supported indefinitely by a particular habitat, allowing for seasonal and random changes, without degradation of the environment and without diminishing carrying capacity in the future.
- ***Carrying capacity refers to the maximum number of activities (biological, developmental, agricultural, and industrial, population) that can be supported over a period of time in the habitat without damaging the existing quality of life, balance of resources, ecology and productivity of the ecosystem***.
- The ecological sensitivity of ecosystems refers to their ability to cope with various kinds of environmental disturbances that have the potential of adversely changing the character of the natural landscapes.
- Identification of Ecologically sensitive Regions (ESRs) considering spatially both ecological and social dimensions of environmental variables helps in ecological and conservation planning as per Biodiversity Act, 2002, Government of India.
- Ecological Sensitive Regions (ESR/ESA) include not only distinctive ecological factors such as mountain, natural conservation area, but also includes human settlements surrounding ecological sensitive areas by forming a complete spatial and social entity.
- ESRs demarcated through adoption of a landscape perspective (spatial composition, pattern, and position) as it provides a common framework to evaluate social, economic, and cultural dynamics and their relationship to sustain ecological goods and services
- ESRs are the interconnected fragile regions of interactive landscape elements, vital to the long-term maintenance of biological diversity, soil, water or other natural resources which could be threatened by unplanned development.

- ESRs delineation through the integration of geology, topography, hydrology and environment is the rigorous framework of sustainable land use planning. This would include ecologically critical areas, cultural critical areas, natural resource critical areas and natural hazard critical areas and necessitates coordination from local, state, and federal efforts to achieve protection objectives.
- Development and implantation ESR framework requires harmonization between demarcation of priority biodiversity features with the active involvement of different stakeholders and agencies (conservation agencies & resource managers) in effective implementation. Stakeholder participation in decision making of ESR regions aid in understanding the complex and dynamic nature of environmental problems and lends a flexible and transparent decision making through a diversity of knowledge and values.
- GoI prohibits or restricts the location of industries and carry out certain operations on the basis of considerations like the ecological sensitivity under section 5 of EPA 1986 (Environment Protection Act, 1986, GoI).
- The current research attempts to integrate ecological and environmental considerations into administration and prioritizes regions at Panchayat levels (local administrative unit) in Netravati River basin, Central Western Ghats, Karnataka state considering attributes (biological, Geo climatic, Social, etc.) as ESR (1-4) through weightage score metrics.
  - ESR 1 represents zone of highest conservation, no further degradation allowed. ESR 1 can be treated as a highly sensitive region and more conservation is to be imposed by regulatory authorities as well as VFCs (Village forest committees).
  - ESR 2 represents a zone of higher conservation and forms a transition for highest conservation and moderate conservation regions.
  - ESR 3 represents moderate conservation region and only regulated development is allowed in these areas.
  - ESR 4 represents least diversity areas and the developments are allowed as per the requirement by strict vigilance from regulatory authorities. It is recommended that these regions are also has a lot of scope for further enrichment of environment by stakeholders and forest department intervention. In ESR 2 & ESR 3 further developments are allowed through only critical review of regulatory and extensive consultations with stakeholders.

- The ESRs have been delineated at the village levels. There are 433 villages in the Netravathi river basin. Identification of ESRs in Netravathi region would aid in sustainable planning towards the sound ecological regional development.
- 28 grids represent ESR 1, 12 grids represent ESR 2, 14 grids represent ESR 3 and the rest 20 grids represent ESR 4. The 38% of the area of grids represents ESR 1, 16% of the area shows ESR 2, 19 % of the area shows ESR 3 and only 27 % area covers ESR 4.
- **Village wise ESR analysis reveals that there are 111 villages in ESR-1, 69 villages in ESR-2 119 villages in ESR-3 and 134 villages in ESR 4. ESR 1 and ESR 2 are to be strictly no-go area with respect to developments and ESR 4 is referred as a least possible eco-sensitive region. The Community-based Conservation (CBC) approaches in ESR 2 and 3 would help in the conservation of biological diversity (or wildlife).**
- Persistence of the endemic (rare, threatened, etc.) species in ESR 1 and 2 calls for serious attention from conservationists and decision makers to initiate programs immediately for conservation.
- Forests with innumerable streams (i.e. water course forests) in the Western Ghats, offer tremendous potential for carbon stocking per unit area while also bettering the hydrology of these mountains which form the main watershed for the entire Indian peninsula. These water course forests are not only rich with biodiversity but are also with high biomass, which highlights the greater carbon sequestration potential and their prime role towards mitigation of impacts of global warming. This emphasizes the need for the review of existing forest policies to ensure sustenance of ecological services through the sustainable forest management strategies.
- Rivers / streams in the ecologically sensitive regions should not be diverted or manipulated as it would affect the water retention capability of the catchment and ground recharge potential. This would affect the sustenance of water in the streams (as streams become seasonal). This would also affect the downstream users' right for adequate freshwater. Studies have revealed of salinity ingressions in freshwater resources with diversions depriving the downstream dwellers of fresh water and livelihood.
- Millions of subsistence farmers and other forest dwellers of Western Ghats can not only be partners in micro-level planning for prudent water use but also stand to gain

in a big way from carbon credits for their new role as promoters and guardians of watershed vegetation. Rendering such service for mitigating global climatic change can also, same time, serve well the cause of eco-sensitive regions in an otherwise much impacted biodiversity hotspot. The premium should be on conservation of the remaining ecologically sensitive regions, which are vital for the water security (perenniality of streams), mitigation of global carbon and food security (sustenance of biodiversity). There still exists a chance to restore the lost natural evergreen to semi-evergreen forests in the Western Ghats region through appropriate conservation and management practices. The management of biodiversity hotspot regions should focus on the conservation as well as socio-economic developmental aspects.

- These ESRs or eco-clusters approach aids in the conservation of ecology, biodiversity, water resources, culture and traditions while paving way for location specific economic development, primarily aimed at elevating levels of livelihood security. ESRs are seen in the context of sustainability and environmental friendly behavior as means for a socio-ecological transition in the long run.
- The eco-clusters at decentralized levels aid as driver for conservation of ecologically sensitive regions and implementation of an appropriate regional economic policies with the necessary incentive structures to foster eco-innovation as well as growth and employment at local levels (with the region specific industries such as agro processing, etc.). This envisage the foundation of an on-going process to integrate ecological and environmental considerations into administration in the ecologically fragile and biodiversity rich districts of Western Ghats. The integrated database on biodiversity and socio processes furnish analyzed data, advice and management prescriptions to beneficiaries at every level from the village communities to the Government. Eco-clusters are crucial for a sustainable development and thus need political commitment and incentives for the development of eco-industry sector (based on the local renewable natural resources). Thus, ESRs will aid as catalysts in a well-ordered decisionmaking process through stake holder's active participation with the priorities for sustainable livelihood.

CARRYING CAPACITY OF NETRAVATHI RIVER BASIN BASED ON THE ECOLOGICAL SENSITIVENESS

Executive Summary:

The conservation and sustainable management of ecosystems are the vital components in the pursuit of development goals that are ecologically, economically and socially sustainable. This requires an understanding of the complex functioning of ecosystems, and recognition of the full range and diversity of resources, values and ecological services that they represent. In this regard, the current research envisages integration of the ecological, environmental considerations into administration and management of river basins, which is a major step towards an ecological audit that eventually should result in the conservation and sustainable use of biodiversity. The four dimensions that are relevant to the estimation of carrying capacity are:

(i) The stock of available resources to sustain rates of resource use in production.

(ii) The capacity of the environmental media to assimilate wastes and residuals from production and consumption.

(iii) The capacity of infrastructure resources (e.g., distribution and delivery systems) to handle the flow of goods and services and resources used in production.

(iv) The effect of both resource use and production outputs on quality of life.

Ecosystem carrying capacity can be defined as 'the maximum number of a species that can be supported indefinitely by a particular habitat, allowing for seasonal and random changes, without degradation of the environment and without diminishing carrying capacity in the future. ***Carrying capacity refers to the maximum number of activities (biological, developmental, agricultural, and industrial, population) that can be supported over a period of time in the habitat without damaging the existing quality of life, balance of resources, ecology and productivity of the ecosystem***. Ecological Carrying Capacity provides physical limits as the maximum rate of resource usage and discharge of waste that can be sustained for economic development in the region. The aim of Environmental Carrying capacity is to adjust/increase the ability of the natural environment. Carrying capacity depends on

1) Resources (Biological or Non Biological) that influences on the number of species in the habitat based on the current condition.

2) Interaction (Physical, Chemical, Biological) between the resources and the processes involved in conversion/production of resource to a desired output with residuals and wastes in the environment
3) Habitat (Region), Human Choices, Living Standards, Time, technology
4) Economic Conditions, Growth Strategies and Policies;
5) Social-Cultural and Political Aspects

Planning for development within the limits of carrying capacity recognises that humankind is dependent on the productive capacity of ecosystems, and therefore, a minimal level of ecosystem integrity is to be maintained for human survival. Planning for sustainable development calls for trade-offs between the desired production-consumption levels through the exploitation of *supportive capacity* within its regenerative capacity and environmental quality within the *assimilative capacity* of regional ecosystem. The utilisation of carrying capacity, thus, requires a series of adjustments to reconcile competing operations in the developmental process through participation of various stakeholders. Assessment of the carrying capacity involves detailed study of ecology and human life in the region. This would be the best guide and tool for both policy makers to choose appropriate developmental and other income generating projects which are in tune with the ecology of the district. The carrying capacity studies, if adapted to the village panchayat levels, can transform lives of people at grass-root level through better understanding of their surroundings, by adopting lifestyles having greater harmony with their environment, so as to reap maximum sustainable benefits.

Due to the increased scale of human activities, exploitation, demand of resources led to production of larger amount of goods and services with byproducts and wastes damaging the environment and the ecosystem at local, regional and global scales, effecting sustainable development in the region. Through carrying capacity investigations, it is possible to identify locations for conservation (ecologically sensitive) as well as development in the region as carrying capacity allows us to divide the region into various classes based on the different resource availability.

Carrying capacity research in the Netravathi River basin began, through inventorying, mapping and monitoring of the vegetation and fauna. Such a dynamic documentation process enabled to keep proper stock of its biological and ecosystem diversities and to supervise their

judicious use for sustainable progress. Data required for natural resource planning included spatial data such as, information of physiography of the area, land use, assets, etc. The scope of a carrying capacity study has been extended to the analysis of supportive capacity in the region with respect to resource availability/utilisation, supply/demand, infrastructure/congestion and assimilative capacity/residuals. Hence, the carrying capacity is assessed as the ability to produce desired outputs (i.e., goods and services) from a limited resource base (i.e., inputs or resources) while at the same time maintaining desired quality levels in this resource base.

Ecological carrying capacity provides physical limits as the maximum rate of resource usage and discharge of waste that can be sustained for economic development in the region. The ecological sensitivity of ecosystems refers to their ability to cope with various kinds of environmental disturbances that have the potential of adversely changing the character of the natural landscapes. Identification of Ecologically sensitive Regions (ESRs) considering spatially both ecological and social dimensions of environmental variables helps in ecological and conservation planning as per Biodiversity Act, 2002, Government of India. The framework of delineation of Ecological Sensitive Regions (ESR) would help in identifying local hotspots of biodiversity, ecology and hydrology. The current research attempts to integrate ecological and environmental considerations into administration, and prioritizes regions at Panchayat levels (local administrative unit) in Netravati River basin, Central Western Ghats, Karnataka state considering attributes (biological, Geo climatic, Social, etc.) as ESR (1-4) through weightage score metrics. This has provided the details such as regions of extreme sensitivity, high sensitivity, moderate sensitivity corresponds to the zones of principal functions such as prohibited development zone, restricted development zone, an optimized development zone in planning.

The ESRs have been delineated at the village levels. There are 433 villages in the Netravathi river basin. Identification of ESRs in Netravathi region would aid in sustainable planning towards the sound ecological regional development. There are 111 villages in ESR-1, 69 villages in ESR-2 119 villages in ESR-3 and 134 villages in ESR 4. ESR 1 and ESR 2 are to be strictly no-go area with respect to developments and ESR 4 is referred as a least possible eco-sensitive region. The Community-based Conservation (CBC) approaches in ESR 2 and 3 would help in the conservation of biological diversity (or wildlife). Degradation of these eco-

sensitive region with the unplanned developmental path will only erode the sustenance of natural resources and would affect the local livelihood.

1.0 Introduction:

Landscapes are composed predominantly of natural vegetation, which aid in maintain the ecosystem goods and services (Ramachandra et al., 2018). The human welfare is integrally twined with the integrity of an ecosystem which sustains the availability of natural resources. However mismanagement of ecological systems with the unplanned developmental activities has impaired ecosystem services evident from the barren hill tops, conversion of perennial streams to seasonal streams, reduced biological productivities, etc. The anthropogenic activities have altered natural landscapes affecting their capacity of (1) bioremediation - filter nutrients and contaminants from water, (2) flood mitigation - abate flood waters associated with extreme climate events, (3) retain water, soils, and nutrients, (4) resist invasive species establishment, and (5) provide for natural predators of pests (Turner et al. 2007). The ecosystem is experiencing pressures from drivers such as land use land cover [LULC] change, changes in the climate due to enhanced GHG (Greenhouse gas) levels in the atmosphere, pollutants (air, water and land) and propagation of invasive species. This necessitates appropriate policy measures to mitigate the disturbances so as to ensure not to exceed the threshold state from which it may not recover or may take many years to return to its previous state through natural processes (Kinzig et al., 2006). This entails attaining comprehensive knowledge of the ecosystem integrity and the goods and services provided by ecosystems, and the importance of conservation for maintaining the quality of life. Systematic conservation planning is quintessential for prudent resource management and sustainable development. This has been evaluated as the theoretical foundation of sustainable development that adds another dimension to the need for judicious planning by integrating economic development with the ecological, environmental and social equity (Reid et al., 2016). Conservation planning has evolved to minimize the loss of biodiversity and vigil on the exploitation of resources through prioritization of regions rich in biodiversity for conservation (Pressey and Cowling, 2001; Egoh et al., 2007) and the challenge of quantifying ecosystem services in tangible and quantifiable factors (Grant et al., 2008).

Systematic conservation planning has been increasingly encompassed of identifying or expanding conservation hotspots, protected areas or to set a threshold for resource usage and

to influence land use decision making. It requires an assessment of carrying capacity of a region taking into account resource base, ecological sensitiveness, supportive and assimilative capacity of the respective ecosystems, conservation initiatives, etc. Planning also requires assessment of bio-geological systems, spatial priorities (i.e. area selection) for conservation action complemented with the sustainable development strategy in the context of stakeholder collaboration (Knight et al., 2006; Grant et al., 2008). Conservation planning involves assessing the interaction of biotic and abiotic factors, species distribution, datasets of the spatial arrangement of various factors, socioeconomic setup and finally disturbance regimes (Brooks et al., 2004). Sustainable planning integrates interactions between drivers, pressures and responses of more complex social and ecological dynamics as a result of positive and negative feedback responses existing between different activities and policy responses (Fusco, 2002; Ramachandra et al., 2016). The assessment of broad ranges of various factors helps in evolving ecologically significant areas or regions for conservation in a holistic approach. Ecological Sensitive Regions (ESR/ESA) include not only distinctive ecological factors such as mountain, reservoir, natural conservation area, but also includes human settlements surrounding ecological sensitive areas by forming a complete spatial and social entity (Peng et al., 2013). ESR are defined under conservation planning approach as "large units of land or water containing a geographically distinct assemblage of species, natural communities, and environmental conditions" (Olson et al., 2001). Adoption of a landscape perspective (spatial composition, pattern, and position) plays a vital role in demarcating ESRs as it provides a common framework to evaluate social, economic, and cultural dynamics and their relationship to ecological services (Naidoo and Ricketts 2006; Ramachandra et al., 2017).

ESRs are playing a significant role in ensuring ecological and environmental integrity and maintaining the health of the region through their ecological values and management regimes. ESRs are the interconnected fragile regions of interactive landscape elements, vital to the long-term maintenance of biological diversity, soil, water or other natural resources which could be threatened by unplanned development (Leman et al., 2016). ESR should be stratified as environmental sensitivity evaluation through assimilating various trade-off between land development, environmental protection, social well-being, and effective planning for impending development (Dai et al., 2012). ESRs delineation through the

integration of geology, topography, hydrology and environment is the rigorous framework of sustainable land use planning. This would include ecologically critical areas, perceptual and cultural critical areas, natural resource critical areas and natural hazard critical areas and necessitates coordination from local, state, and federal efforts to achieve protection objectives. ESRs prioritization comprehensively captured social and ecological dynamics of a region their mutual interaction and ecosyem's tolerance to transient and endogenous disruption. ESR framework considers aspects of ecosyem's stability to tolerate disturbances, durability to recover or maintain its social-ecological functions and robust to be able to cope with an external pressure (Stirling, 2007). These properties are individually necessary and collectively sufficient for achieving sustainability. Development and implantation ESR framework requires harmonization between demarcation of priority biodiversity features with the active involvement of different stakeholders and agencies (conservation agencies & resource managers) in effective implementation. Stakeholder participation in decision making of ESR regions aid in understanding the complex and dynamic nature of environmental problems and lends a flexible and transparent decision making through a diversity of knowledge and values (Reed, 2008).

The Ministry of Environment, Forests and Climate change (MoEFCC), Government of India has taken an initiative to protect forests and maintenance under section 3 of Environment (Protection) Act 1986 (EPA). Central Government can prohibit or restrict the location of industries and carry out certain operations on the basis of considerations like the ecological sensitivity under section 3 of EPA 1986. The MoEFCC had set up Pronab Sen Committee in the year 2000 to identify parameters for designating ESRs in the country to counter the rapid deterioration of the environment, both nationally and internationally (MoEF, 2000). The committee has defined ecological sensitivity or fragility as permanent and irreparable loss of extant life forms from the world; or significant damage to the natural processes of evolution and speciation. The comprehensive knowledge of a region has become increasingly important for conservation planning and visualization of future growth to overcome the problems of haphazard, uncontrolled development in ecologically sensitive regions (Kennedy et al., 2009). Temporal remote sensing (RS) data, geographic information systems (GIS) techniques, free and open source software (FOSS) technologies are providing efficient

methods for the analysis of LULC dynamics required for planning and protection (Ramachandra et al., 2014).

Unplanned developmental path adopted by unscrupulous decision makers is threatening the ecologically sensitive regions in the Netravathi River basin. River diversions, hydro electric projects, coastal reservoirs, commercial plantations, unscientific tourism, etc. would cause irreplaceable loss of rich biodiversity. In this regard, the current research tries to understand land use dynamics, biodiversity, hydrology, ecology and social aspects in the Netravathi River Basin (includes Gurupura river also) and delineate ecological sensitive regions considering bio-geo climatic variables for prudent management of natural resources.

2.0 Study area: Netravathi River basin

The river Netravathi originates in Bangrabalige valley, Yelaneeru Ghat of Kudremukh in Chikkamagaluru district of Karnataka, Western Ghats, India. The river has a catchment area of 4409 km^2 and covers Chikmagaluru, Hassan, Kodagu, Dakshina Kannada and Udupui districts (Figure 1-3) in 11 taluks. Rainfall varies between 2000 mm (Plains of Mudigere and Sakleshpura taluk) to over 5500 mm (Ghats) (Figure 4). Elevation of the basin ranges from < 0 to 1872 m (Figure 5). It is the lifeline of Dakshina Kannada region supporting the enormous population with rich resource base and diverse cultures. This sacred river runs through numerous popular pilgrim places such as Dharmasthala, Kukke Subramanya etc. (Figure 6). Netravathi main course merges with the river Kumaradhara at Uppinangadi before merging into the Arabian Sea with Gurupura river. The river forms major water source to the Mangalore city, Bantwal and many towns. Figure 7 depicts various landscape elements of the river basin. The river has an inextricable connection between culture and diversity, also forms a major economic source for the people. The rice fields in valleys are often irrigated with perennial streams from forested hill slopes. Many valleys served by watercourses and riparian plains are the seats of the famed spice gardens growing crops like, coconut, arecanut, banana, cardamom, turmeric, black pepper, cocoa, ginger and vanilla. Netravathi river basin is part of the ecologically fragile Western Ghats, one among 35 global hotspots of biodiversity supporting diverse flora and faunal species (Figure 8, 9). Netravathi River systems has numerous perennial streams with typical tropical climax evergreen forested catchment areas of high conservation value. The forest types in the basin vary from tropical wet evergreen to semi-evergreen rain forests, tropical moist deciduous forests, scrub jungles, grasslands and savannas, scattered trees along plantations and abandoned fields. The significant floral

species includes *Knema attenuate, Gymnacranthera canarica, Holigarna ferruginea, Myristica malabarica, Ochreinauclea missionis, Madhuca insignis, Memecylon angustifolium, Syzygium travancoricum, Pandanus unipappilatus, Helminthostachys zeylanicus, Diplazium esculentum, Strobilanthes ciliates, Hopea ponga, Vateria indica, Euonymus indica, Carallia brachiata, Madhuca neeriifolia, Calophyllum apetalum, Elaeocarpus tuberculatus, Vitex leucoxylon Kingiodendron pinnatum* etc., and many of them are under Critically Endangered, Vulnerable, Threatened categories. The region is home to endangered Myristica swamps having Critically Endangered *Syzigium travancoricum* and *Gymnacranthera canarica* (Vulnerable) are amongst many other species. The swamp ecosystem is under higher threat due to horticulture expansion and land conversion for other developmental activities. The area has a large number of medicinal plants and non-timber forest product (NTFP) yielding plants. Every year millions of rupees worth *Myristica malabarica* aril, honey and other NTFP products are collected from the riparian forest.

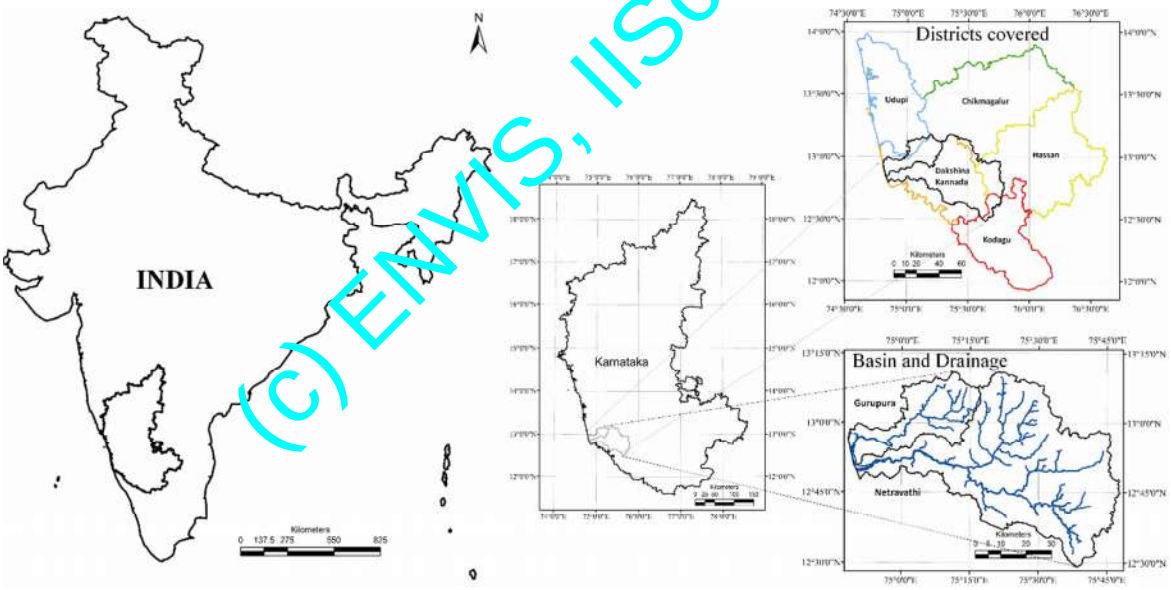


Figure 1: Netravathi River basin, Central Western Ghats, Karnataka State, India

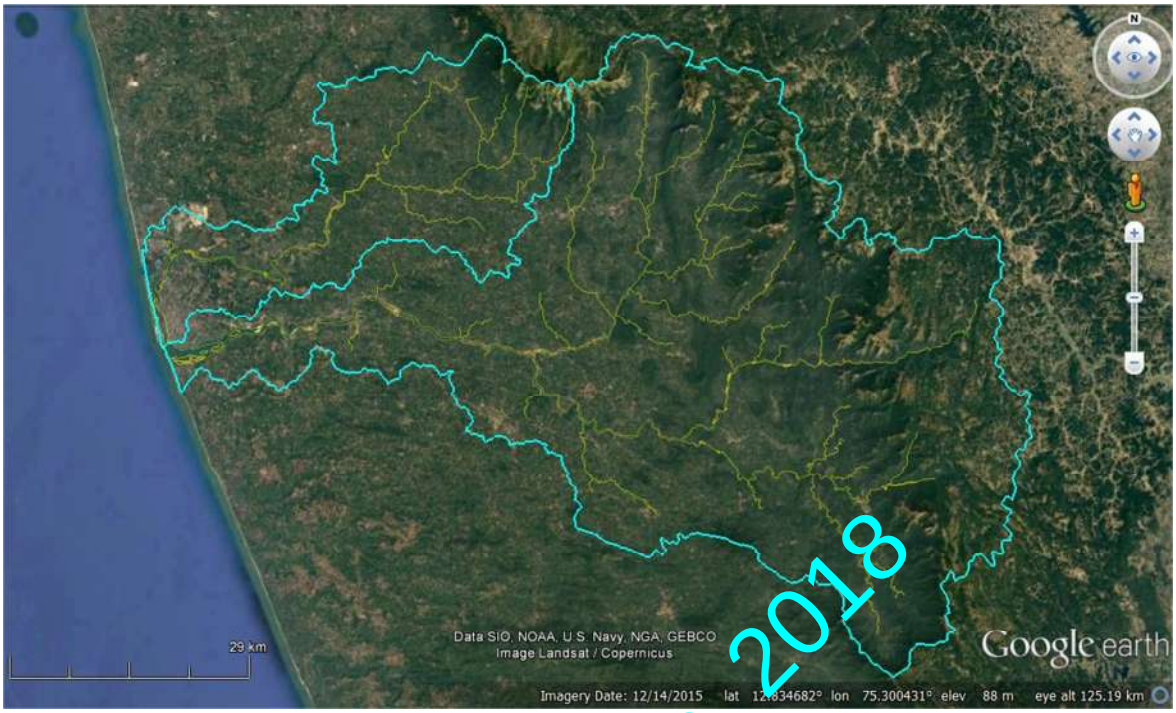


Figure 2: Netravathi catchment (with tributaries) overlaid on Google earth (http://earth.google.com).

Figure 3: Administrative boundary - taluks (spread across Chikmagalur, Hassan, Kodagu, Dakshina Kannada and Udupi districts, Karnataka State) in the Netravathi River basin.

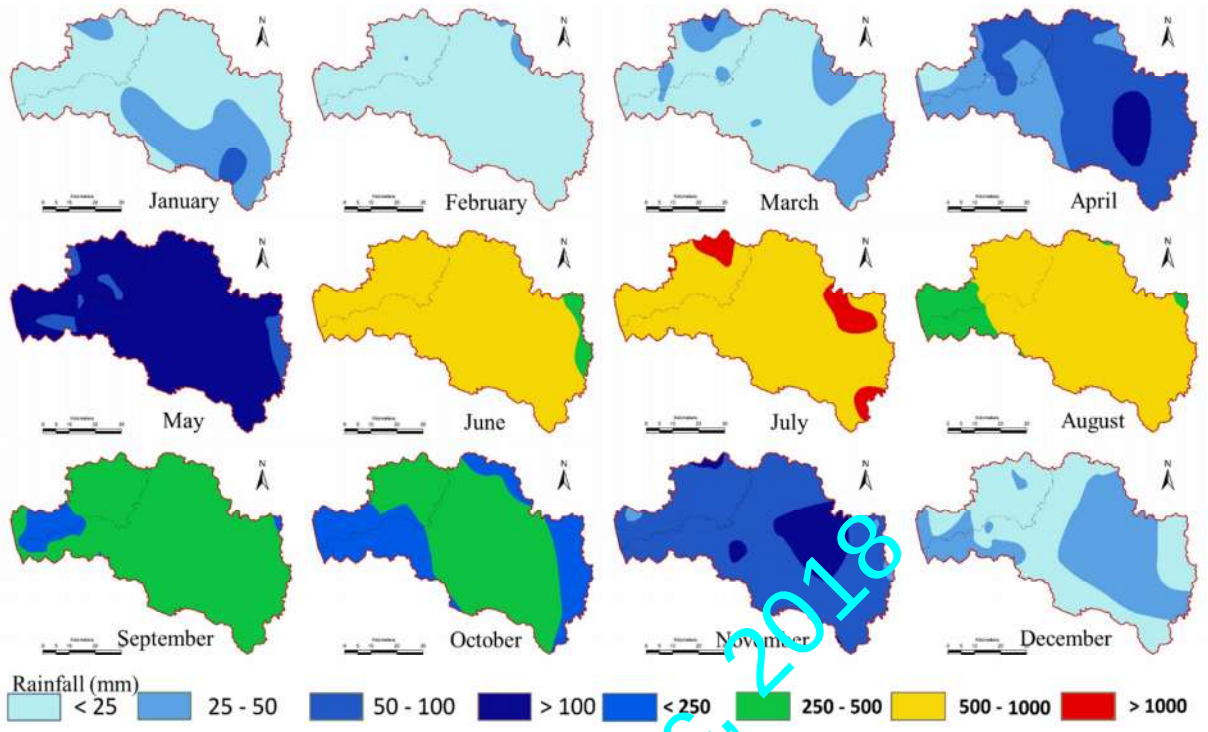


Figure 4: Spatial patterns of monthly rainfall in the Netravathi River basin

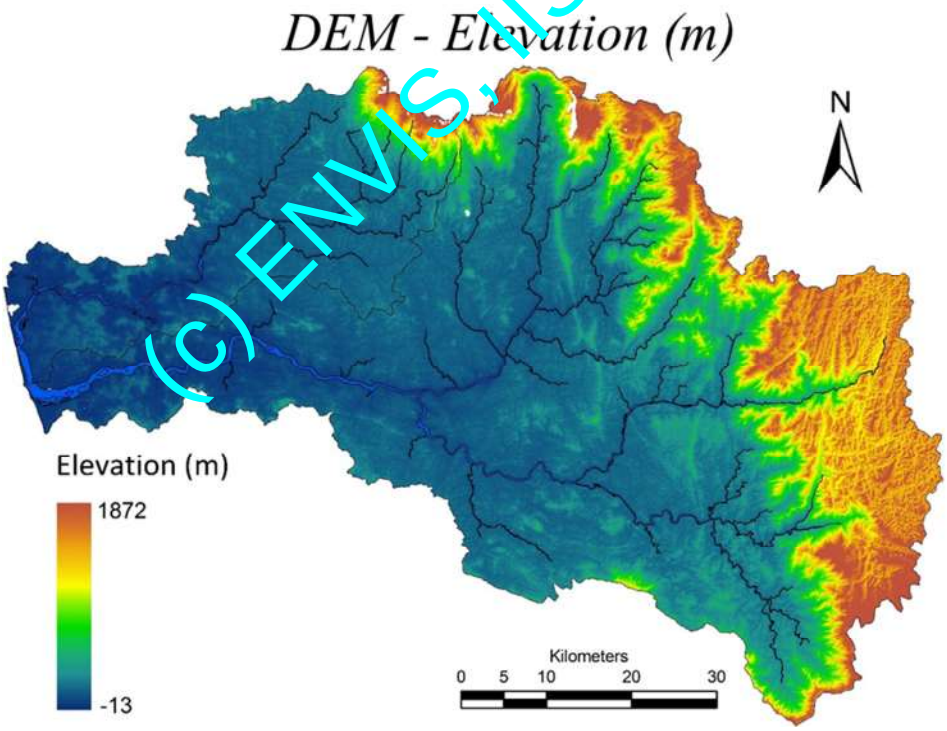


Figure 5: Undulating topography - elevation profile of Netravathi River basin

Figure 6: Cultural diversity in the Netravathi River basin.

Figure 7: Various landscape elements in the Netravathi river basin

Figure 8: Glimpse of flora diversity in the Netravathi River basin

Figure 9: faunal diversity in the Netravathi River basin

3.0 Method:

Figure 10 and 11 outlines the overall method adopted for delineating ecologically sensitive villages in the Netravathi River basin. Land use dynamics is understood as per the standard

protocol using remote sensing data as described in Figure 10, which involved i) data acquisition, ii) data preprocessing and iii) classification.

i) Data Acquisition: The process of data acquisition involves the collection of Primary and Secondary Data. Primary Data includes Remote Sensing Data and Field Data. Remote Sensing Data (of about 10 scenes) of Landsat 8 for the year 2016 was downloaded from USGS web portal (https://earthexplorer.usgs.gov). GPS (pre calibrated Global Positioning System) and AGPS based field surveys were done in order to supplement land use analysis (with training data, geocontrol points, etc.). Secondary Data collection involves the collection of ancillary data such a French institute Puducherry vegetation maps (Pascal, 1986), Geographical Survey of India topographic land use maps (http://www.portal.gsi.gov.in), Biodiversity portal (http://indiabiodiversity.org/), and Virtual earth data such as Google Earth (http://earth.google.com), Bhuvan (http://bhuvan.nrsc.gov.in). The Secondary data provide additional input to the field data for data pre-processing and classification.

ii) Data Preprocessing: This involves Geo-referencing and Radiometric correction of RS data. GPS based field data along with online spatial data (Google earth; http://earth.google.com, Bhuvan: http://bhuvan.nrsc.gov.in) were used to geo-reference the remote sensing data. Error up to 30 meter (1 pixel) was allowed during the process of Geo-referencing the data. RS data was checked for radiometric errors and enhancement was carried out for those datasets having errors. The correct image was cropped to the area of interest (Netravathi Basin).

iii) Classification: Remote sensing data classification is a process of producing a thematic map by assigning categories to each pixel based on the spectral signatures obtained from a stack of multi-band RS data (Lillesand et al., 2004; Gonzalez and Woods, 2007). The process of classification involves the creation of False Color Composite, selection of training sites, classification and accuracy assessment. Creation of FCC helps in identifying the heterogeneous feature. NIR, Red and Green bands are stacked to create an FCC. Secondary data and Field data are used in association with Remote Sensing data to delineate heterogeneous features covering at least 15% of the scene area. Features such as Forests (evergreen, deciduous, scrub, mixed forest), Grasslands, Built-up, Agriculture (Sown and Fallow), Plantation (Coconut, Rubber, Tea, Coffee, etc.), Water bodies, Others (Quarry, Sand, Open lands, Rocky outcrops) were identified. Maximum likelihood classifier is one of best and most commonly used classification tool (Bharath et al., 2012; Vinay et al., 2013;

Bharath et al., 2014a, b; Ramachandra et al., 2016; Ramachandra et al., 2017). The supervised classification scheme of Gaussian maximum likelihood classifier (GMLC) scheme is adopted for land use analysis under 6 different land use categories using GRASS GIS (Geographical Analysis Support System). GRASS is a free and open source geospatial software with the robust functionalities for processing vector and raster data available at (http://wgbis.ces.iisc.ernet.in/grass/). The training data (60%) collected has been used for classification, while the balance is used for accuracy assessment to validate the classification. The test samples are then used to create error matrix (also referred as confusion matrix) Kappa (κ) statistics and overall (producer's and user's) accuracies to assess the classification accuracies (Lillesand et al., 2014).

The study area is divided into 5'× 5' equal area grids (74) covering approximately 9 x 9 km^2 to account the changes at micro scale. The data of various themes were also collected based on literature review, unpublished datasets, and ground-based surveys. A detailed database has been created for various themes covering all aspects of land to the estuarine ecosystem. A series of maps pertaining to various themes were developed based on the data. The weightage metric score has been computed to captures the priorities associated with various themes (Figure 11). Developing a weightage metric score analysis requires combining knowledge from a wide array of disciplines (Termorshuizen and Opdam, 2009), planning should acknowledge and actively integrate present and future needs for landscape (Ramachandra et al., 2017). The approach has chosen a framework based on respective themes' relative weights (Beinat, 1997) for developing eco-sensitive regions. This approach provides a transparent system for combining multiple data sets together to infer the significance of a particular region.

The weightage is defined in Equation 1:

$$Weighatge = \sum_{i=1}^{n} W_i V_i \ \ldots (1)$$

Where n is the number of data sets, V_i is the value associated with criterion i, and W_i is the weight associated with that criterion. Each criterion is described by an indicator mapped to a value normalized between 10 to 1. The value 10 corresponds to very higher priority for conservation whereas 1 is converse to above. The value 7, 5 and 3 corresponds to high, moderate, low levels of conservation. In particular, the weightages, which is based on an individual proxy and draws extensively on GIS techniques, stands out as the most effective

method. The final ESR map will result as a guide for the conservation of most sensitive regions and rest. The map can be used by decisionmakers as a basis for effective planning.

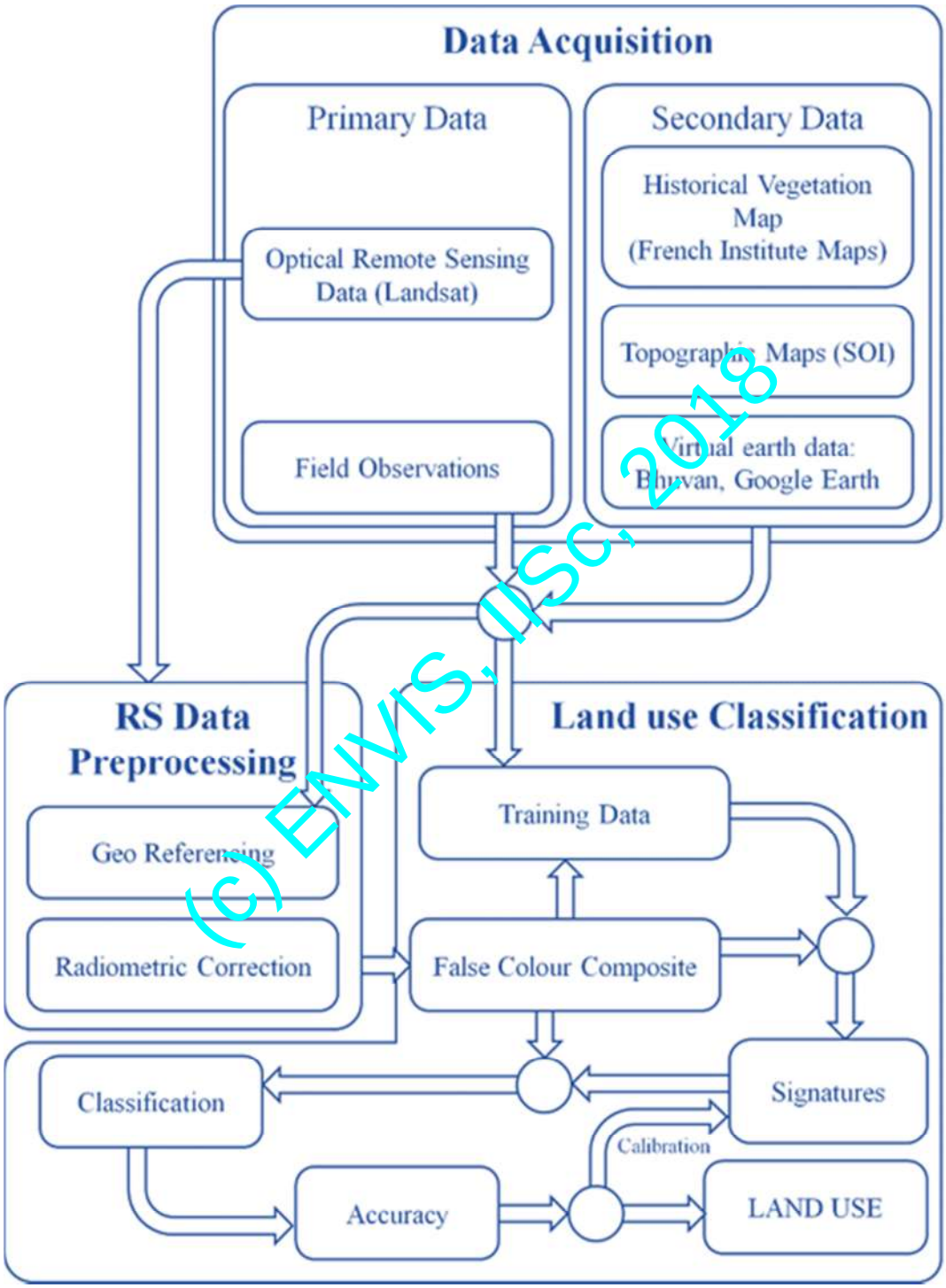


Figure 10: Method followed for land use analysis

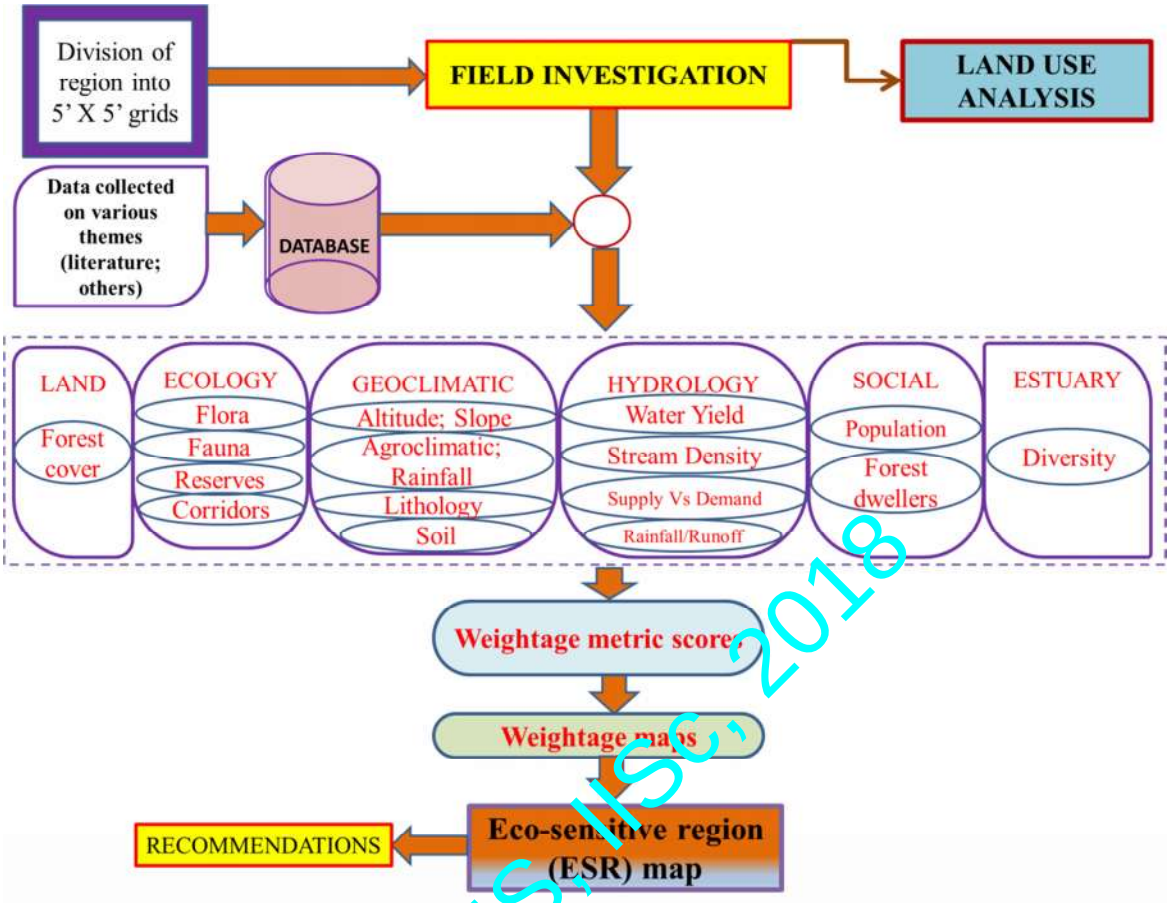


Figure 11: Computation of ecologically sensitive regions.

4.0 Results:

4.1 Land use analysis:

The forests of Netravathi river basin with the repository of rich biodiversity has been supporting the livelihood of people in the districts of Central Western Ghats. The land use analysis of Netravathi river basin depicts the status of forest cover during the year 2016 (Figure 12 and Table 1). The area under forest cover shows 51.67 % after losing significant patch of forests for mini-hydroelectric, infrastructure projects and monoculture plantations. The plantations constitute 26.42 % of the basin and major forests are confined to the eastern side of the basin (Figure 13). The market interventions in agriculture (through commercial plantations) have resulted in the loss of cropland as well as encroachment of forests. Large tracts of forests were replaced with exotic species of monoculture plantations such as acacia, eucalyptus, rubber and teak etc.. Land conversion is major problem noticed i.e. conversion of forest to agriculture; agriculture to coffee/coco/areca nut plantations. The western portion of

the basin is dominated by agriculture and plantations and built-up cover. More edges reveals loss of connectivity and largest forest patches and are prevalent due to anthropogenic interventions in the landscape,. The entire basin is a habitat for key species such as tigers and elephants. The accuracy of classification has been verified with sample data collected from the field and online spatial data (Google earth). The overall accuracy of classification is 89 %.

Table 1: Land use information of Netravathi basin.

SNO	CATEGORY	DESCRIPTION	Ha	%
1	FOREST	Evergreen forests, deciduous forest, degraded forests, scrublands, Soppina betta	224900	**51.67**
2	PLANTATIONS	Horticulture and Forest plantations	115010	**26.42**
3	AGRICULTURE	Current Sown and Fallow Agricultural lands	21800	5.01
4	BUILT-UP	Buildings, Roads and paved surfaces	9410	**2.16**
5	OTHERS	Open area, Grasslands, Riverbed, Sand, Quarries, Cloud and Shadow	61030	14.02
6	WATER	Rivers, Lakes, Ponds, Estuary	3150	0.72
TOTAL AREA			435300	

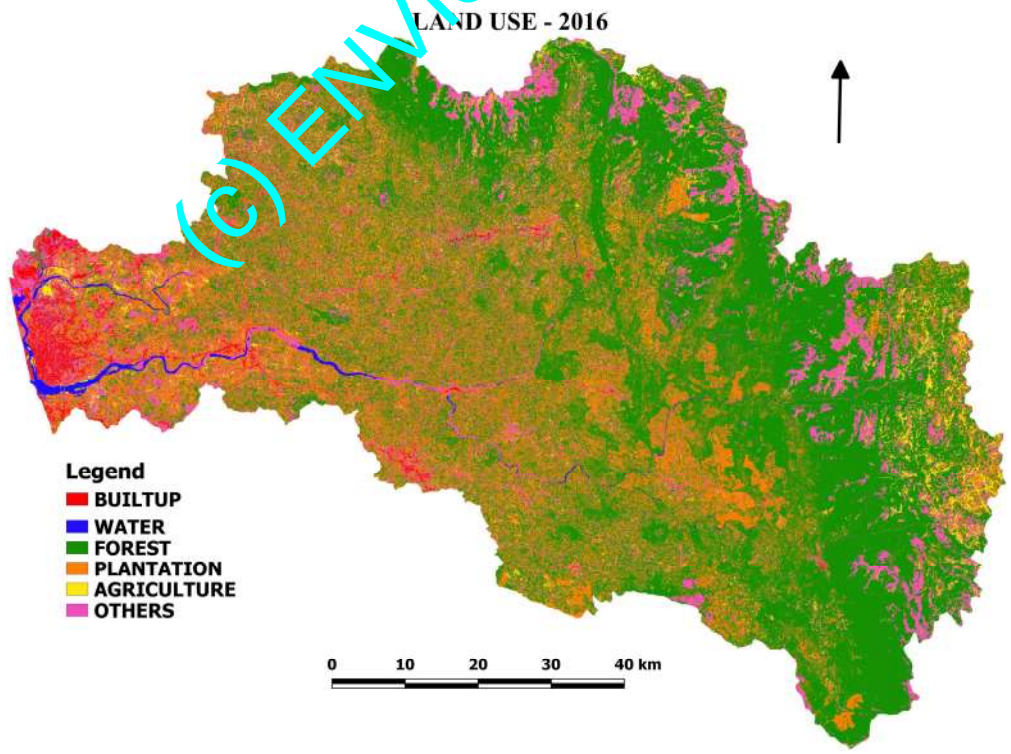


Figure 12: Land use analysis of Netravathi river basin.

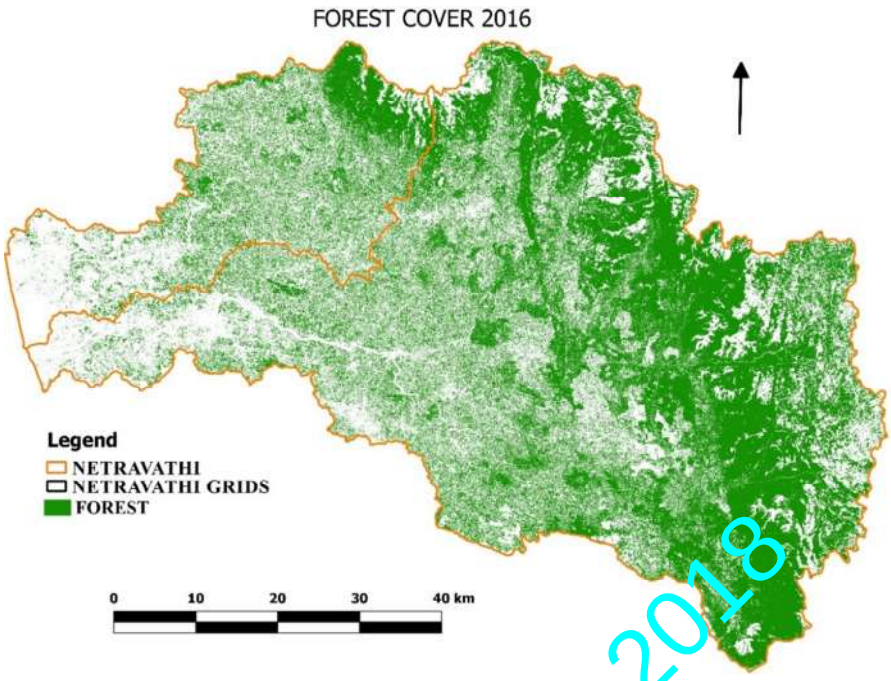


Figure 13: Forest cover of Netravathi Basin.

4.2 Ecological Sensitive Regions (ESR) of Netravathi River Basin:

ESR demarcation provided a detailed picture of Netravathi River basin across various themes through multi sector datasets. The various themes are selected and evaluated based on literature and field measurements. Themes considered are: Land, Ecology, Geo-climatic, Hydrology, Social and Estuarine diversity, which are discussed in the following subsections.

Land: Land use analysis provided the spatial extent and the present status in the basin (Figure 14). The forest cover of the basin was considered to understand the connectivity, extent of fragmentation and ecological functionalities. The eastern portion represents good forest cover as compared to the west. The greater forest cover is represented by grids of Kumara Parvatha, Gundia, Kudremukh National Park (KNP) region. The forest cover weightages (Figure 15) shows higher, moderate ranking is observed in eastern grids. The cultivation in the nearby plots and roads are badly affecting natural cover. The higher intact forest can be seen in grids of KNP, Gundia region, and were assigned higher weights.

Ecology: The ecology of Netravathi River basin is analyzed by variables explaining biodiversity such as endemic taxa (flora and fauna), the status of conservation reserves, elephant movement path etc., using field data and also the data compiled from published

literatures. A detailed database of flora and fauna has been developed which includes occurrence (latitude, longitude), species name, family name, International Union for Conservation of Nature (IUCN) status, data source, protection etc., and Figure 16 depicts the distribution pattern of these taxa. Figure 17 and 18 depicts flora categorised as per IUCN status and its relative weightages (Annexure A; B) in grids. The flora database has 762 entries covering 429 flora species in 95 families. The basin has good distribution of endemic, critically endangered and threatened species such as *Actinodaphne malabarica, Aglaia canarensis, Aglaia lawii, Artocarpus hirsutus, Calophyllum apetalum, Cinnamomum sulphuratum, Garcinia indica, Kingiodendron pinnatum, Madhuca insignis, Myristica malabarica, Syzygium travancoricum, Vateria indica, Hopea parviflora, Hopea ponga* and *Knema attenuate etc.,* The region is home to many very rare, endemic and endangered wildlife (Figure 19). The faunal database has 864 entries covering 418 species under 126 families. Main predators are tiger (*Panthera tigris*), leopard, wild dog (dhole) and sloth bear. Leopards are in good number and wild dogs are in very less number, usually sighted in KNP region and Gundia basin. Prey animals are barking deer, spotted deer (*Axis axis*), wild boar, sambar (*Cervus unicolor*), gaur (*Bos gaurus*). One can also find Lion-Tailed Macaque (*Macaca silenus*), Malabar Giant Squirrel, Slender Loris etc. Some of the important birds are Malabar Parakeet, Malabar Trogon, Malabar Pied Hornbill, Malabar Grey Hornbill, Indian Grey Hornbill, Great Indian Hornbill, Emerald Dove, Ceylon Frog mouth, Indian Paradise-flycatcher etc. There are a wide variety of snakes i.e., King Cobra, Cobra, Malabar Pit Viper, Hump-nosed pit Viper, Bamboo Pit Viper, Kraft, Ornate flying snake, wolf snake etc. There is also a wide variety of butterflies found in the reserve. Some of them are Crimson Rose, Common Rose, Leaf Clipper, Tigers, Southern Bird wing, Cruiser etc. So, higher weightages (10) are assigned to grids (Figure 20) covering all endemic, critically endangered, threatened species and least were given as 3 for Least concern category of fauna.

The conservation area or protected area are considered as crucial regions in ESR delineation. The basin has large tracts of forest protected under Kudremukh National Park, Pushpagiri Wildlife Sanctuary (PWLS) (Figure 21). KNP is administered and protected as NP from 1987 under the Karnataka Forest Act 1963, Karnataka Forest Rules 1969 and Wildlife Act 1972. KNP is spread over an area of 563 km^2. And falls in three districts namely, Dakshina Kannada district (158 km^2), Udupi district (89 km^2) and Chikmagalur district (316 km^2). There are four forest ranges - Belthangadi, Karkala, Kerekatte and Kudremukh. There are two forest sub-divisions: Kudremukh and Kundapur, which contribute to the area of the national

park. The Lion-Tailed Macaque (LTM) considered 'flagship' species occur in this region and conserving their habitats helps in conserving wildlife population in the region (Change, 2013). KNP is aiding as repository of rich biodiversity reserve with several endangered and globally significant wildlife species like the tiger (*Panthera tigris*), Malabar civet (*Viverra civettina*), Leopard (*panthera pardus*), Wild dog (*Cuon alpinus*), Sloth bear (*Melurus ursinus*) Flying Lizard (*Draco dussumieri*), Flying Snake (*Chrysopelea ornata*), King Cobra (*Ophiophagus hannah*), Shield Tail Snakes (Uropeltidae spp.), Travancore Tortoise (*Indotestudo jorsteni*), Forest Cane Turtle (*Geoemyda silvatic*) and possibly several of which are endemic to the area. There are about 200 species of birds, 30 species of reptiles, 100 species of butterflies and moths, and 50 species of fish found in KNP. KNP comes under the Global Tiger Conservation Priority-I, under the format developed jointly by Wildlife Conservation Society (WCS) and World Wide Fund-USA.

Pushpagiri Wildlife Sanctuary (PWLS) is located in Somwarpet taluk of Kodagu district, Karnataka. PWLS adjoins Bisle reserve forest to the north and Kukke Subramanya forest range to the west. PWLS was declared vide notification number AHFF. 173 FWL. 87(11) dated 2nd September 1987. The final notification was issued on No.FEE.57 FWL. dated 13th June 1994. The topography of PWLS is dominated by steep terrains (160-1712 m) with waterfalls, swampy areas and streams. The rivers Lingadaholé, Kumaradhara, Marigundholé and Uppangalholé flows through the sanctuary and acting as lifeline for the downstream population by the maintenance of ecological balance and soil and moisture conservation. It has dense evergreen and semi evergreen vegetation, with shola forests and grasslands in areas of higher elevation. It is one of the largest tropical evergreen forests in Karnataka with nearly 70% of the sanctuary covered with evergreen forests. The flora includes *Artocarpus integrifolia, Artocarpus hirsuta, Artocarpus fraxinifolius, Alstonia scholaris, Calophyllum elatum, Calophyllum inophyllum, Calophyllum apetalum, Cedrella toona, Poeciloneuron indicum, Mesua ferrea, Palaquium ellipticum, Dipterocarpus indicus, Hardwickia binata, Vateria indica, Canarium strictum, Adina cardifolia, Syzigium cuminii, Lagerstromia lanceolate, Caryota urens, Antiaris toxicaria, Trewia nudiflora, Eugenia gardneri, Emblica officinalis, Terminalia peniculata, Terminalia chebula, Terminalia chebula, Terminalia belerica, Lagerstromia lanceolata, Xylia xylocarpa, Terminalia tomentosa*, Diopyros species, Ficus species, Albezzia species *and Anthocephalus cadamb,* etc. PWLS is rich in fauna, which includes Asian Elephant, Lion-Tailed Macaque, Indian Wild Dog, Brown Palm Civet, Indian Giant Squirrel, Indian Hare, Spotted Deer, Sambar, Gaur, Giant Flying Squirrel,

Travancore Flying, Otter species, Stripe-necked Mongoose, cobra, Indian rock python, king cobra and bamboo pit viper. The region has a rich diversity of birds (16 endemic endangered) such as Nilgiri wood-pigeon, Grey-breasted laughing thrush, blue-winged parakeet, grey-headed bulbul, Malabar grey hornbill, black and orange flycatcher and Nilgiri flycatcher. It harbors beautiful endemic and endangered papilionids viz, Malabar banded peacock, Paris peacock, Malabar raven, and Malabar banded swallowtail. Pushpagiri lies at the junction of the southern and northern ranges of Western Ghats. Towards the south, wildlife migration corridors extend from Pushpagiri to far away Wayanad Tiger Reserve in Kerala via Nagarhole and Bandipur tiger reserves. In the north, the 12 contiguous reserve forests act as vital corridors, connecting Kudremukh and two other tiger reserves in the state. Figure 22 depicts grids assigned higher weightages that covered in protected areas.

The elephants regarded as 'Umbrella species' or premier 'Flagship species' and sometimes as 'Keystone species'. Due to their prime role in ecology and environment elephants are described as endangered by the Wildlife Protection Act 1972 (Appendix-1) and by Appendix 1 of the Convention of International Trade of Endangered Species of Flora and Fauna (CITES) in 1975. Netravathi basin forms a vital elephant corridor that connects to notified Mysore Elephant Reserve. The Mysore Elephant Reserve was notified by the Karnataka Government in November 2002 (Vide GO FEE 231 FWL 2000, 25/11/2002), which forms a link connecting Western Ghats and Eastern Ghats covering many wildlife sanctuaries, National Parks etc. It covers the total area of 6,724 sq.km. The Bisle Reserve Forest of Netravathi river basin, vide the said GO, constitutes a vital part of the Mysore Elephant Reserve. It covers an area of 3,339 ha (Survey Number I and II in Bisle reserve forest). It adjoins Kempholé Reserve Forest in north and Pushpagiri Wildlife Sanctuary in the south. It is an integral and important part of the Mudumalai-Nagarhollé-Brahmagiri-Muttodi Corridor (Figure 23, 24). The grids that are part of these ecologically sensitive areas are assigned higher weightages (elephant corridor area) as shown in Figure 25.

Geo-climatic: Geo-climatic information of region was analyzed to identify sensitive zones by considering altitude, slope, agro-climatic zones and rainfall. The high altitude regions are prone to landslides due to heavy rain, has extreme weather conditions, low humidity. Figure 26 shows the altitude map of the district; highest elevation is 1872 m in Mudigere taluk. The weightage map is generated by considering > 800 m as a higher priority for conservation and > 400 m is moderate and rest is least concern (Figure 27). Slope map (Figure 28) is generated

to identify the regions which are more sensitive; alteration of these regions will have a higher impact. Increase in the population makes people move towards sensitive areas like highlands because of soil fertility, market-based agricultural ativities intensification. In such areas, landscape disturbances have lead to soil erosion, landslides, secondary plant succession, and ultimately to land abandonment. The slope > 15 degrees is considered as a more sensitive region and assigned higher weightage (Figure 29). Geologically, the catchment is dominated by Gneiss rocks. Lateritic rocks are found in at Mangalore, Buntwala and Karkala taluks. Charnokites are found in abundance in Buntwala and Puttur, Basaltic rocks are found at the transition zones in the taluks of Puttur and Beltangadi. Alluvial type is found at the Coast. Traces of Schist and Granitic rocks are found at Puttur, Beltangadi and Sakleshpura Taluks. Figure 30 depicts the lithological map of Netravathi river basin. These bedrocks play a major role in transferring water to the aquifers which contribute to base flow. Porosity and specific yield of bedrocks are the factors that define aquifer recharge and base flows. In general, Granitic rocks have low porosity i.e., about 3 - 5%, Aluvial rocks have the highest porosity i.e., about 20 -25%. Netravathi catchment is dominated by gneisses rock type which is a secondary rock formed due to metamorphism of primary volcanic rocks and has a porosity of 8 – 10% (31). Figure 32 portraits the weightages assigned as per porosity of basin.

Soil depth and texture decides the water holding capacity of the catchment. Forests aid the soils with organic matter, roots penetrate deeper creating more void spaces allowing more water to percolate and store in the substrata. Netravathi catchment is dominated by clayey soils, only the coastal portion of the catchment is dominated by sandy soil (Figure 33). Gravelly, sandy soils have high water infiltration capability and allow water to easily pass through the strata without much retention, where a loamy and clayey soils have fewer pore spaces due to which infiltration capability is very low but have a higher water holding capacity which supports larger vegetation, keeps the rivers perennial in natural condition. Soils are moderately deep to very deep in nature (Figure 34). Soils along the Plains to the transition zones, Ridges are Clayey-Skeletal. Ghats and Transition Zones of Netravathi is dominated by Deep Soils with sparse Moderate Deep Soils, whereas the Ghats and transition zones of Gurupura have Very Deep Soils. The plains of both Catchment were dominated by Moderate Deep Soils. Coast zone again shows the dominance of Very Deep Soils. Presence of deeper soils with clayey content in the Ghats have higher water retention capability during post monsoons and summer, keeping the Netravathi perennial, but overexploitation of water for monoculture had altered some of the perennial streams to intermittent streams. The

weightages are assigned based on water infiltration and soil depth characteristics as shown in Figure 35. Agroclimatic zones of the basin are considered to understand climatically suitable for different crops. The planning based on this will aim at scientific management of regional resources to meet the food, fodder and fuelwood without adversely affecting the status of natural resources and environment. The region has two major agroclimatic zones as per National Bureau of Soil Survey & Land Use Planning based on rainfall, soil group etc., as shown in Figure 36. The efficient management of agroclimatic zones indicates balanced growth attained by proper utilization of local resources involving local people. The higher weightages have been assigned to the grids covered in Sahyadri's with rich resource base (Figure 37).

Long-term daily precipitation data of 1901-2013 were collected from the Directorate of Economics and Statistics, Government of Karnataka (Directorate of Economics and Statistics) pre-processed in order to rectify missing/erroneous rainfall records considering rainfall in neighboring rain gauge stations. Rectified data were further analysed for spatiotemporal variations. The data were further analysed for assessing trend, frequency, dependability, return period. Rain Gauge stations were identified and located using Google earth and Karnataka State Rain Gauge station map (Karnataka State Rain Gauge Stations). Interpolation was carried out understand the spatial dynamics of rainfall across the catchment. Post-processing (extraction) was carried out to quantify rainfall within the catchment. The temporal analysis was carried out to understand the variability, dependability, return period of rainfall at each taluk. India Meteorological Department classifies rainfall at regional scale as Excess, Normal, Deficient/Drought, Scanty/Severe Drought conditions as excess (Rainfall > + 20% average annual rainfall); normal (20% average annual rainfall < Rainfall < + 20% average annual rainfall); deficient (60% average annual rainfall < Rainfall < - 20% average annual rainfall); scanty (99% average annual rainfall < Rainfall < - 60% average annual rainfall). Figure 38 depicts the method involved in understanding the temporal dynamics of precipitation. The rainfall pattern of the district is analyzed to mark the sensitive regions for conservation. Most of the basin (Figure 39) is falling in the high rainfall zone (> 3500 mm), except eastern parts of Hassan district. The tallest emergent exceeding, endemic species are well distributed in higher rainfall region. The diversity, endemism, and rainfall are interrelated each other. The disturbance in these regions will have a major impact on the landscape. Spatial analysis indicates, Ghats receive the highest rainfall in the catchment about Average Annual rainfall of 4000-5200 mm, whereas the transition zones

receive rainfall in the range of 4000 mm to 4500 mm, lowest rainfall is observed in the plains of Mudigere and Sakleshpura Taluks ranging between 2800 mm to 4000 mm. The detailed taluk level rainfall temporal dynamics are analysed and included in Annexure C. The Figure 40 shows weightage map considering higher rainfall gradient with greater weightage followed by moderate and low.

Hydrology: Hydrology of the region is assessed sub-basin wise to account perennial, seasonal flows of the region. Perennial flows in streams of a region depict health of the ecosystem. Hydrological characteristics of the basin have been analysed and assigned weights based on the variables such as stream density; water yield; runoff; runoff/rainfall ratio; supply vs demand. Stream density is defined as the ratio of stream length the catchment area. Higher the stream density in a catchment indicates of good hydrologic regime. Stream density has a direct impact on lag time and hydrograph peak. For a rainfall event, basins with high drainage densities will have relatively rapid response time (shorter lag time) and steeper limbs as against low-density drainages, i.e., precipitation gets into streams quicker in high dense drainages, in contrary to catchments with low dense drainages, precipitation has to travel as surface runoff, base flow, pipe flow, through fall enhancing lag time. Figure 41 depicts that Ghats have higher drainage density as against the coast and plains. Netravathi and Gurupura catchment together have Stream density of 2.5km per sq.km. Grids in the Ghats indicates higher stream density as against the coastal plains and assigned higher weights as shown in Figure 42. Natural Resource Conservation method was used to quantify the Runoff at Sub basin level in the catchment. Annual water yield is represented in Figure 43. The catchment has an annual average yield of 400 TMC (2603 mm). Figure 43 shows weightages assigned as per runoff.

Runoff to Rainfall ratio across sub-catchments area depicted in Figure 44, indicating that the Ghats with good forest cover has lower runoff capabilities i.e., high retention capacities, compared to the coastal and plain lands. Figure 45 depicts weightages assigned as per runoff-rainfall ratio. Hydrological status, i.e., ratio of Supply to Demand indicates that the water available in the catchment after meeting biotic requirements. Total Water demand was quantified as a function of Agriculture Demand, Domestic and Livestock water demands. Total water demand other than Terrestrial Environmental demand (Evapotranspiration from the forest) and Aquatic Environmental Demand (Streamflow maintenance), is about 124 TMC.and with the addition of Evaporation of about 98 TMC, total water demand would

increase to 222 TMC, considering Environmental flow of 30% Mean Annual Runoff, about 128 TMC, Total water Demand would increase to 350 TMC. The basin depicts Supply to existing Annual demand ratio of 1.1 (Figure 46). The higher weights were assigned to the grids with greater ratio , which indicates of surplus water conditions (Figure 47).

Social Aspects: The forest-dwelling communities of the region are considered as one of the key variables for grids prioritization. These people are directly and indirectly being contingent on forest resources. The forest-dwelling communities are *Malekudiya, Marathi Naiks Gowdlu.* Jenukuruba Kadukuruba *and* Yeravas (Lalitha, 2015). They are socially and politically backward and most of them depend on casual labor, trading forest products for their livelihood. *Malekudiyas* speak Tulu language are employed as agricultural laborers on bigger farms and also gain income from the forest produces. The *Marathi Naiks, Gowdlu* speak Kannada language and distributed well and gain income from Non-timber forest produce (NTFPs) that they collect and also as daily labor. The cattle population in the villages is creating a greater problem in KNP and affecting regeneration. The department was taken restorative activities to move 5,000 families (20,000 people, 90 percent of them were tribal people) from KNP area. The presence of tribes considered as higher weightages (Figure 48, 49). Population density is considered as another proxy of ESR mapping. The population density of each grid is analyzed (Figure 50) based on census data of 2011. It is noticed of higher resource extractions with the population (Figure 51). The grids with higher population densities were assigned lower weightages (1) and lower density regions were assigned higher conservation weightages (10).

Estuarine diversity. Estuarine ecosystems are a tiny ribbon of land, but the emissions from their destruction are nearly one-fifth of those attributed to deforestation worldwide (Pendleton et al., 2012). The major mangrove species present are *Acanthus ilicifolius, Acrostichum aureum, Aegiceras corniculatum, Avicennia alba, Avicennia officinalis, Bruguiera gymnorrhiza, Excoecaria agallocha, Kandelia candel, Rhizophora mucronata, Sonneratia alba* and *Sonneratia caseolaris* (Suma, 2013; Reddy et al., 2015). The farmers also plant rows of mangrove trees just outside these bunds to fortify them from collapse (Figure 52). This traditional system of estuarine cultivation with mangrove planting was a sustainable system. Netravathi estuary is one of the highly productive estuarine system in west coast supporting numerous life forms. The higher weightages are assigned emphasizing productivity to protect in future from further disturbances (Figure 53).

Theme wise spatial layers with prioritized grids were overlaid, which aided in delineating ecologically sensitive regions (ESR). The grid wise weights were aggregated to compute final composite weights and grouped into four categories. Figure 54 shows 28 grids represent ESR 1, 12 grids represent ESR 2, 14 grids represent ESR 3 and the rest 20 grids represent ESR 4. The 38% of the area of grids represents ESR 1, 16% of the area shows ESR 2, 19 % of the area shows ESR 3 and only 27 % area covers ESR 4. Figure 54 depicts village level ecological sensitiveness and Table 3 provides the details of the villages in the respective ESRs spread across five districts. ESR 1 represents zone of highest conservation, no further degradation allowed. ESR 1 can be treated as a highly sensitive region and more conservation is to be imposed by regulatory authorities as well as VFCs (Village forest committees). ESR 2 represents a zone of higher conservation and forms a transition for highest conservation and moderate conservation regions. ESR 3 represents moderate conservation region and only regulated development is allowed in these areas. ESR 4 represents least diversity areas and the developments are allowed as per the requirement by strict vigilance from regulatory authorities. It is recommended that these regions are also has a lot of scope for further enrichment of environment by stakeholders and forest department intervention. In ESR 2 & ESR 3 further developments are allowed only after critical review of regulatory and extensive consultations with stakeholders. Small-scale tourism may be encouraged adopting benefit sharing with local communities such as homestay, spice farms, eco-friendly boating etc. The uncontrolled development should be discouraged in and around of pristine lakes, primeval forest patches, perennial water bodies. The site-specific (clustered base) sustainable developments can be taken up at each panchayat, which has least impact on the ecosystem.

Figure 55 shows ecologically significant areas such as Gundya, Pushpagiri WLS, Kudremukh NP, Yettinaholé regions. These areas are majorly covered in ESR-1 & 2 which signifies the necessity of protection from further degradations. The village wise ESR delineation has shown in Figure 56 and Annexure D provides taluk wise categorized ESR villages under each district. The village wise ESR analysis shows Netravathi river basin covers total 433 villages of across five districts (Table A). The ESR-1 shows 111 villages, ESR-2 shows 69 villages, ESR-3, 4 shows 119 and 134 villages respectively. The Dakshina Kannada district has 307 villages out of which 62 villages depict ESR-1. Forests of these villages need to be protected on priority. The controlled and regulated activities in each ESR region are listed in Table 4. The Annexure E and Figure I, II shows ecologically sensitive areas as per earlier literatures (Gadgil committee report and Kasturirangan committee reports).

Table 2: ESR Villages under various districts of Kali river basin.

SNO	DISTRICT NAME	ESR-1	ESR-2	ESR-3	ESR-4	TOTAL
1	Dakshina Kannada	**62**	31	95	119	307
2	Udupi	**1**	6	0	15	22
3	Chikmagaluru	**9**	7	0	0	16
4	Hassan	**33**	21	24	0	78
5	Kodagu	**6**	4	0	0	10
NETRAVATHI RIVER BASIN		**111**	69	119	134	**433**

Table 3: Activities that can be allowed in ESR -1, 2 3 & 4.

SNO	ACTIVITIES	ECOLOGICALLY SENSITIVE REGIONS			
		ESR-1	ESR-2	ESR-3	ESR-4
1	**ENERGY** (A) Solar (Rooftop)	✓	✓	✓	✓
	(B) Wind power	✗	✓	✓	✓
	(C) Bio energy	✗	✓	✓	✓
	(D) Coal based (Thermal power)	✗	✗	✗	✗
	(E) Gas or liquid fuel based	✗	✗	✗	✓
	(F) Hydro power (Major)	✗	✗	✗	✗
	(G) Hydro power (Micro)	✗	✗	✗	✓
	(H) Nuclear power	✗	✗	✗	✗
2	**FORESTS** (A) Land use change (Forest to non-forest usages)	✗	✗	✗	✗
	(B) Monoculture plantations	✗	✗	✗	✗
	(C) Extraction of medicinal plants (with strict regulations)	✗	✗	✓	✓
	(D) Forest improvement through VFCs	✓	✓	✓	✓
	(E) NTFP collection	✓ (Strict regulation by department)	✓	✓	✓
3	**AGRICULTURE** (A) Agroforestry	✓	✓	✓	✓
	(B) Organic farming	✓	✓	✓	✓
	(C) Land use change / Encroachments	✗	✗	✗	✗
	(D) Genetically modified crops	✗	✗	✗	✗
	(E) Animal Husbandry	✓	✓	✓	✓

4	**HORTICULTURE** (A) Organic farming	✓	✓	✓	✓
	(B) Nitrogen and Phosphorus (N&P) fertilizers	×	×	×	✓ Dosage as prescribed by Agriculture department
	(C) Endosulfan	×	×	×	×
	(D) Pesticide	×	×	×	✓
	(E) Watermelon & Muskmelon farming	×	✓	✓	✓
5	**INDUSTRIES (Larger scale)** (A) Agro-processing industries	✓	✓	✓	✓
	(B) Information Technology industries (IT)	×	×	✓	✓
	(C) Red category (Polluting) industries	×	×	×	×
	(D) Garment industries	×	×	✓	✓
	(E) New establishment of Industries	×	×	×	✓ (Allowed only after critical review by local stake holders and experts)
	(F) Nonpolluting (Green) Industries	×	×	✓	✓
6	**INDUSTRIES (Small scale)** (A) Garment industries	×	✓	✓	✓
	(B) <u>Domestic (Home based) industries</u> a. Papad	✓	✓	✓	✓
	b. Mango processing	✓	✓	✓	✓
	c. Areca nut processing & Coir industries	×	✓	✓	✓
	d. Milk products and processing	✓	✓	✓	✓
	e. Dry fruits & Spices	✓	✓	✓	✓
	f. Fruit processing (Ex: Kokum Juice *(Garcinia indica)*)	✓	✓	✓	✓
	g. Fish products processing	✓	✓	✓	✓
	h. Bee keeping and bee nurseries	✓	✓	✓	✓
	i. Pongamia plantations for biofuel (in private lands)	×	✓	✓	✓
	j. Bio pesticides manufacturing	×	✓	✓	✓

	k. Poultry farms and powdered eggs	✗	✓	✓	✓
	l. Vegetable dyes; fruits and vegetables preservation	✓	✓	✓	✓
	m. Medicinal plants cultivation and processing	✓	✓	✓	✓
	n. Aromatic plants and essential oil distillation; orchids and cut flowers harvesting industries	✗	✓	✓	✓
7	**TOURISM INDUSTRY**	✗	✓	✓	✓
	(A) Ecotourism				
	(B) Organic village and homestay	✓	✓	✓	✓
	(C) VFC managed tourism	✓	✓	✓	✓
	(D) VFC managed homestay tourism in higher forest cover regions and protected areas	✗	✓	✓	✓
	(E) Arts and handicrafts museum and trade center	✓	✓	✓	✓
8	**MINING AND MINERAL EXTRACTION**	✗	✗	✗	✗
	(A) Iron ore				
	(B) Manganese	✗	✗	✗	✗
	(C) Bauxite	✗	✗	✗	✗
	(D) Limestone	✗	✗	✗	✓
	(E) Quartz	✗	✗	✗	✓
	(F) Sand extraction (on sustainable basis by Ban on exporting)	✗	✗	✓	✓
9	**WASTE DISPOSAL**	✗	✗	✗	✗
	(A) Hazardous waste processing units				
	(B) Solid waste disposal	✗	✗	✗	✓ (For composting and manure preparation)
	(C) Liquid waste discharge	✗	✗	✗	✓ (Treatment plants (STP) for processing)
	(D) Recycling and waste processing and units	✗	✗	✗	✓ (compliant with PCB)
10	**TRANSPORTATION**	✗	✗	✗	✓ (Allowed only after strict EIA)
	(A) Roads and expressways				
	(B) Rail and freight corridors	**Subject to EIA; Strict regulation and social audit**			

	(C) Up gradation of existing infrastructure	✗	✗	✓ (Subject to EIAs, strict regulation and social audit)	✓

Remarks

- The ESR_1 represents a zone of highest conservation, no further degradation allowed. ESR-2 has the potentiality to become as ESR-1 provided with strict regulations and improvement of forests and its environs by more protection. A small change in ESR-2 will have more adverse effects in ESR-1.
- Forest Rights Act to be implemented in its true spirit by reaching out to people.
- Monoculture plantations are not allowed, existing exotics should be replaced by planting endemic species.
- Promote decentralized electricity, use of renewable energy sources such as (solar, wind power).
- The local bio resource based industry should be promoted. All should be strictly regulated and be subject to social audit.
- Adapt development projects which will have a least environmental impact by involving local community members in decision making and environmental monitoring.
- No new major roads, railway lines are allowed, except when highly essential and subject to EIA, by imposing strict regulation and social audit.
- Tourism Master Plan should be based on MoEFCC regulations (after taking into account social and environmental costs).
- Controlled activities are permitted based on socio-economic importance and activities such as depriving wetlands, natural forests, the introduction of alien invasive species are not permitted.

LAND

Figure 14: Forest cover of Netravathi river basin

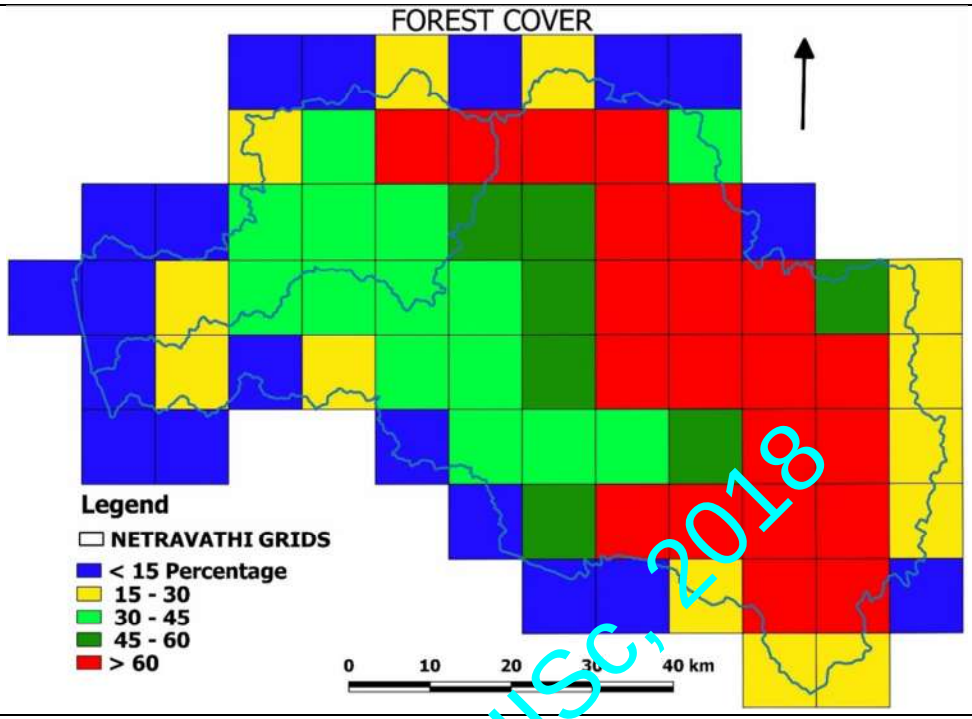
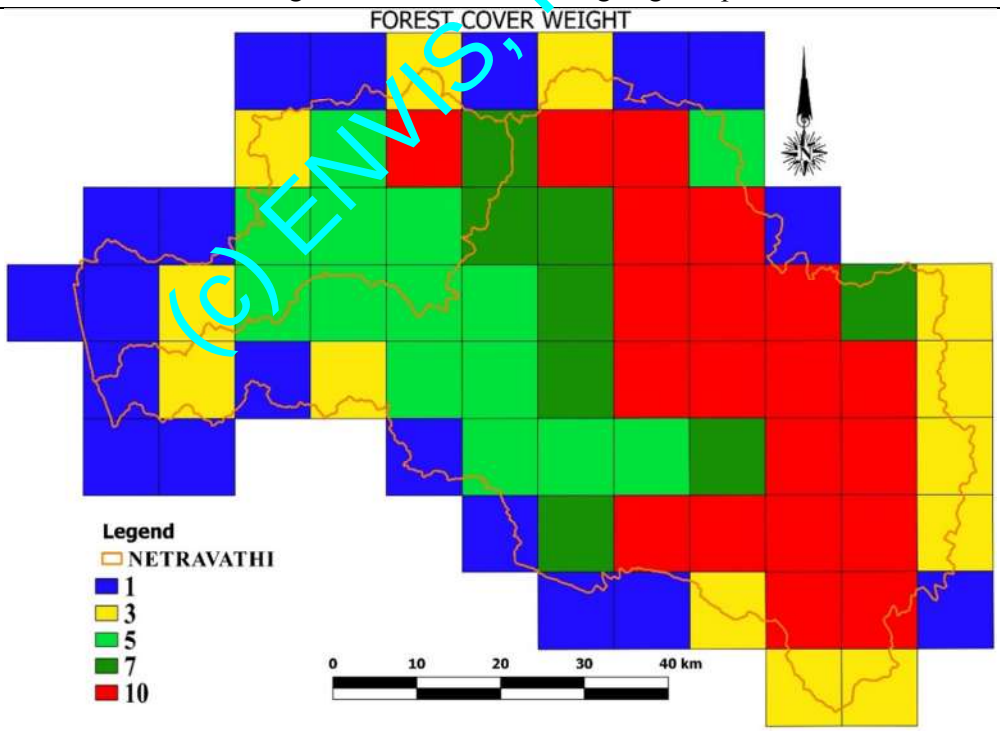


Figure 15: Forest cover weightage map



ECOLOGY

Figure 16: Flora and Fauna distribution in Netravathi

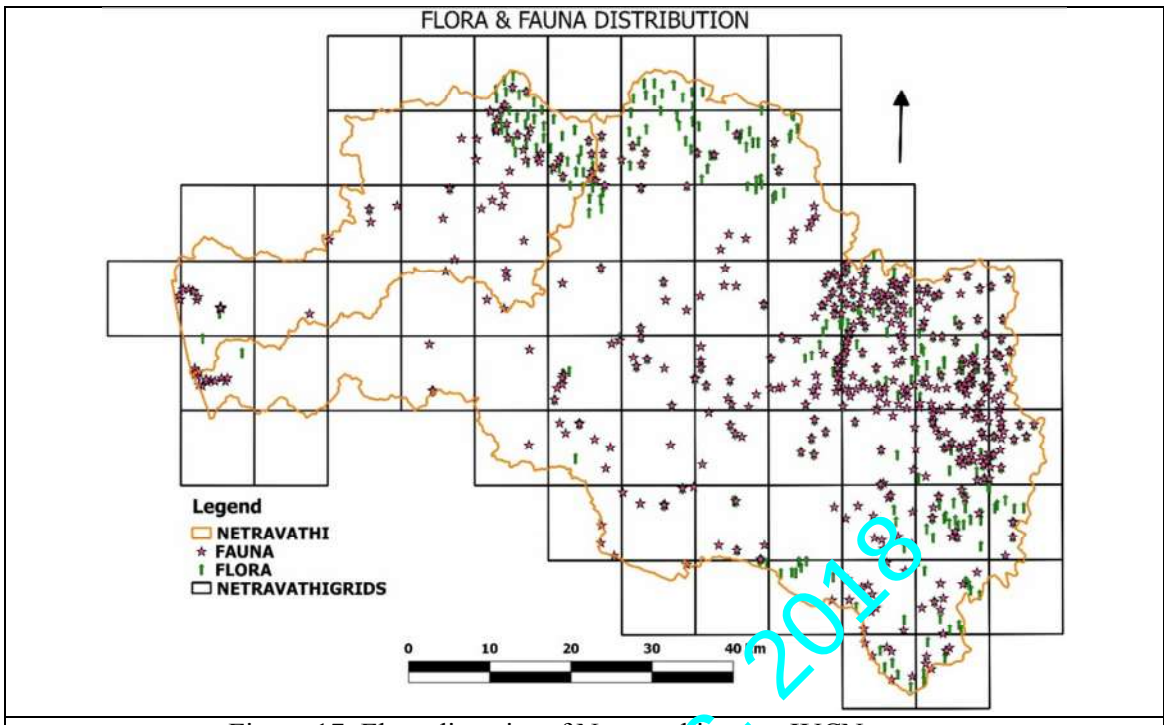


Figure 17: Flora diversity of Netravathi as per IUCN status

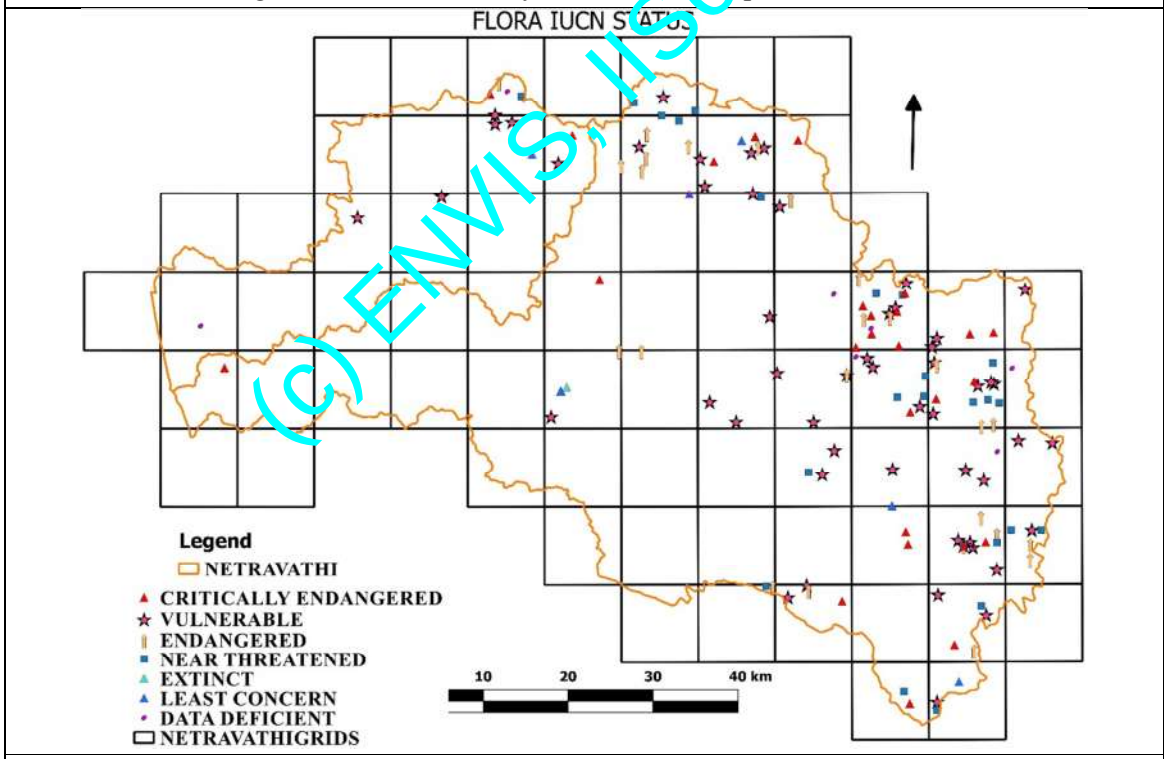


Figure 18: Weightages of flora

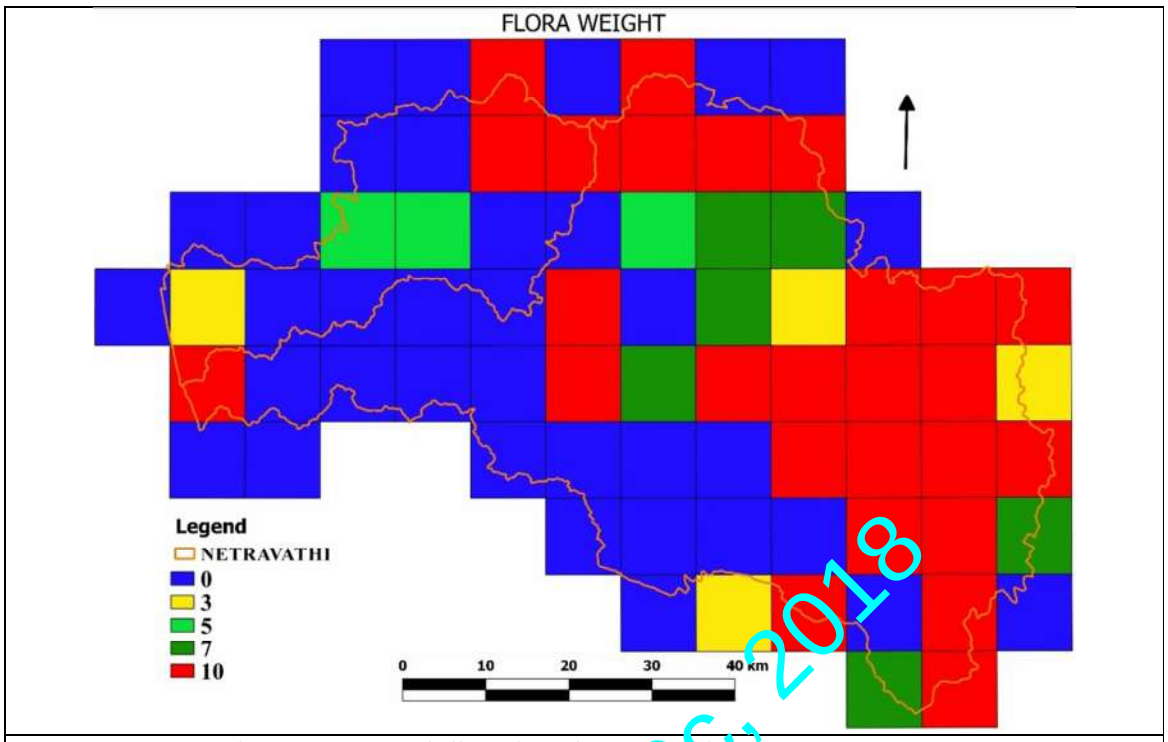


Figure 19: Faunal diversity of Netravathi as per IUCN status

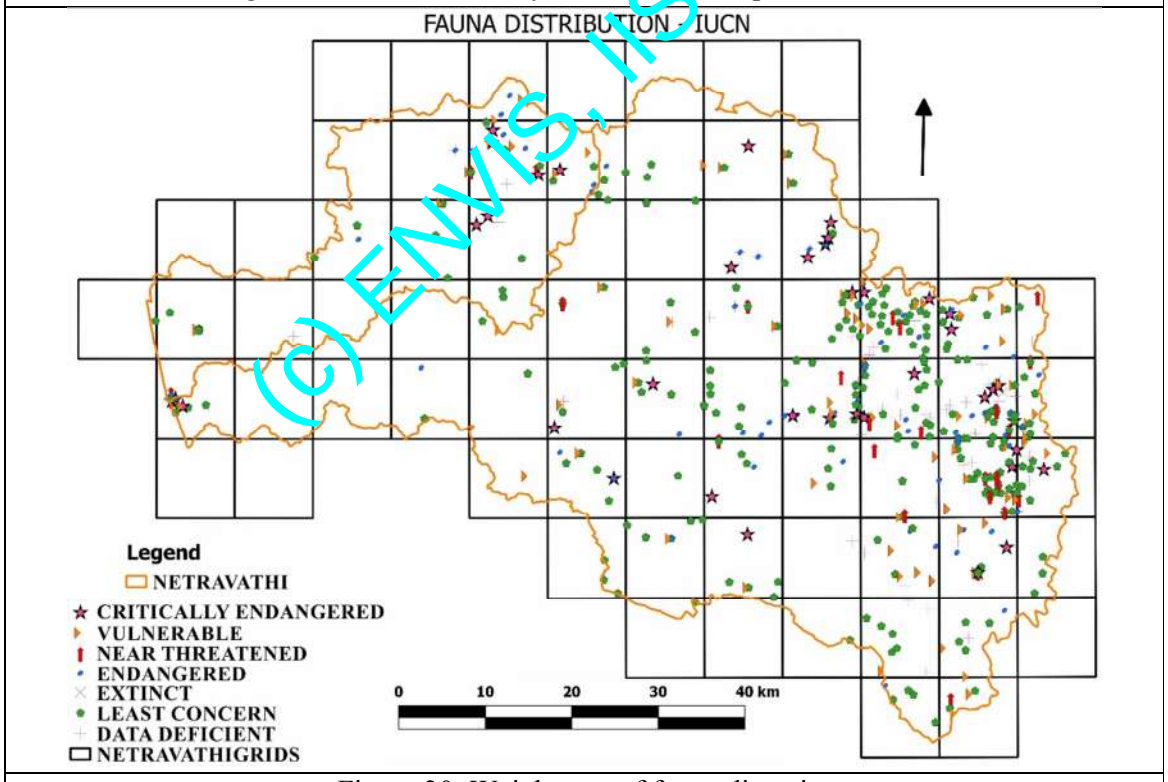


Figure 20: Weightages of fauna diversity

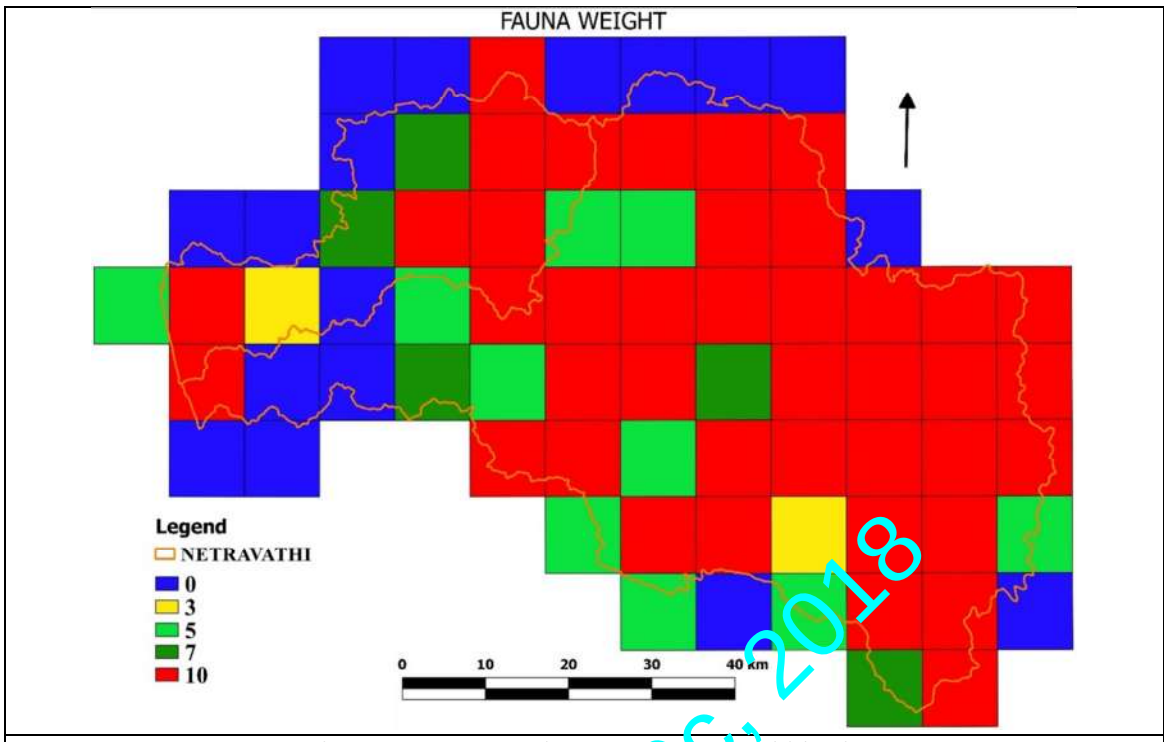


Figure 21: Protected Areas of Netravathi basin

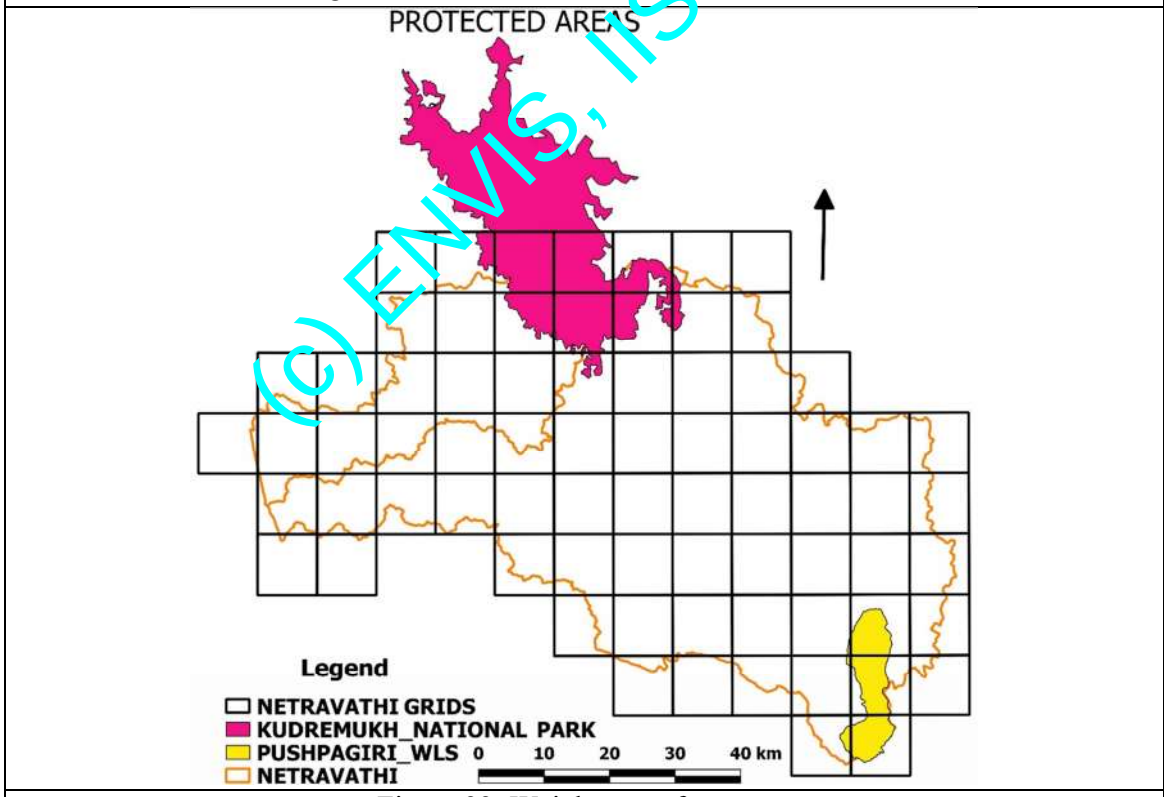


Figure 22: Weightages of reserves

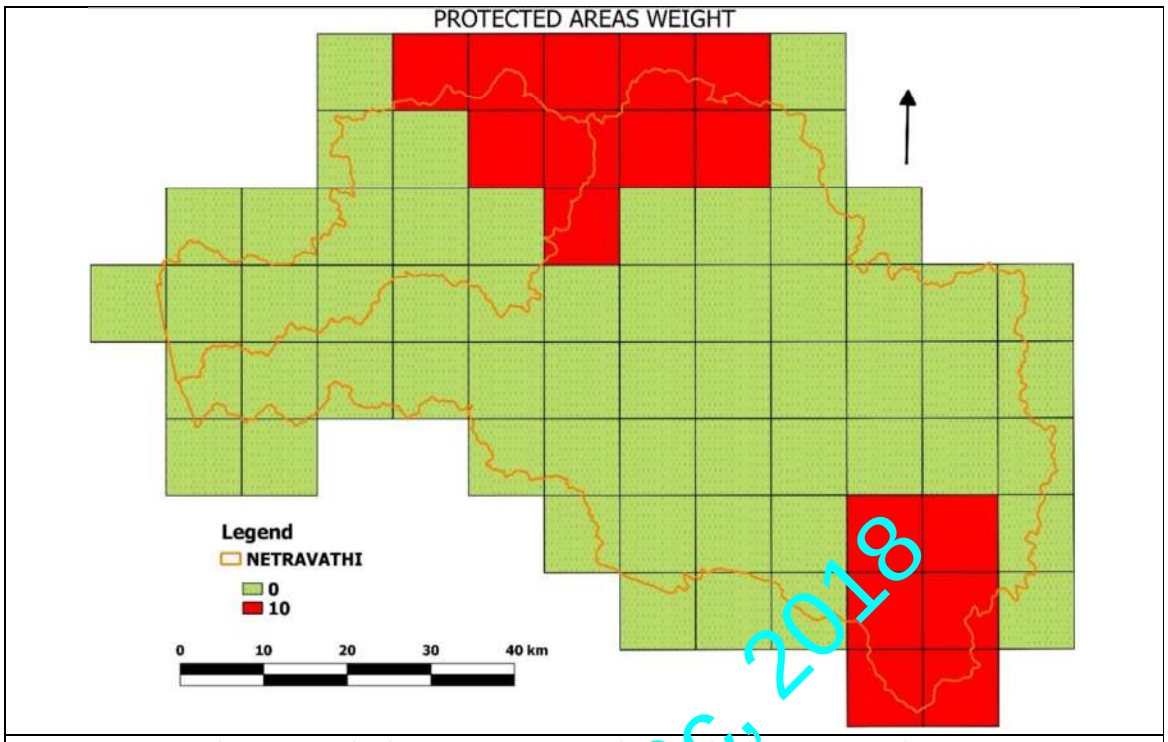


Figure 23: Elephant movement path (Muttodi to Bannerghatta)

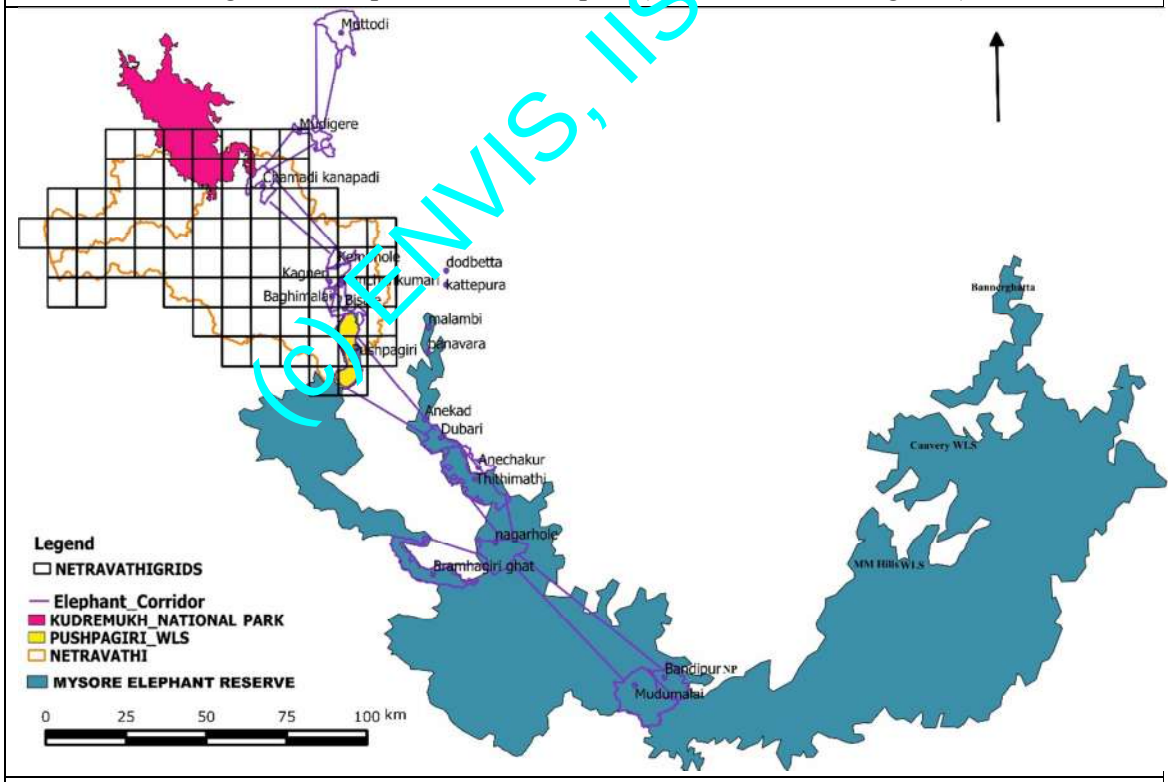


Figure 24: Prime elephant movement path in Netravathi basin

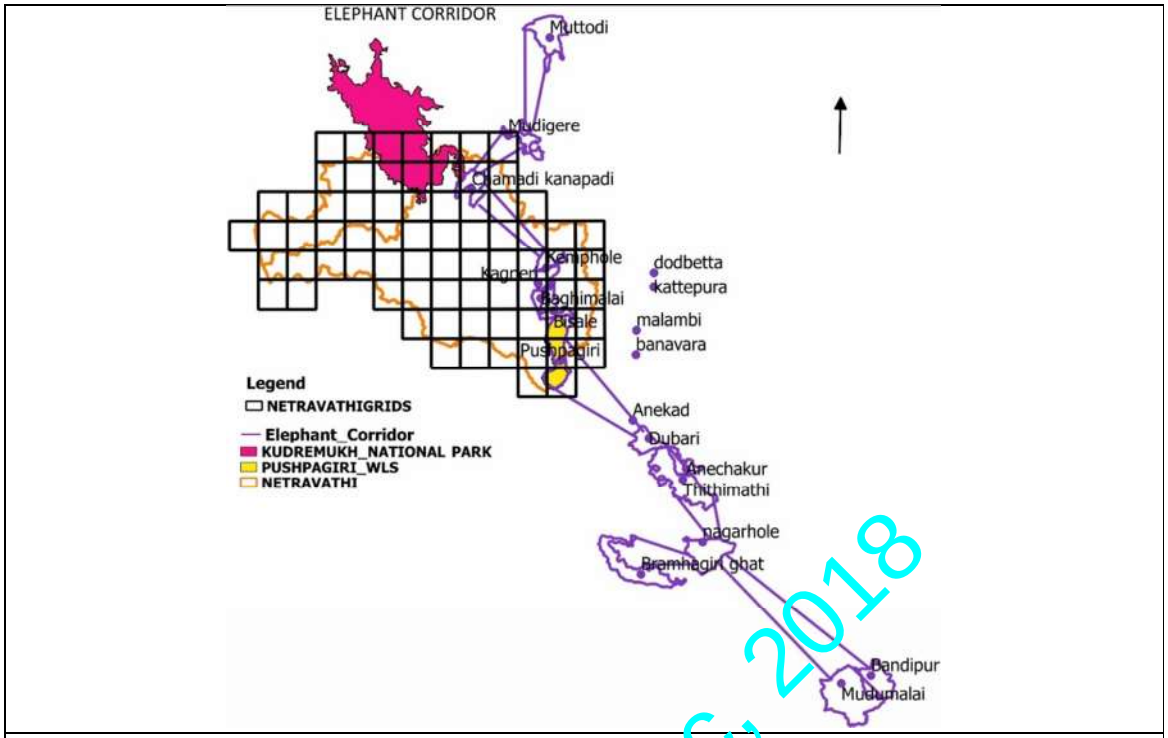
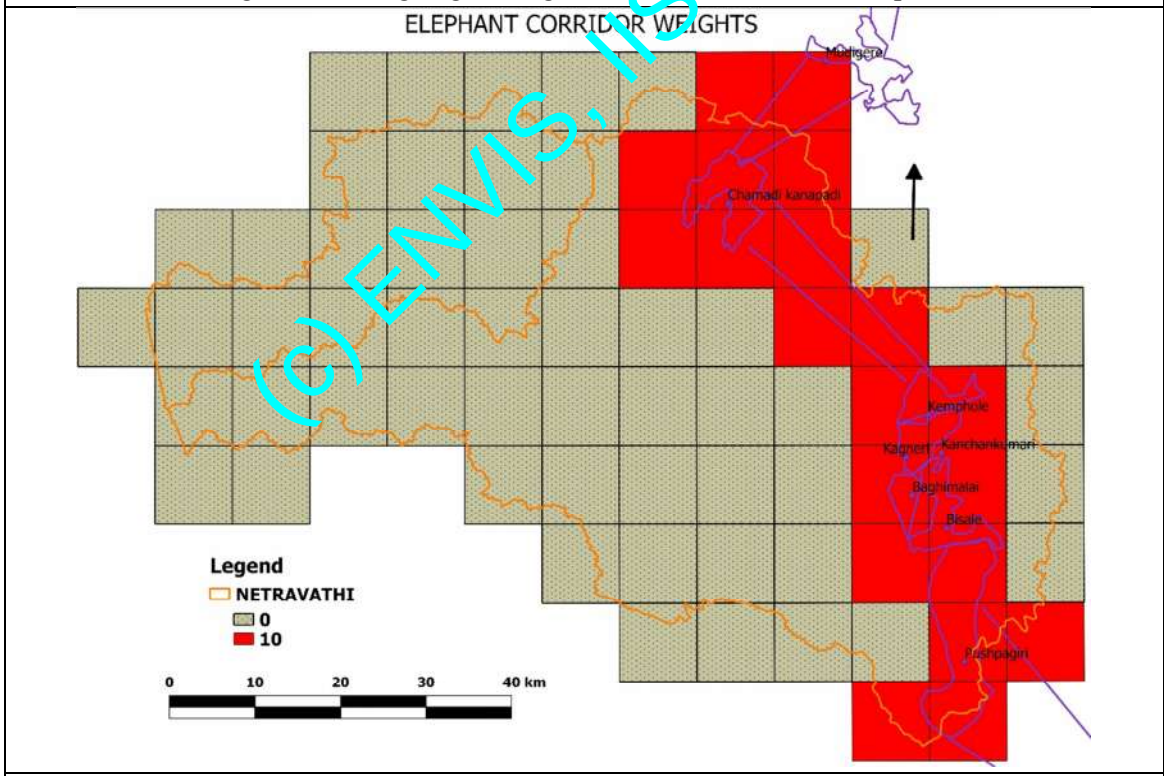


Figure 25: Weightages assigned for elephant movement path.



GEO-CLIMATIC

Figure 26: Altitude (m) of Netravathi

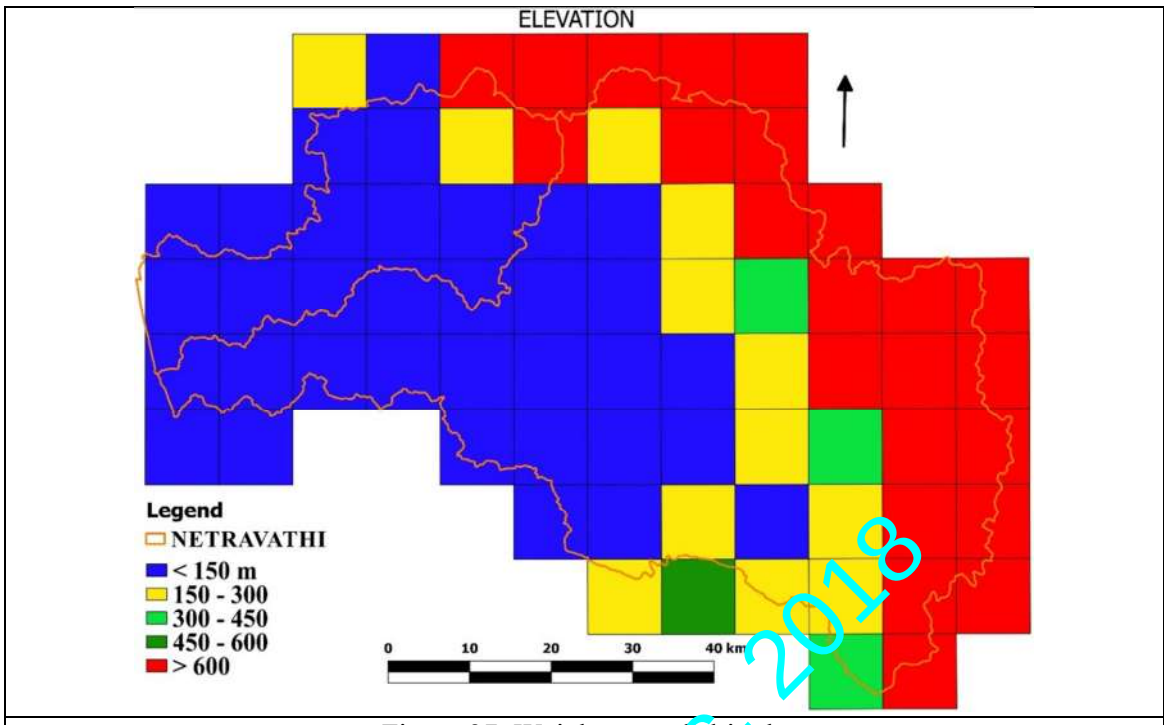


Figure 27: Weightages of altitude

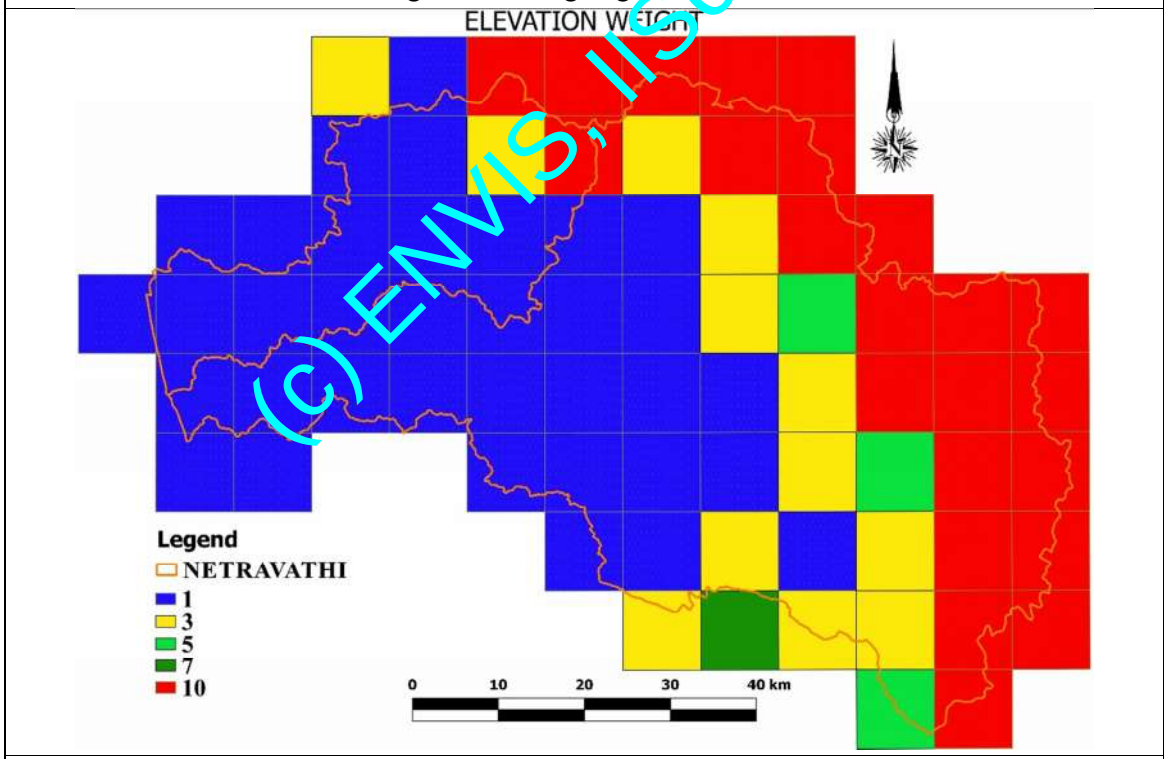


Figure 28: Slope (%) map of Netravathi

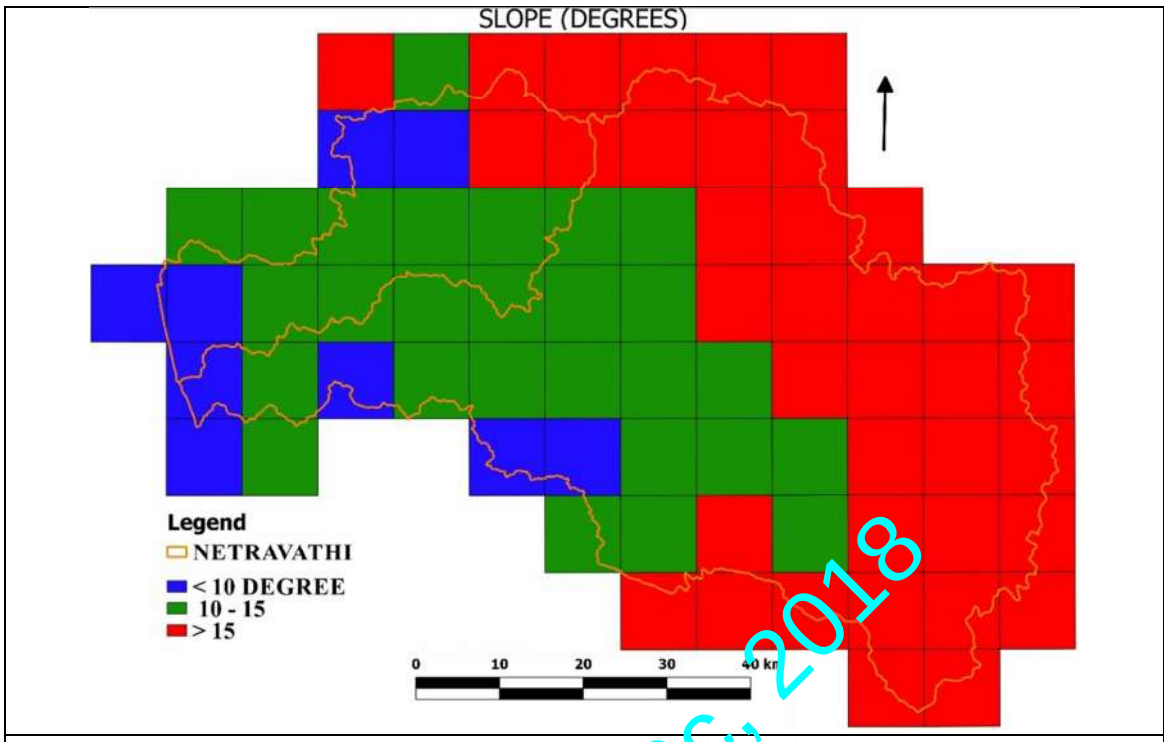


Figure 29: Weightage map of slope values

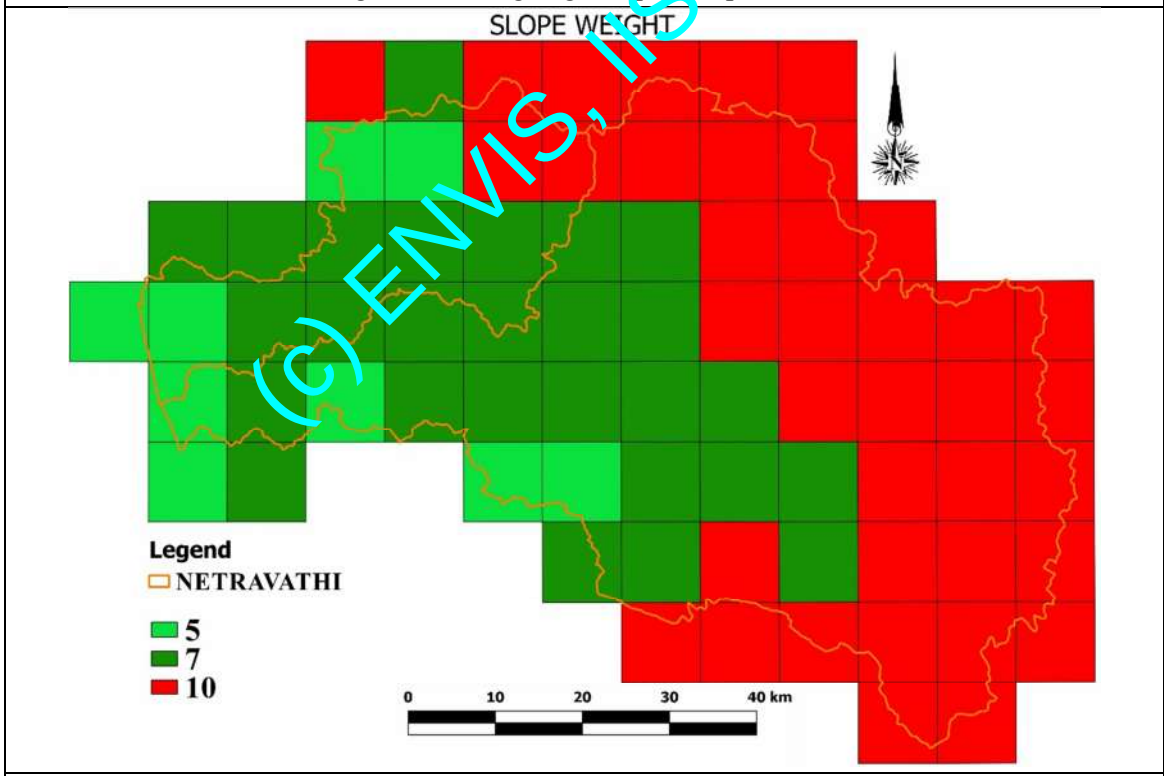


Figure 30: Lithology of Netravathi basin

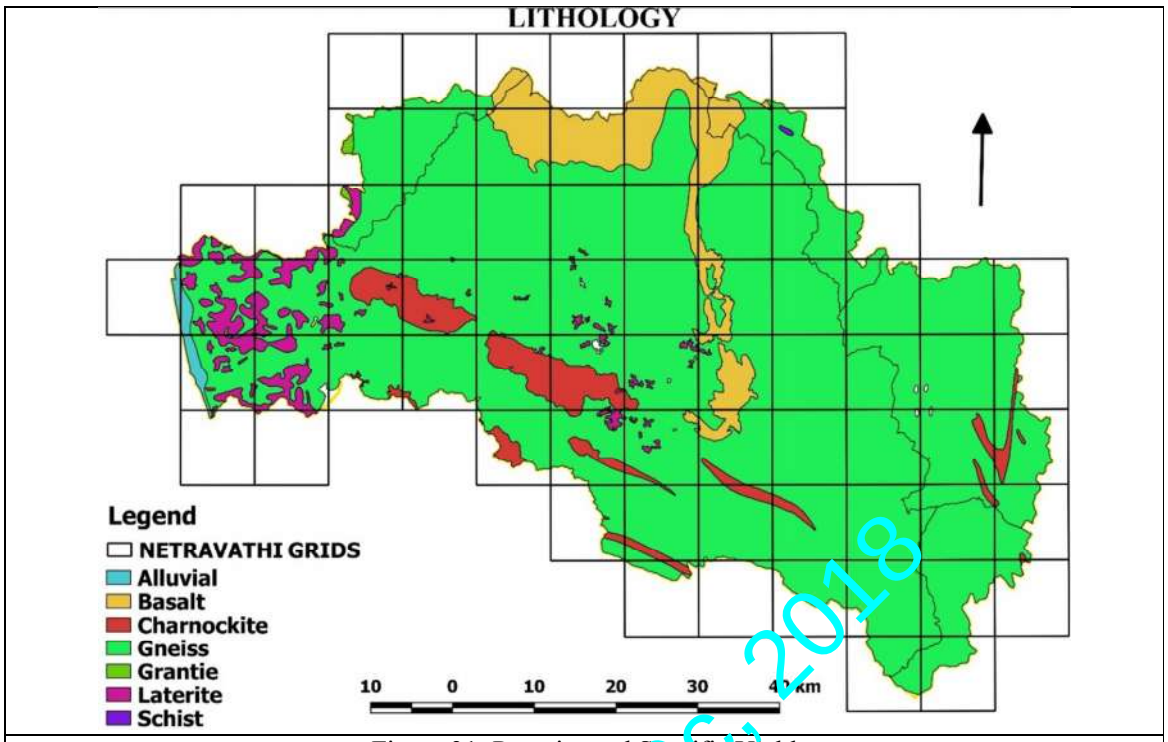


Figure 31: Porosity and Specific Yield

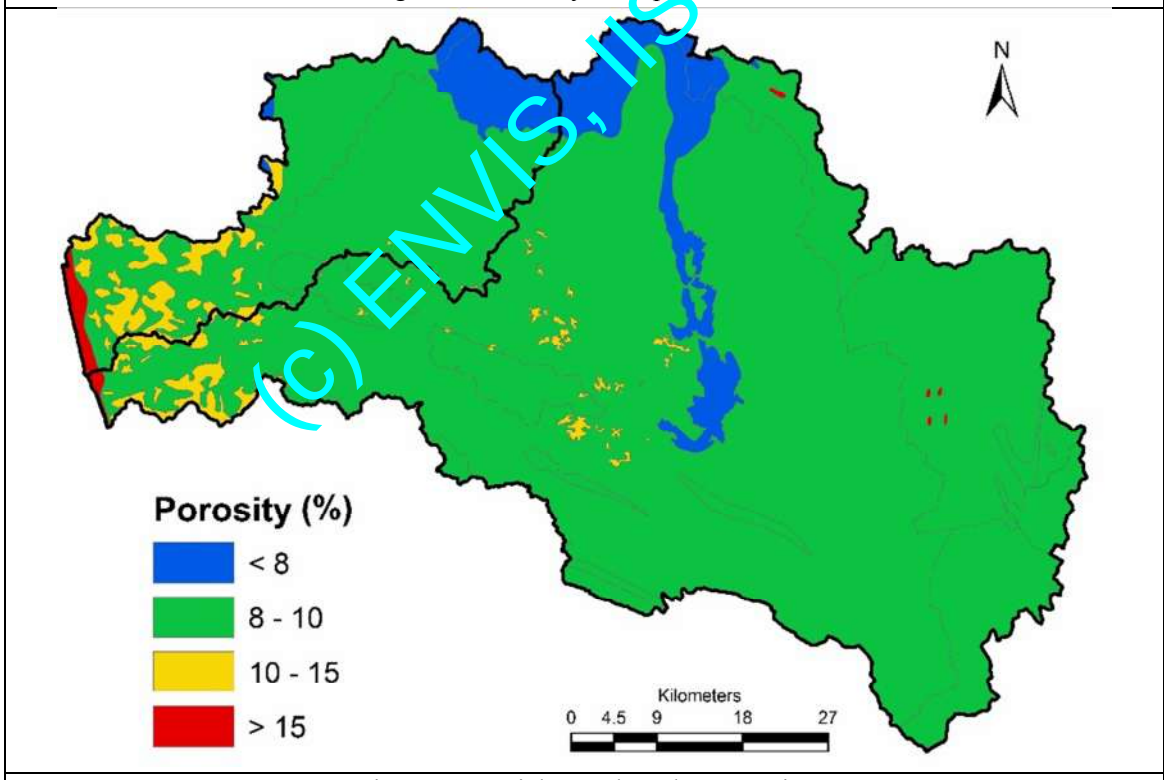


Figure 32: Weightages based on porosity

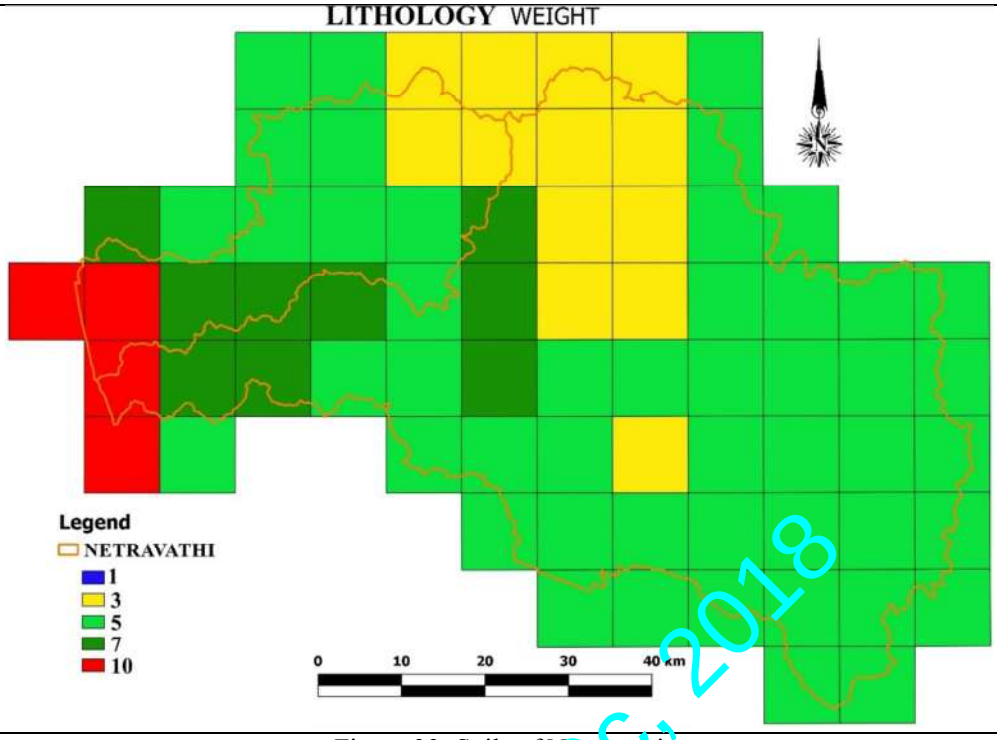


Figure 33: Soils of Netravathi

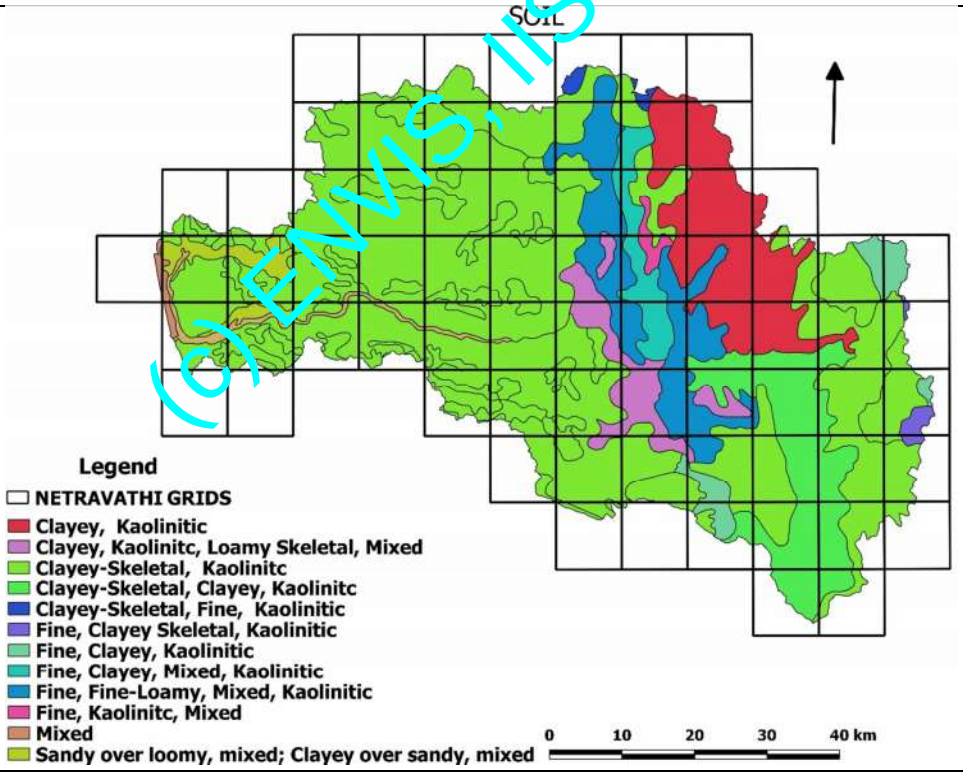


Figure 34: Soil depth across the basin

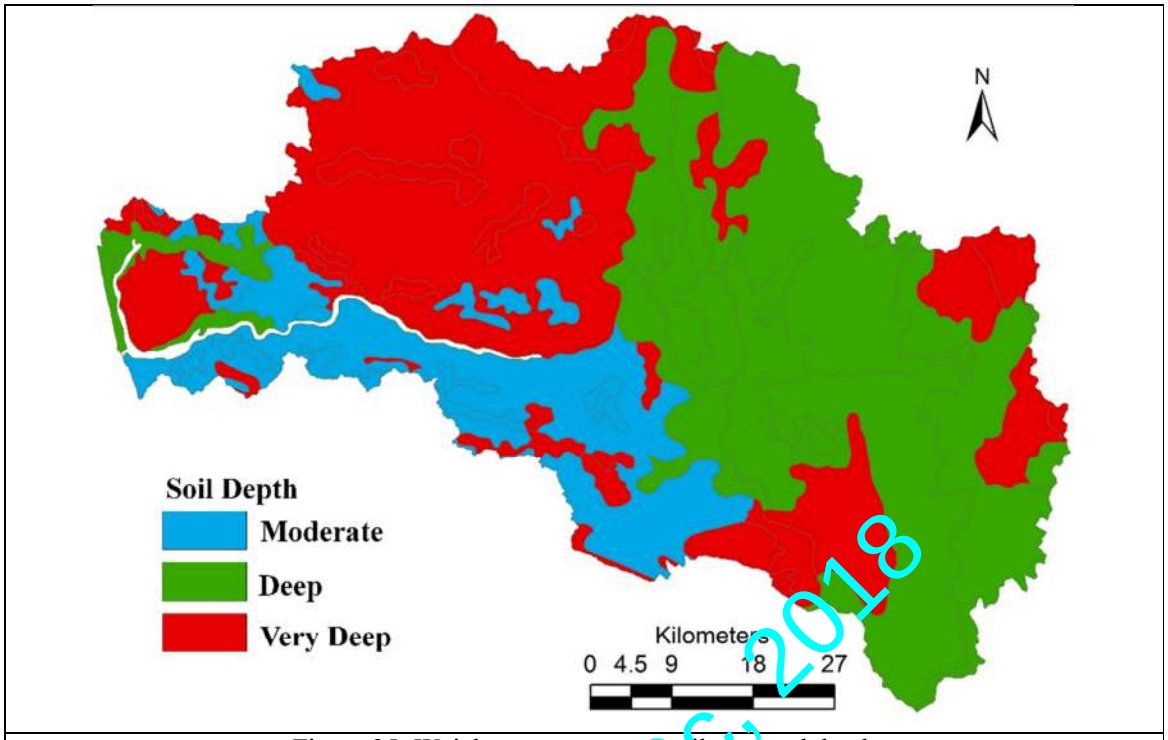


Figure 35: Weightage map as per soil type and depth

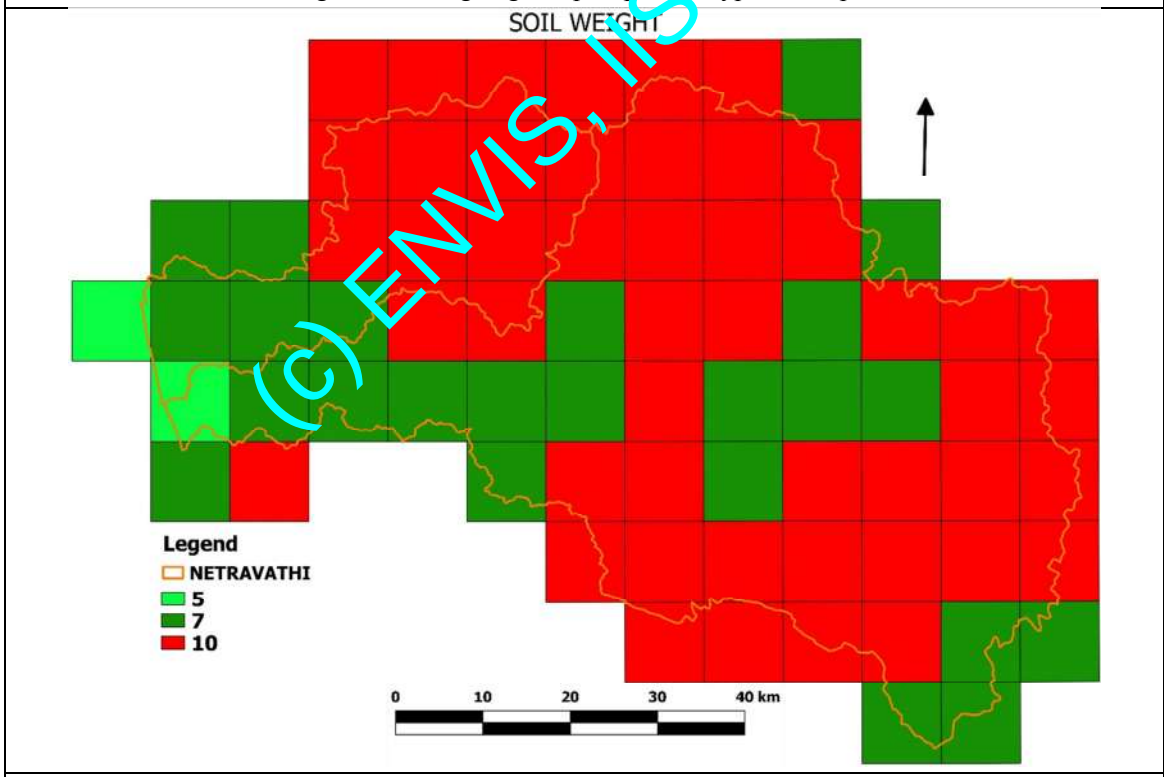


Figure 36: Agro climatic zones of Netravathi basin.

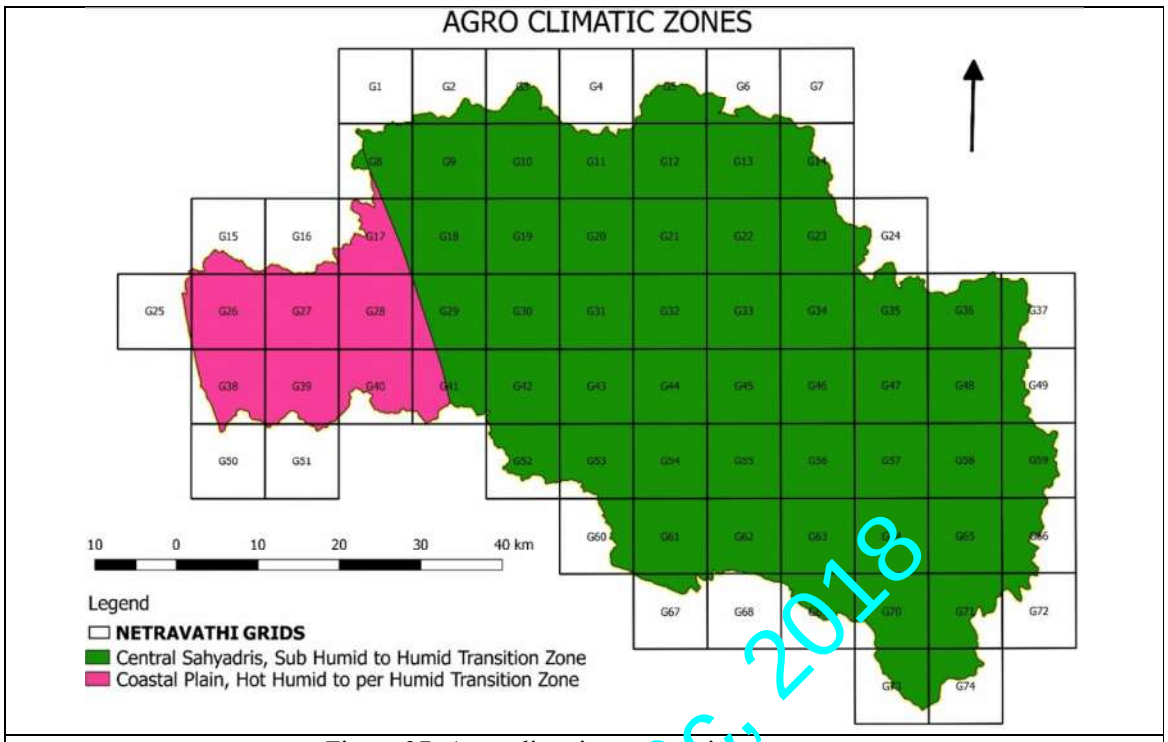


Figure 37: Agro climatic zones weightage map

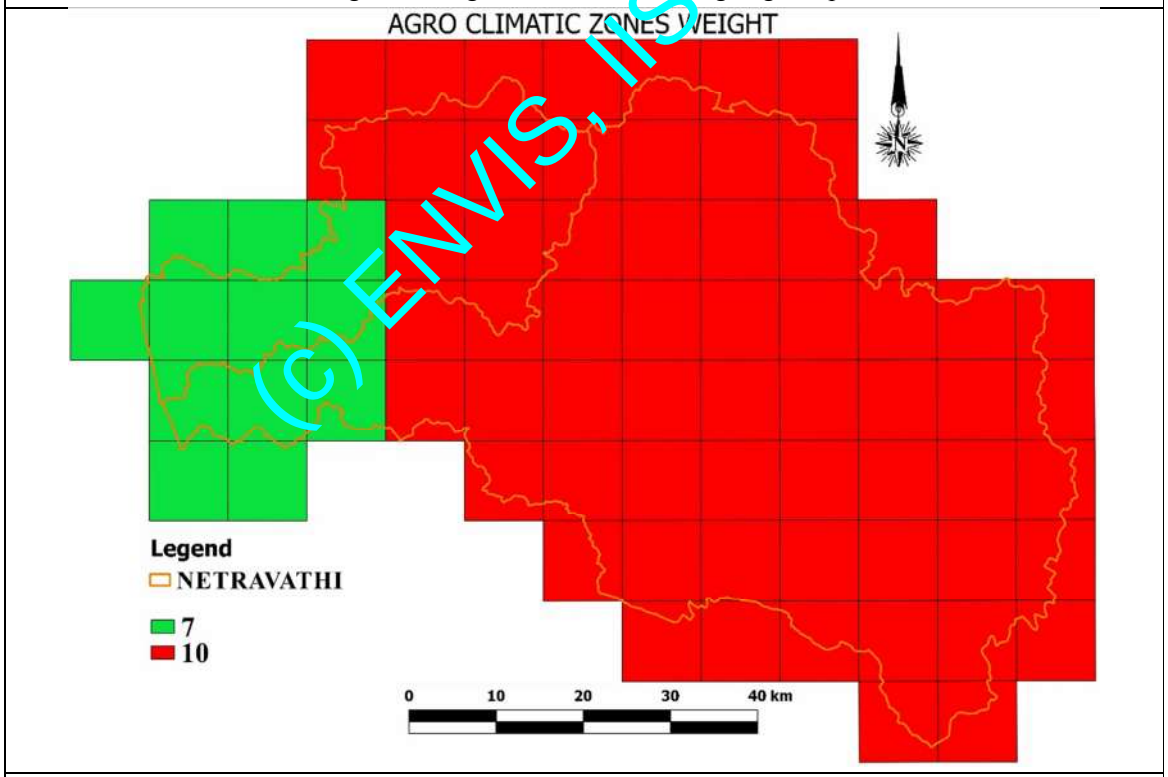


Figure 38 (a): Method adopted for analyzing and rain gauge stations spatial distribution

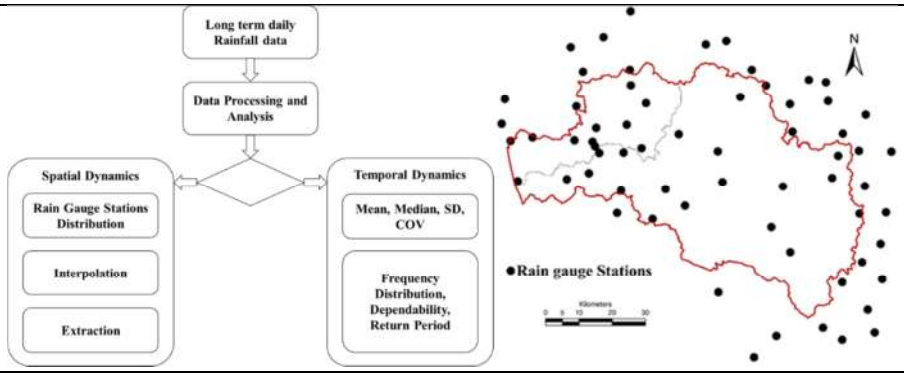


Figure 39: Rainfall map of Netravathi basin

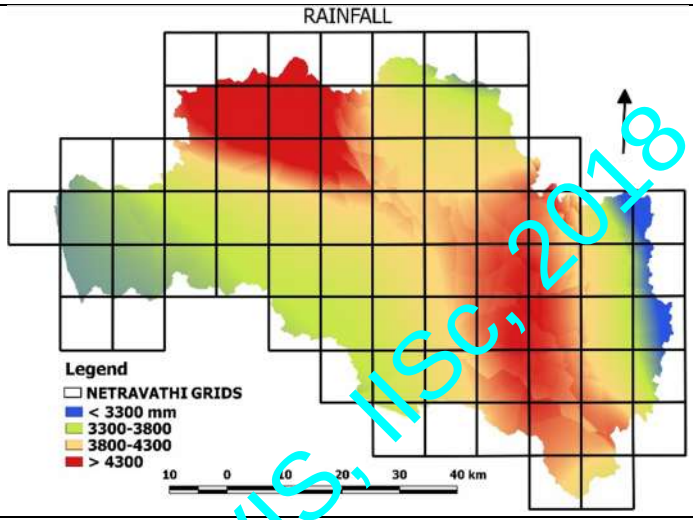
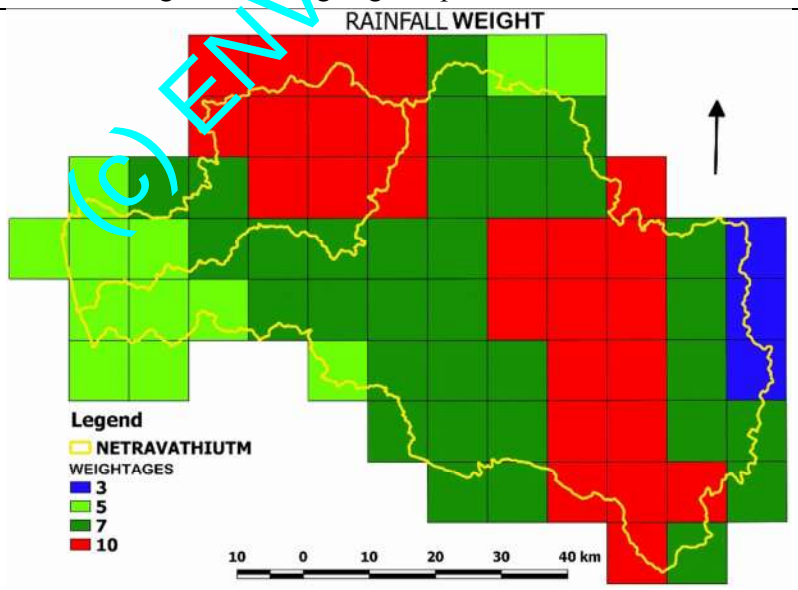


Figure 40: Weightage map based on rainfall



HYDROLOGY

Figure 41: Stream density of Netravathi

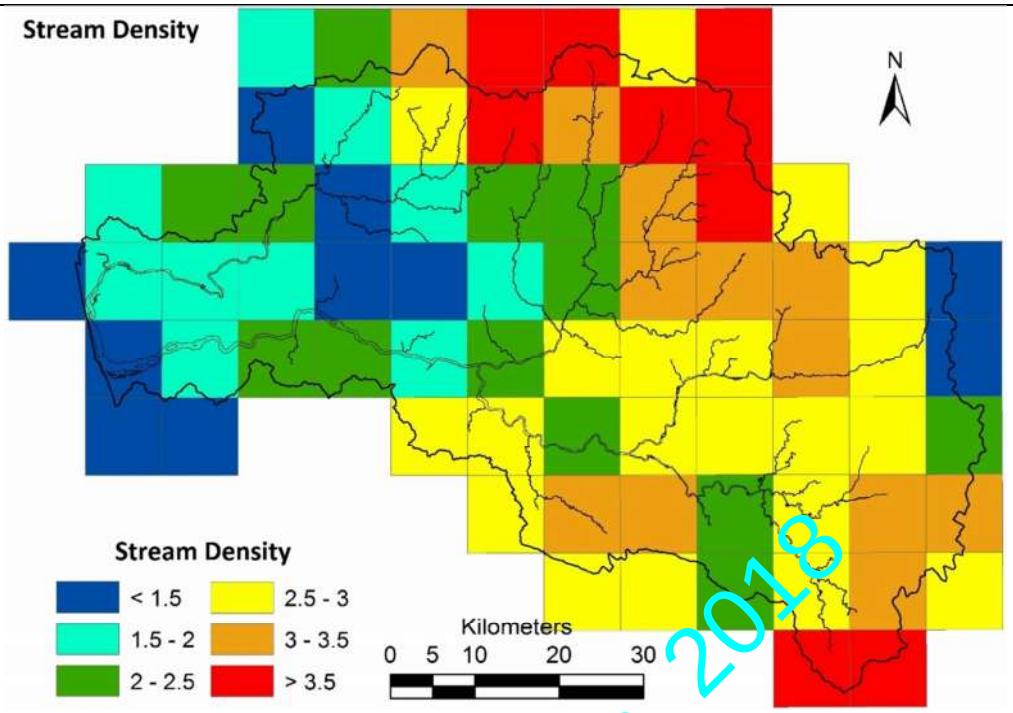


Figure 42: Weightage map based on stream density

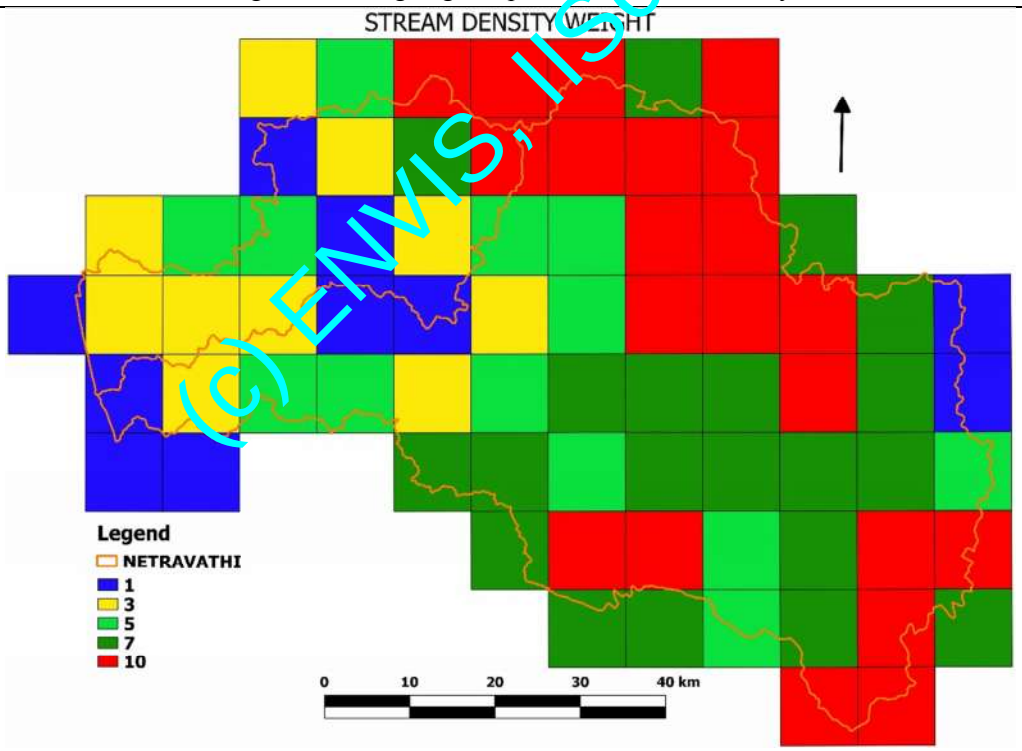


Figure 43: Annual Runoff of entire basin

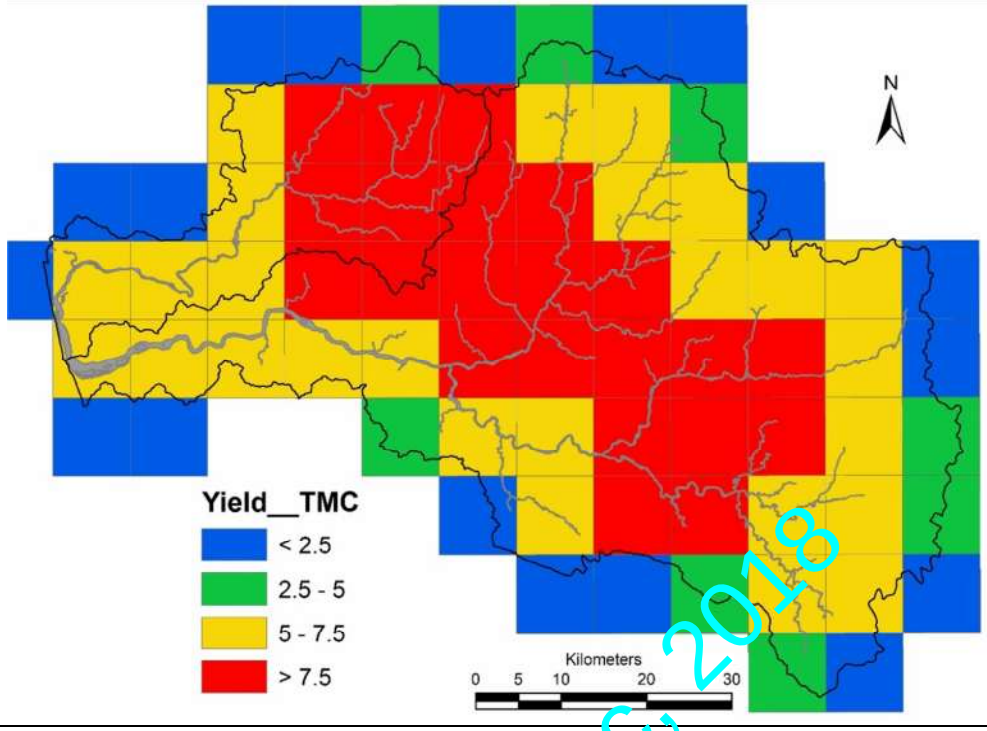


Figure 43: Annual yield weight

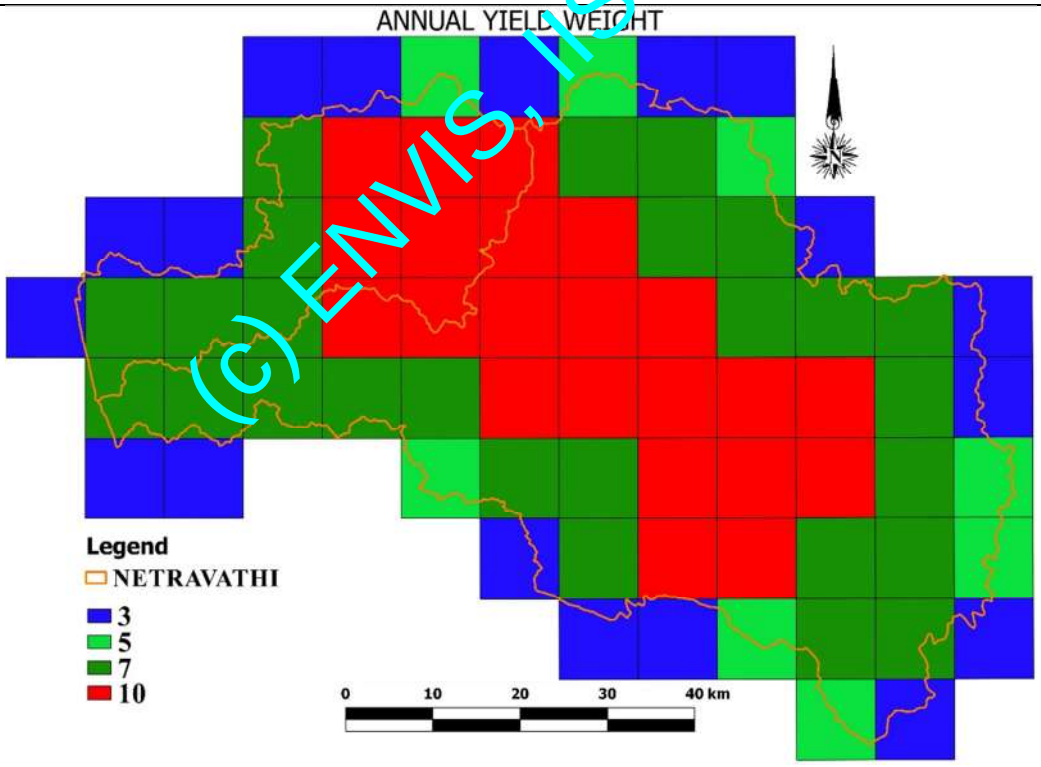


Figure 44: Runoff and Rainfall raio

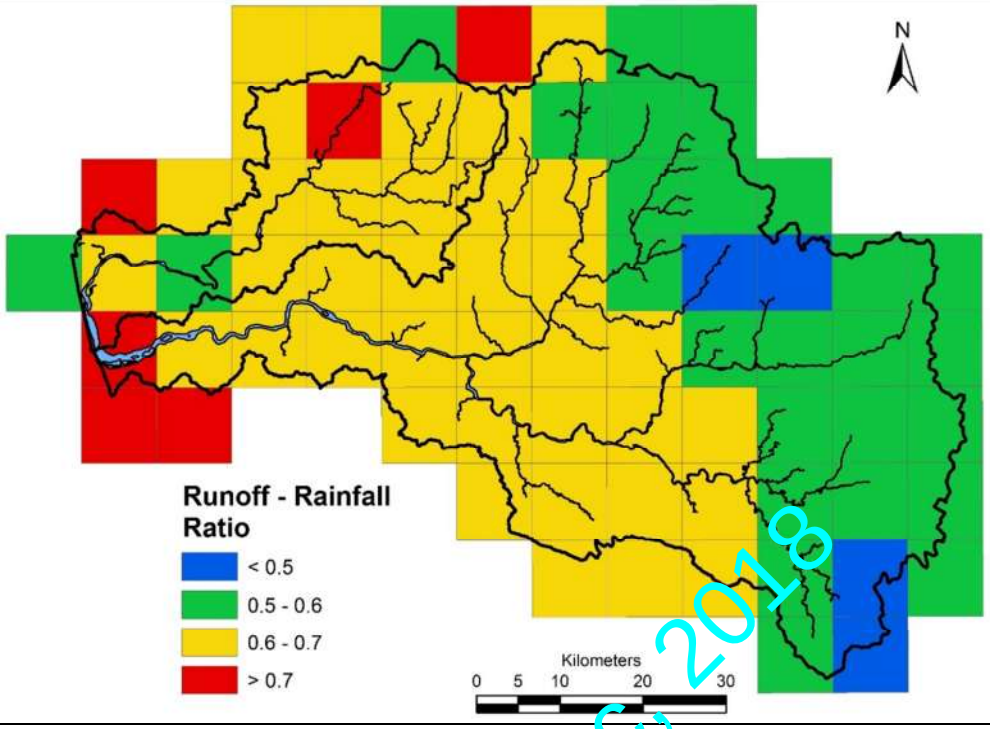


Figure 45: Weightages based on ratio of runoff and rainfall

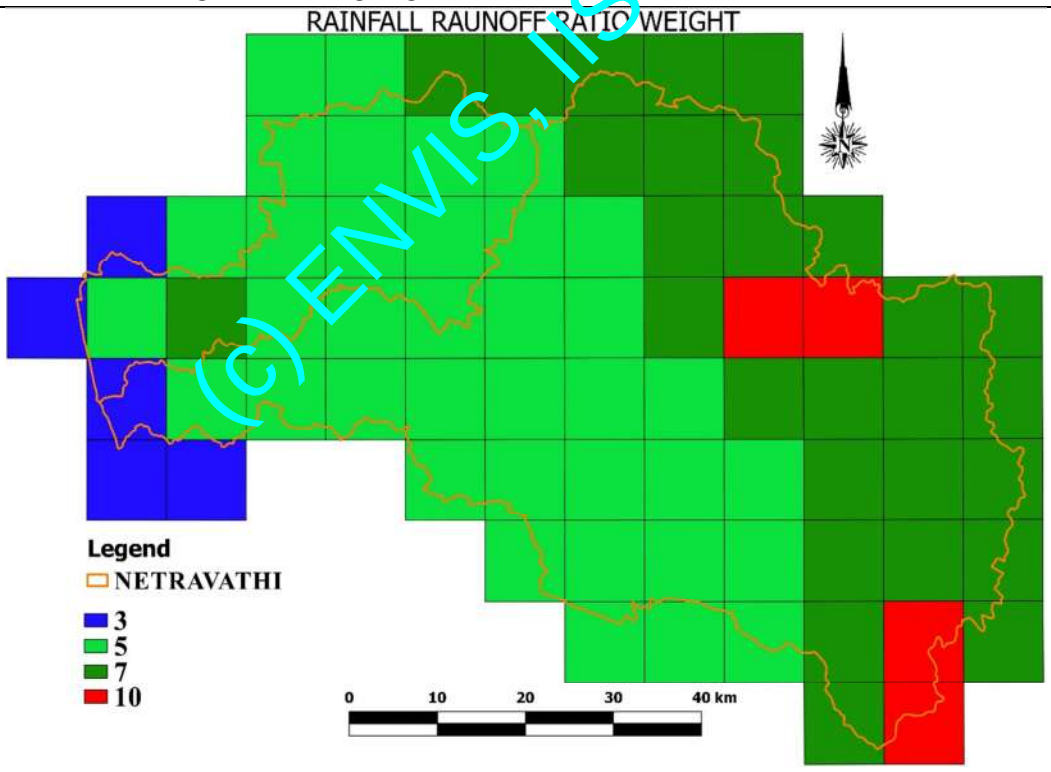


Figure 46: Supply to demand ratio of water in Netravathi.

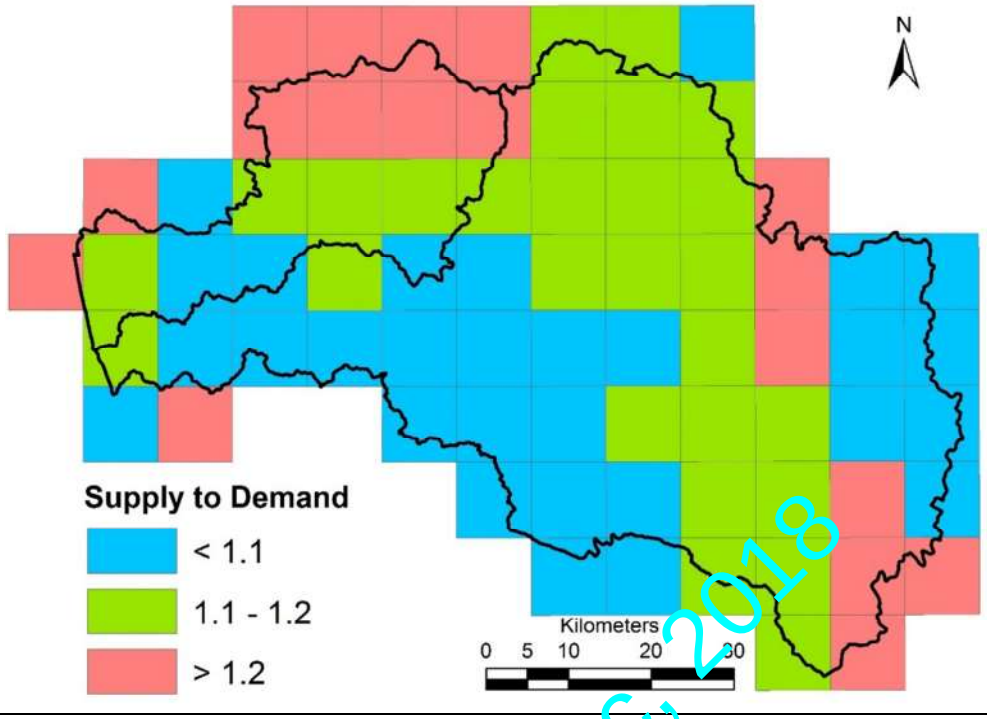
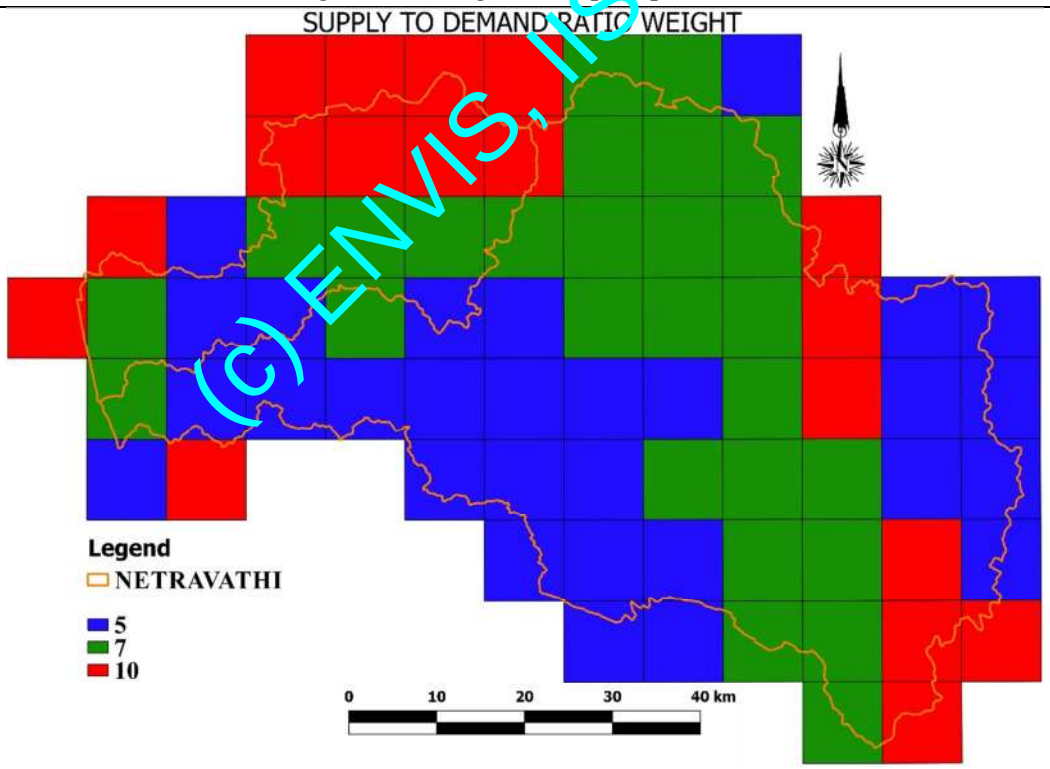


Figure 47: Weightate maps as per ratio.



SOCIAL ASPECTS

Figure 48: Forest dwelling communities distribution in Netravathi river basin

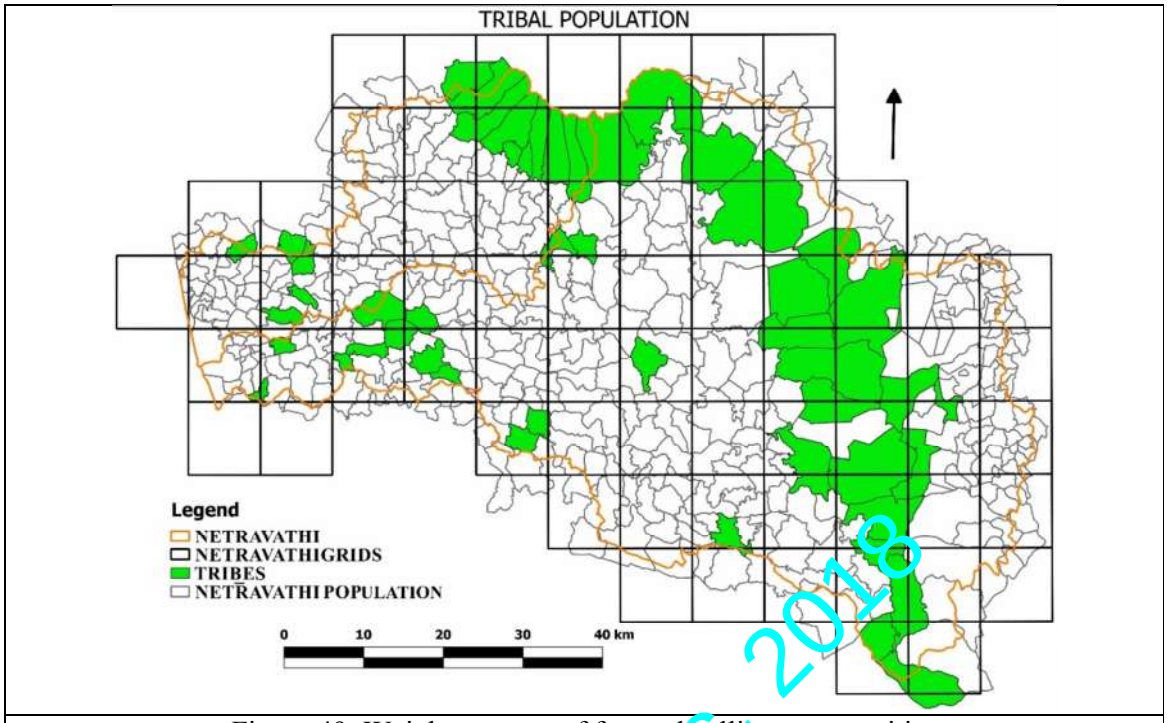


Figure 49: Weightage map of forest dwelling communities

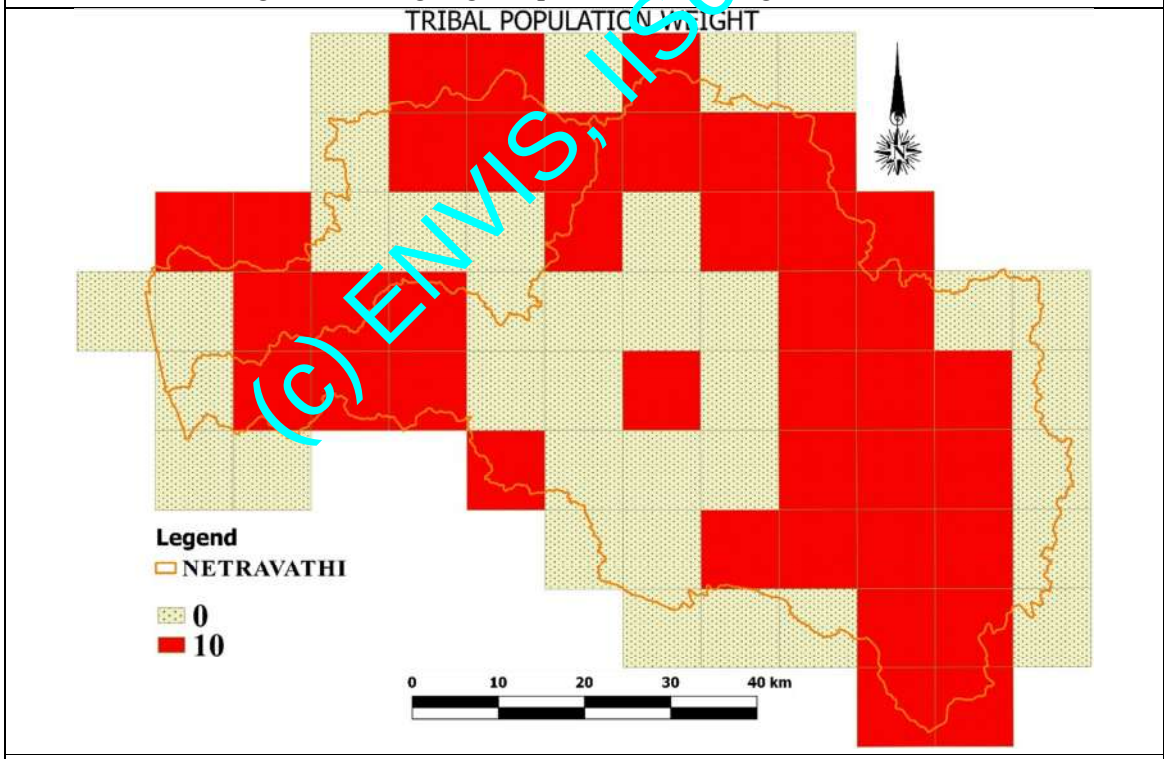


Figure 50: Population density map

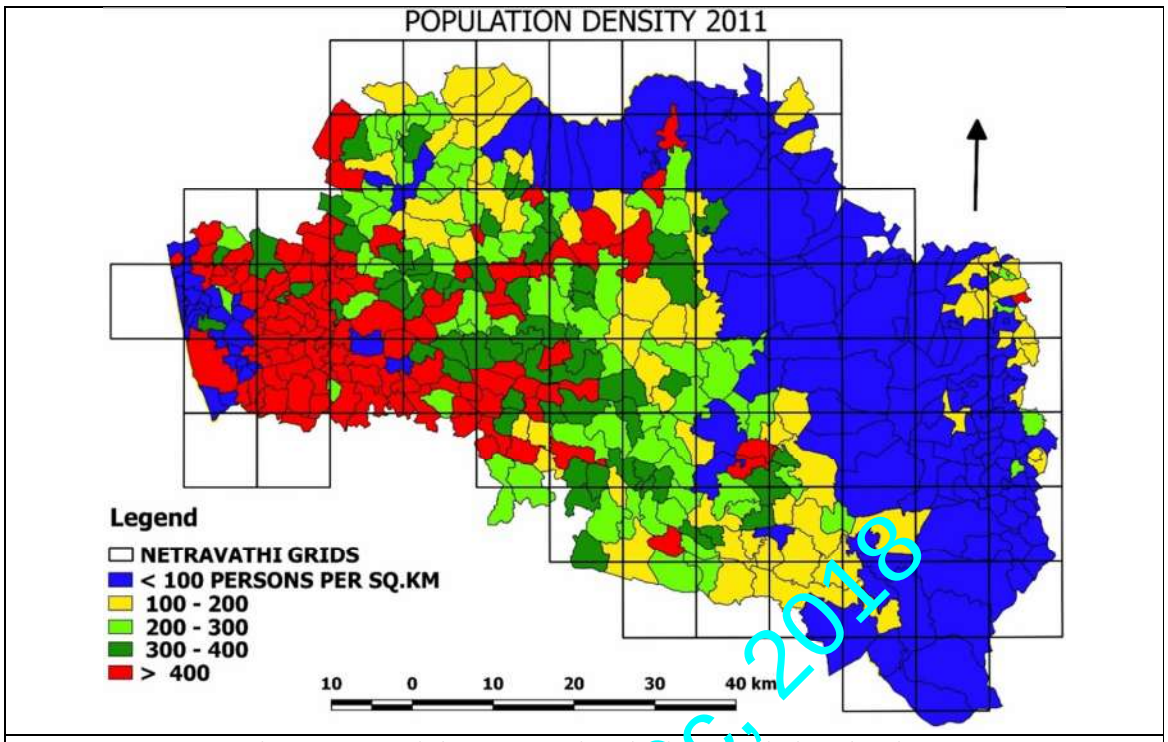
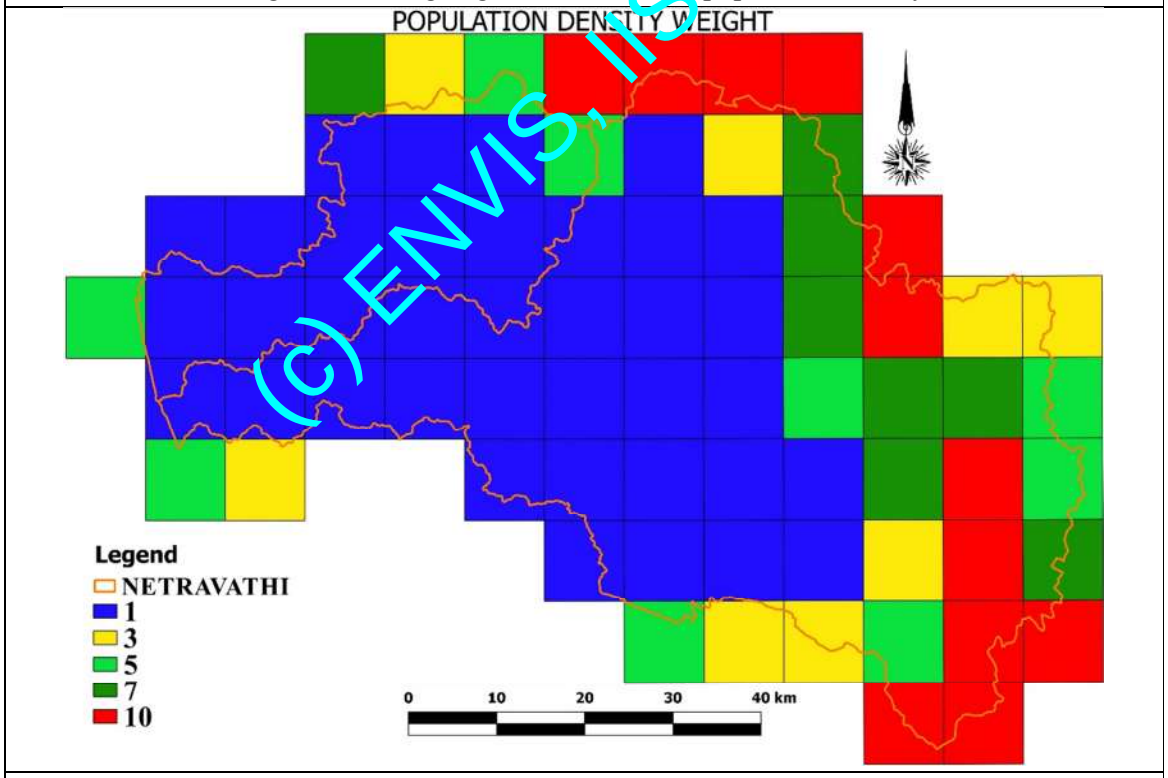


Figure 51: Weightage associated with population density



ESTUARINE DIVERSITY

Figure 52: Estuaries of Netravathi

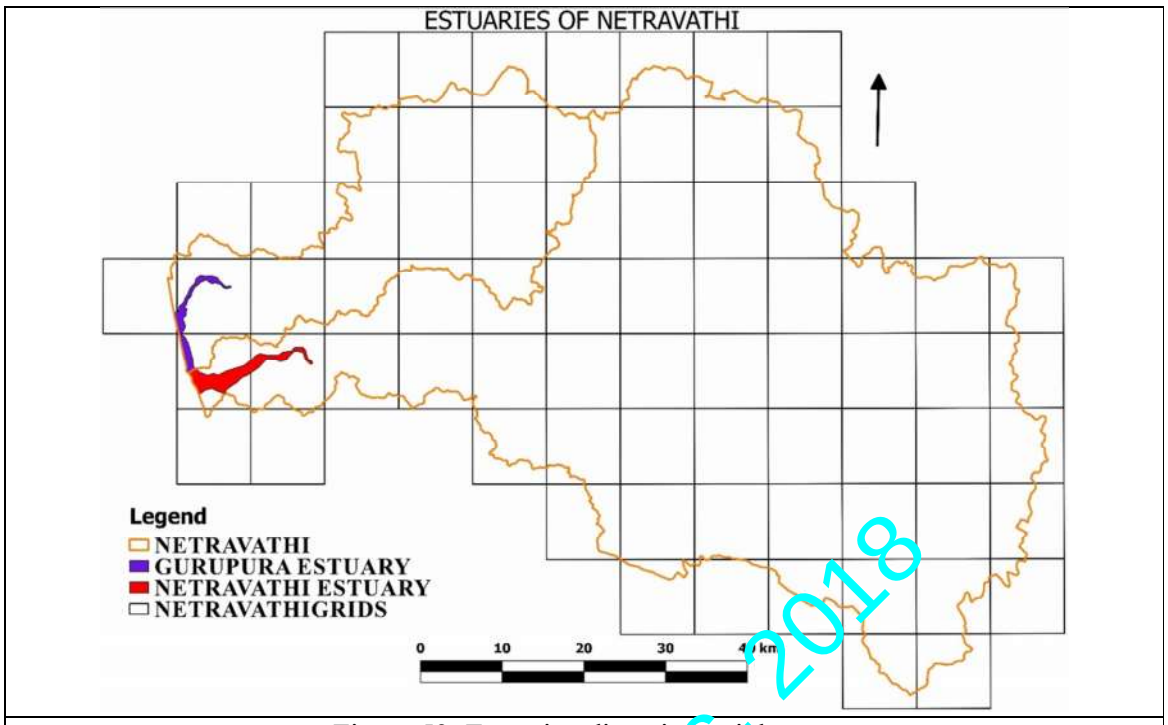


Figure 53: Estuarine diversity weightages

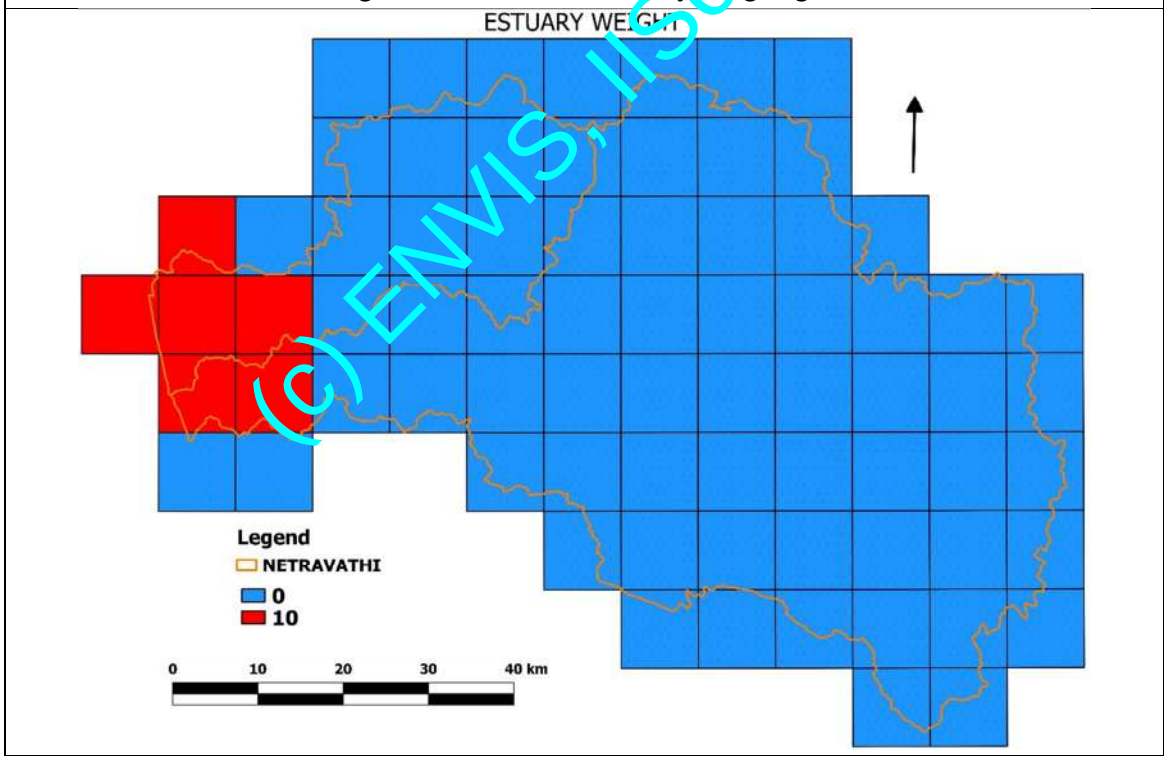


Figure 54: Ecologically Sensitive Regions of Netravathi river basin

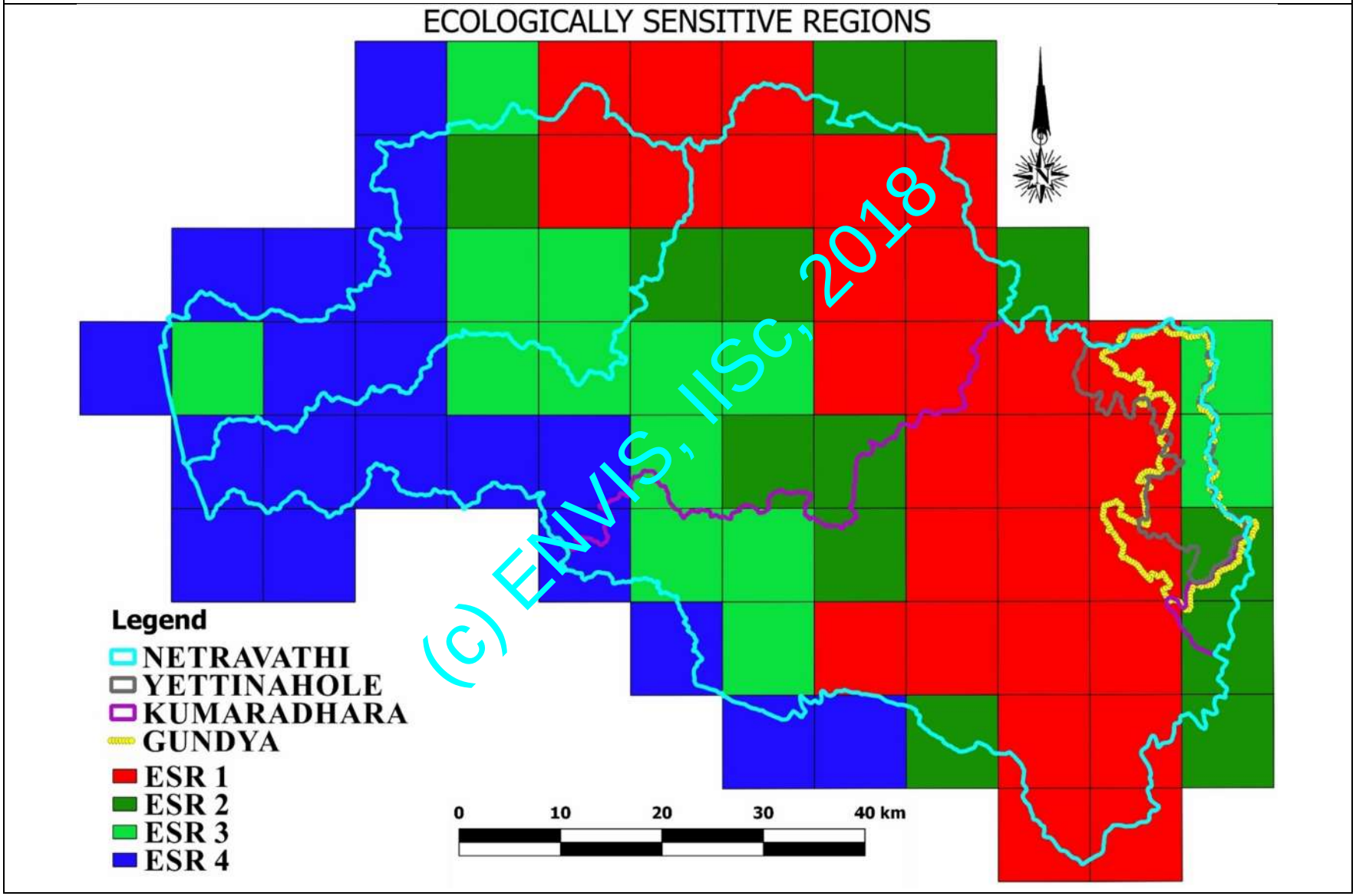


Figure 55: Ecologically Significant areas of Netravathi river basin

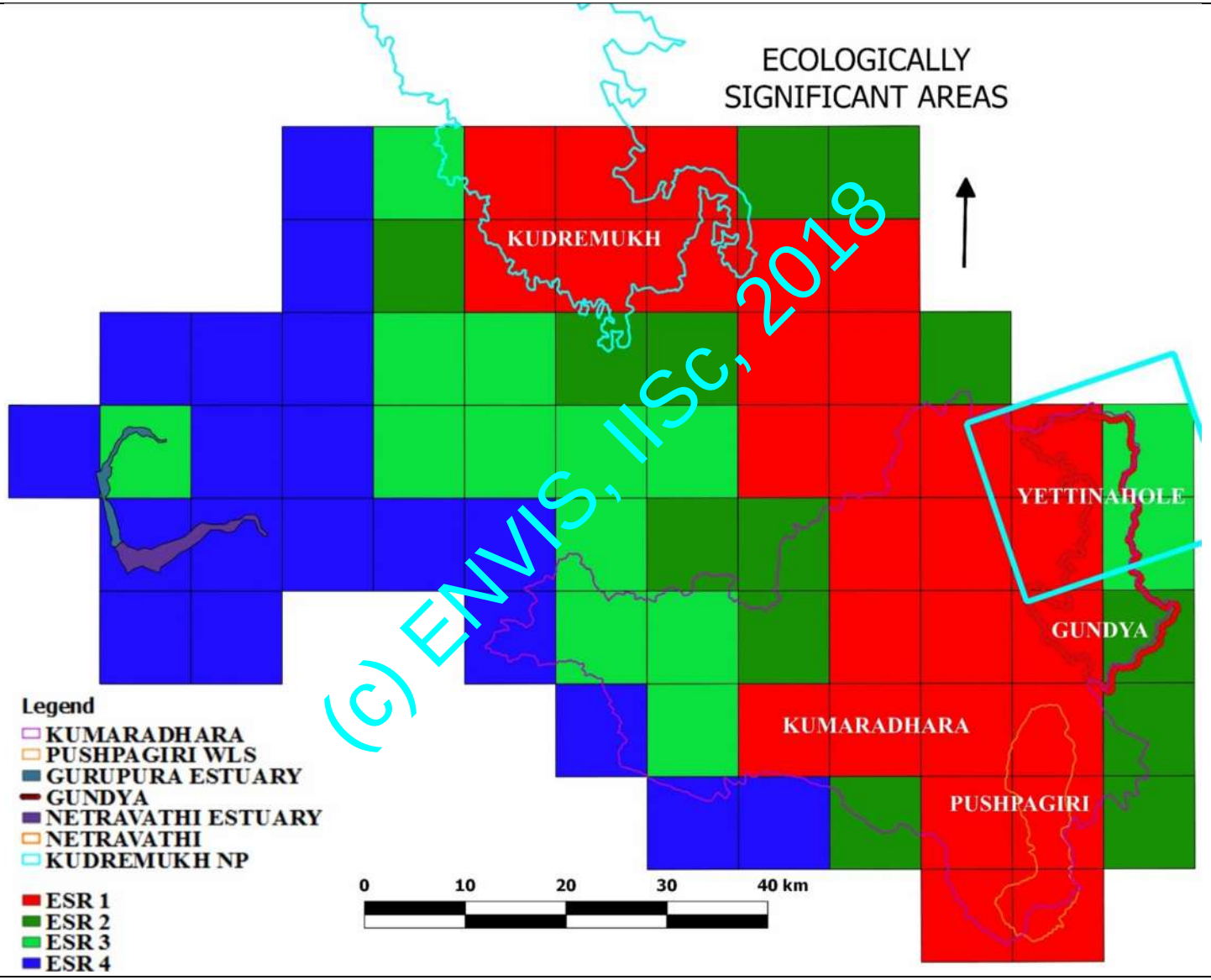
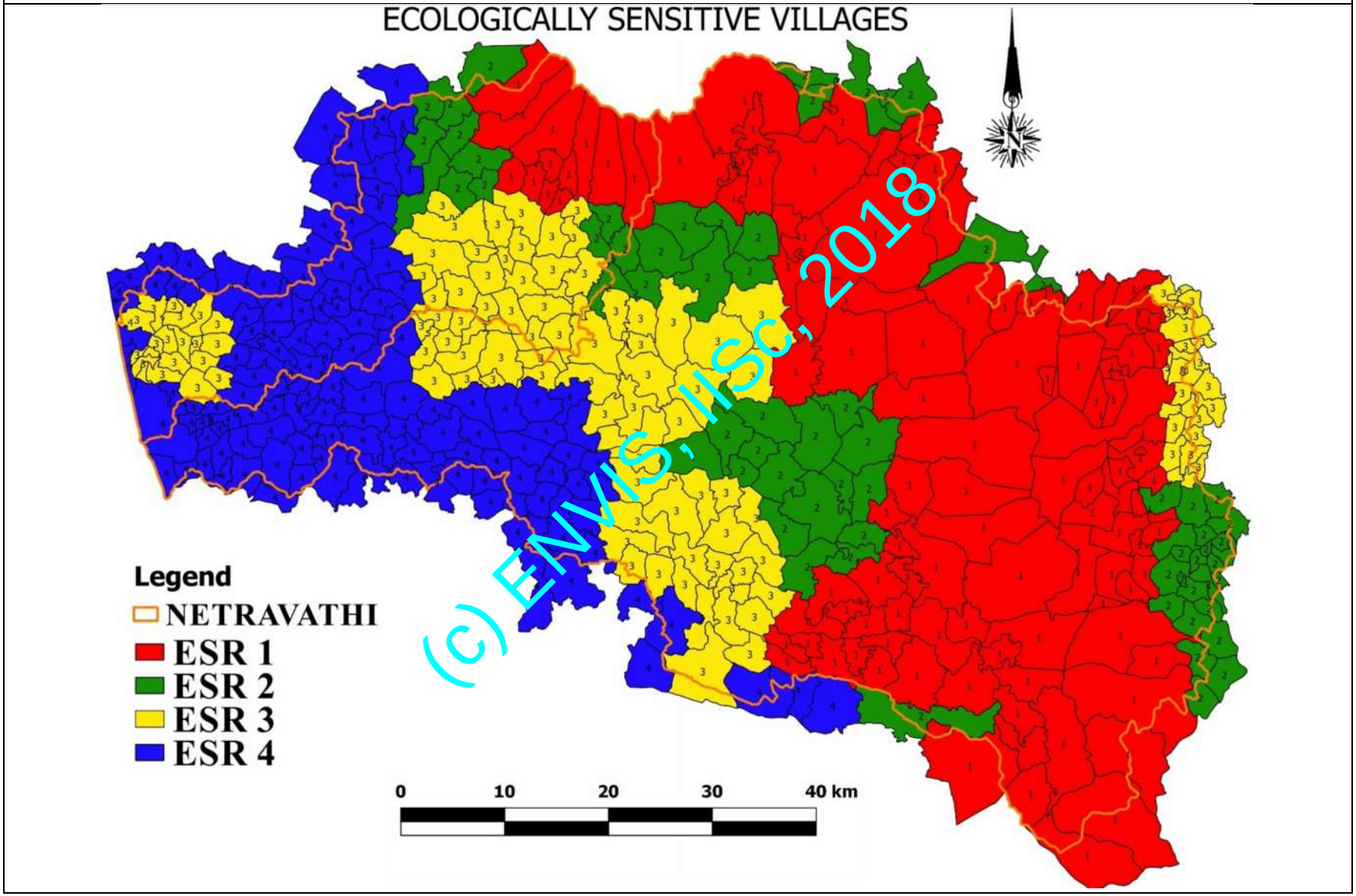


Figure 56: Village level Ecologically Sensitive Regions



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Annexure A

Annexure A: Flora species in Netravathi River Basin.

Sno	Latitude	Longitude	Species Name	Family Name	Location	Source	IUCN Status	Endemism	Ecological Status
1	13.053	75.389	*Abrus precatorius*	Fabaceae	Netravathi River	Ramachandra et al 2007	NE		
2	12.708	75.675	*Acacia auriculiformis*	Fabaceae	Netravathi River	Ramachandra et al 2007	NE		
3	12.684	75.667	*Acacia concinna*	Fabaceae	Netravathi River	Ramachandra et al 2007	NE		
4	12.715	75.701	*Acacia mangium*	Fabaceae	Netravathi River	Ramachandra et al 2007	NE		
5	12.663	75.696	*Acampe sp*	Orchidaceae	Netravathi River	Ramachandra et al 2007	NE		
6	12.834	74.836	*Acanthus ilicifolius*	Acanthaceae	Netravathi Esturay	Reddy et al 2015	LC		
7	12.591	75.669	*Achyranthes aspera*	Amaranthaceae	Netravathi River	Ramachandra et al 2007	NE		
8	12.827	74.842	*Acrostichum aureum*	Pteridaceae	Netravathi Esturay	Reddy et al 2015	LC		
9	12.811	75.440	*Actinodaphne malabarica*	Lauraceae	Kumaradhara River	Ramachandra et al 2013	VU		
10	12.873	75.655	*Actinodaphne malabarica*	Lauraceae	Kumaradhara River	Ramachandra et al 2013	VU		
11	12.679	75.686	*Actinodaphne tadulingamii*	Lauraceae	Uppangala forest	Pascal and Pelissier 1996	NE	E/SWG	
12	12.536	75.683	*Adathoda vasica*	Acanthaceae	Netravathi River	Ramachandra et al 2007	NE		
13	12.764	74.865	*Aegiceras corniculatum*	Myrsinaceae	Netravathi Esturay	Suma et al 2013	LC		
14	12.861	75.344	*Ageratum conyzoides*	Asteraceae	Netravathi River	Ramachandra et al 2007	NE		
15	12.790	75.668	*Aglaia anamalayana*	Meliaceae	Gundia Basin	Gururaj et al 2007	NE	E/SI	Rare
16	13.091	75.401	*Aglaia barberi*	Meliaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	VU	E/SWG	
17	12.679	75.686	*Aglaia barberi*	Meliaceae	Uppangala forest	Pascal and Pelissier 1996	VU	E/SWG	
18	12.679	75.686	*Aglaia beddomei*	Meliaceae	Uppangala forest	Pascal and Pelissier 1996	NE		
19	12.780	75.546	*Aglaia canarensis*	Meliaceae	Kumaradhara River	Ramachandra et al 2013	VU		

20	12.685	75.681	*Aglaia canarensis*	Meliaceae	Kumaradhara River	Ramachandra et al 2013	VU		
21	12.922	75.477	*Aglaia eleginoides*	Meliaceae	Netravathi River	Ramachandra et al 2007	VU		
22	12.679	75.686	*Aglaia jainii*	Meliaceae	Uppangala forest	Pascal and Pelissier 1996	VU	E/SWG	
23	12.604	75.711	*Aglaia jainii*	Meliaceae	Surlabi	Ramesh et al 1997	VU	E/SWG	
24	12.810	75.524	*Aglaia lawii*	Meliaceae	Kumaradhara River	Ramachandra et al 2013	VU		
25	12.626	75.659	*Aglaia lawii*	Meliaceae	Kumaradhara River	Ramachandra et al 2013	VU		
26	12.844	75.250	*Aglaia littoralis*	Meliaceae	Kanara	Ramesh et al 1997	LC	E/SWG	
27	12.679	75.686	*Aglaia simplicifolia*	Meliaceae	Uppangala forest	Pascal and Pelissier 1996	NT	E/SWG	
28	12.679	75.686	*Agrostistachys meeboldii*	Euphorbiaceae	Uppangala forest	Pascal and Pelissier 1996	NE		
29	13.152	75.174	*Alstonia scholaris*	Apocynaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE		
30	12.760	75.610	*Alstonia scholaris*	Apocynaceae	Netravathi River	Ramachandra et al 2007	NE		
31	12.886	75.497	*Alternanthera sessilis*	Amaranthaceae	Netravathi River	Ramachandra et al 2007	NE		
32	12.896	75.337	*Anacardium occidentale*	Anacardiaceae	Bandaru	EMP 2011	NE		
33	13.053	75.389	*Anacardium occidentale*	Anacardiaceae	Netravathi River	Ramachandra et al 2007	NE		
34	13.051	75.337	*Anamirta cocculus*	Menispermaceae	Netravathi River	Ramachandra et al 2007	NE		
35	12.762	75.681	*Ancistrocladus heyneanus*	Ancistrocladaceae	Gundia Basin	Gururaj et al 2007	NE	E/SI	Common
36	13.166	75.375	*Andropogon foulksii*	Poaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE		
37	13.121	75.381	*Anthristiria ciliata*	Annonaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE		
38	12.679	75.686	*Antiaris toxicaria*	Moraceae	Uppangala forest	Pascal and Pelissier 1996	NE	E/WG	
39	12.947	75.363	*Antidesma menasu*	Euphorbiaceae	Netravathi River	Ramachandra et al 2007	NE	E/SI	
40	12.774	75.774	*Antidesma menasu*	Euphorbiaceae	Gundia Basin	Gururaj et al 2007	NE	E/SI	Common
41	12.679	75.686	*Antidesma montanum*	Phyllanthaceae	Uppangala forest	Pascal and Pelissier	NE		

						1996			
42	12.742	75.725	*Apama siliquosa*	Aristolochiaceae	Gundia Basin	Gururaj et al 2007	NE	E/SI	Common
43	12.853	75.332	*Aporosa lindleyana*	Euphorbiaceae	Netravathi River	Ramachandra et al 2007	NE		
44	12.796	75.724	*Ardisia solanacea*	Myrsinaceae	Gundia Basin	Gururaj et al 2007	NE	E	Common
45	13.156	75.199	*Arenga wightii*	Arecaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE	E/SI	Rare
46	12.776	75.675	*Arenga wightii*	Arecaceae	Gundia Basin	Gururaj et al 2007	NE	E/SI	Rare
47	12.789	75.267	*Aristida cetacea*	Poaceae	Netravathi River	Ramachandra et al 2007	NE		
48	12.816	75.239	*Artabotrys sp*	Annonaceae	Netravathi River	Ramachandra et al 2007	NE		
49	12.679	75.686	*Artocarpus heterophyllus*	Moraceae	Uppangala forest	Pascal and Pelissier 1996	NE		
50	13.050	75.120	*Artocarpus hirsutus*	Moraceae	Netravathi River	Ramachandra et al 2007	VU	E/SWG	
51	13.128	75.178	*Artocarpus hirsutus*	Moraceae	Naravi	Ramesh et al 1997	VU	E/SWG	
52	13.128	75.178	*Artocarpus hirsutus*	Moraceae	Naravi	Ramesh et al 1997	VU	E/SWG	
53	13.061	75.406	*Artocarpus hirsutus*	Moraceae	Charmadi	Ramesh et al 1997	VU	E/SWG	
54	13.061	75.406	*Artocarpus hirsutus*	Moraceae	Charmadi	Ramesh et al 1997	VU	E/SWG	
55	13.102	75.471	*Artocarpus hirsutus*	Moraceae	Madugundi	Ramesh et al 1997	VU	E/SWG	
56	13.102	75.471	*Artocarpus hirsutus*	Moraceae	Madugundi	Ramesh et al 1997	VU	E/SWG	
57	12.636	75.516	*Artocarpus hirsutus*	Moraceae	Guthigaru	Ramesh et al 1997	VU	E/SWG	
58	12.636	75.516	*Artocarpus hirsutus*	Moraceae	Guthigaru	Ramesh et al 1997	VU	E/SWG	
59	12.754	75.533	*Artocarpus hirsutus*	Moraceae	Kumaradhara River	Ramachandra et al 2013	VU	E/SWG	
60	12.860	75.560	*Artocarpus hirsutus*	Moraceae	Addahole	Anandhi et al 2013	VU	E/SWG	Common
61	12.932	75.613	*Artocarpus hirsutus*	Moraceae	Sakaleshpur	Ramesh et al 1997	VU	E/SWG	
62	12.932	75.613	*Artocarpus hirsutus*	Moraceae	Sakaleshpur	Ramesh et al 1997	VU	E/SWG	
63	12.819	75.654	*Artocarpus hirsutus*	Moraceae	Balehalla	Ramesh et al 1997	VU	E/SWG	
64	12.819	75.654	*Artocarpus hirsutus*	Moraceae	Balehalla	Ramesh et al 1997	VU	E/SWG	
65	12.679	75.686	*Artocarpus hirsutus*	Moraceae	Uppangala forest	Pascal and Pelissier 1996	VU	E/SWG	
66	12.748	75.709	*Artocarpus hirsutus*	Moraceae	Gundia Basin	Gururaj et al 2007	VU	E/SWG	Common

67	12.850	75.720	*Artocarpus hirsutus*	Moraceae	Aluvalli	Ramesh et al 1997	VU	E/SWG	
68	12.850	75.720	*Artocarpus hirsutus*	Moraceae	Aluvalli	Ramesh et al 1997	VU	E/SWG	
69	12.653	75.722	*Artocarpus hirsutus*	Moraceae	Kumaradhara River	Ramachandra et al 2013	VU	E/SWG	
70	12.775	75.737	*Artocarpus integrifolia*	Moraceae	Gundia Basin	Ramachandra et al 2010	NE	E/SI	Common
71	13.028	75.029	*Artocarpus integrifolius*	Moraceae	Netravathi River	Ramachandra et al 2007	NE	E/SI	
72	12.831	75.411	*Artocarpus integrifolius*	Moraceae	Nelyadi	EMP 2011	NE	E/SI	
73	12.938	75.629	*Artocarpus lakoocha*	Moraceae	Netravathi River	Ramachandra et al 2007	NE		
74	13.095	75.394	*Arundinaria villosa*	Poaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE		
75	12.709	75.620	*Arundinella purpurea*	Poaceae	Netravathi River	Ramachandra et al 2007	NE		
76	13.158	75.396	Arundinella sp	Poaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE		
77	13.084	75.488	*Atalantia wightii*	Rutaceae	Neriya	Ramesh et al 1997	NE	E/WG	
78	13.084	75.488	*Atalantia wightii*	Rutaceae	Neriya	Ramesh et al 1997	NE	E/WG	
79	12.663	75.759	*Atlantia racemosa*	Rutaceae	Netravathi River	Ramachandra et al 2007	NE		
80	12.680	75.759	*Aurundinella metzii*	Poaceae	Netravathi River	Ramachandra et al 2007	NE		
81	12.896	74.824	*Avicennia alba*	Avicenniaceae	Netravathi Esturay	Reddy et al 2015	LC		
82	12.915	74.826	*Avicennia officinalis*	Avicenniaceae	Netravathi Esturay	Reddy et al 2015	LC		
83	12.751	75.263	*Baccaurea courtallensis*	Euphorbiaceae	Mundoor	Ramesh et al 1997	NE	E/SWG	
84	12.751	75.263	*Baccaurea courtallensis*	Euphorbiaceae	Mundoor	Ramesh et al 1997	NE	E/SWG	
85	12.704	75.442	*Baccaurea courtallensis*	Euphorbiaceae	Yenmooru	Ramesh et al 1997	NE	E/SWG	
86	12.704	75.442	*Baccaurea courtallensis*	Euphorbiaceae	Yenmooru	Ramesh et al 1997	NE	E/SWG	
87	12.679	75.686	*Baccaurea courtallensis*	Euphorbiaceae	Uppangala forest	Pascal and Pelissier 1996	NE	E/SWG	
88	12.721	75.609	*Bambusa arundinacea*	Poaceae	Netravathi River	Ramachandra et al 2007	NE		
89	12.805	75.706	*Bauhinia phoenicea*	Fabaceae	Gundia Basin	Ramachandra et al 2010	NE	E/SI	Common
90	12.679	75.686	*Beilschmiedia*	Lauraceae	Uppangala	Pascal and	EN	E/SWG	

			wightii		forest	Pelissier 1996			
91	13.177	75.192	*Bischofia javanica*	Phyllanthaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE		
92	13.136	75.326	*Bischofia javanica*	Phyllanthaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE		
93	13.046	75.499	*Blachia denudata*	Euphorbiaceae	Neriya	Ramesh et al 1997	EN	E/SWG	
94	13.046	75.499	*Blachia denudata*	Euphorbiaceae	Neriya	Ramesh et al 1997	EN	E/SWG	
95	12.679	75.686	*Blachia denudata*	Euphorbiaceae	Uppangala forest	Pascal and Pelissier 1996	EN	E/SWG	
96	12.566	75.697	*Blachia denudata*	Euphorbiaceae	Hammiyala	Ramesh et al 1997	EN	E/SWG	
97	12.566	75.697	*Blachia denudata*	Euphorbiaceae	Hammiyala	Ramesh et al 1997	EN	E/SWG	
98	13.050	75.468	*Blachia umbellata*	Euphorbiaceae	Neriya	Ramesh et al 1997	NE	E/SWG	
99	13.050	75.468	*Blachia umbellata*	Euphorbiaceae	Neriya	Ramesh et al 1997	NE	E/SWG	
100	12.679	75.686	*Blachia umbellata*	Euphorbiaceae	Uppangala forest	Pascal and Pelissier 1996	NE	E/SWG	
101	12.679	75.686	*Blepharistemma membranifolia*	Lauraceae	Uppangala forest	Pascal and Pelissier 1996	NE	E/SWG	
102	12.679	75.686	*Blepharistemma membranifolia*	Rhizophoraceae	Uppangala forest	Pascal and Pelissier 1996	NE	E/SWG	
103	12.860	75.405	*Borassus flabellifer*	Arecaceae	Kokkada	EMP 2011	NE		
104	12.639	75.472	*Borassus flabellifer*	Arecaceae	Netravathi River	Ramachandra et al 2007	NE		
105	12.649	75.446	*Borreria hispida*	Rubiaceae	Netravathi River	Ramachandra et al 2007	NE		
106	12.703	75.444	*Borreria stricta*	Rubiaceae	Netravathi River	Ramachandra et al 2007	NE		
107	13.077	75.325	*Bothriochloa pertusa*	Poaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE		
108	12.699	75.363	*Brachiaria milliformis*	Poaceae	Netravathi River	Ramachandra et al 2007	NE		
109	12.773	75.531	*Breynia rhamnoides*	Phyllanthaceae	Netravathi River	Ramachandra et al 2007	NE		
110	12.747	75.698	*Bridelia crenulata*	Euphorbiaceae	Gundia Basin	Gururaj et al 2007	NE	E	Common
111	12.718	75.384	*Bridelia stipularis*	Euphorbiaceae	Netravathi River	Ramachandra et al 2007	NE		
112	12.920	74.825	*Bruguiera gymnorrhiza*	Rhizophoraceae	Netravathi Esturay	Reddy et al 2015	NE		

113	12.826	75.101	*Bryophyllum pinnatum*	Crassulaceae	Netravathi River	Ramachandra et al 2007	NE		
114	12.963	75.292	*Buchanania lanzan*	Anacardiaceae	Netravathi River	Ramachandra et al 2007	NE		
115	13.070	75.272	*Buchanania latifolia*	Anacardiaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE		
116	13.071	75.494	*Caesalpinia mimosoides*	Fabaceae	Netravathi River	Ramachandra et al 2007	NE		
117	13.088	75.420	Caesaria sp	Amanitaceae	Netravathi River	Ramachandra et al 2007	NE		
118	13.073	75.236	*Callicarpa lanata*	Lamiaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE		
119	12.679	75.686	*Callicarpa tomentosa*	Lamiaceae	Uppangala forest	Pascal and Pelissier 1996	NE	E/SI	
120	12.826	75.704	*Callicarpa tomentosa*	Verbenaceae	Gundia Basin	Ramachandra et al 2010	NE	E/SI	Common
121	12.790	75.746	*Callophyllum apetalum*	Clusiaceae	Gundia Basin	Ramachandra et al 2010	VU	E/SI	Common
122	13.039	75.487	*Calophyllum apetalum*	Calophyllaceae	Neriya	Ramesh et al 1997	VU	E/SWG	
123	13.039	75.487	*Calophyllum apetalum*	Calophyllaceae	Neriya	Ramesh et al 1997	VU	E/SWG	
124	12.878	75.582	*Calophyllum apetalum*	Clusiaceae	Kumaradhara River	Ramachandra et al 2013	VU	E/SWG	
125	12.868	75.588	*Calophyllum apetalum*	Clusiaceae	Kumaradhara River	Ramachandra et al 2013	VU	E/SWG	
126	12.890	75.653	*Calophyllum apetalum*	Calophyllaceae	Kadumane	Ramesh et al 1997	VU	E/SWG	
127	12.890	75.653	*Calophyllum apetalum*	Calophyllaceae	Kadumane	Ramesh et al 1997	VU	E/SWG	
128	12.677	75.697	*Calophyllum apetalum*	Calophyllaceae	Kumaralli	Ramesh et al 1997	VU	E/SWG	
129	12.677	75.697	*Calophyllum apetalum*	Calophyllaceae	Kumaralli	Ramesh et al 1997	VU	E/SWG	
130	13.138	75.178	*Calophyllum elatum*	Calophyllaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	VU		
131	13.157	75.361	*Calophyllum elatum*	Calophyllaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	VU		
132	13.110	75.446	*Calophyllum inophyllum*	Calophyllaceae	Netravathi River	Ramachandra et al 2007	LC		
133	12.679	75.686	*Calophyllum polyanthum*	Calophyllaceae	Uppangala forest	Pascal and Pelissier 1996	NE		
134	13.102	75.489	*Calycopteris floribunda*	Combretaceae	Netravathi River	Ramachandra et al 2007	NE		

135	13.128	75.216	*Canarium strictum*	Burseraceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE	E/SI	
136	13.159	75.408	*Canarium strictum*	Burseraceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE	E/SI	
137	12.726	75.718	*Canarium strictum*	Burseraceae	Gundia Basin	Gururaj et al 2007	NE	E/SI	Rare
138	12.727	75.732	*Canscora deccurens*	Gentianaceae	Gundia Basin	Gururaj et al 2007	NE	E/SI	Rare
139	12.788	75.783	*Canthium dicoccum*	Rubiaceae	Gundia Basin	Gururaj et al 2007	VU	E/SI	Common
140	12.955	75.550	*Canthium parviflora*	Rubiaceae	Netravathi River	Ramachandra et al 2007	NE		
141	12.886	75.669	Canthium sp	Rubiaceae	Netravathi River	Ramachandra et al 2007	NE		
142	13.071	75.494	*Caralia antegerima*	Rhizophoraceae	Netravathi River	Ramachandra et al 2007	NE		
143	13.169	75.353	*Careya arborea*	Lecythidaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE		
144	13.088	75.420	*Careya arborea*	Lecythidaceae	Netravathi River	Ramachandra et al 2007	NE		
145	13.102	75.489	*Carissa carandas*	Apocynaceae	Netravathi River	Ramachandra et al 2007	NE		
146	13.096	75.218	*Caryota urens*	Arecaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	LC		
147	13.110	75.446	*Caryota urens*	Arecaceae	Netravathi River	Ramachandra et al 2007	LC		
148	12.533	75.681	*Caryota urens*	Arecaceae	Kadamakal Reserve Forest	Pelissier et al 1998	LC		
149	12.679	75.686	*Caryota urens*	Arecaceae	Uppangala forest	Pascal and Pelissier 1996	LC		
150	12.679	75.686	*Casearia ovata*	Salicaceae	Uppangala forest	Pascal and Pelissier 1996	NE		
151	12.955	75.550	*Cassia alata*	Fabaceae	Netravathi River	Ramachandra et al 2007	NE		
152	12.886	75.669	*Cassia tora*	Fabaceae	Netravathi River	Ramachandra et al 2007	NE		
153	12.921	75.542	*Casuarina equisetifolia*	Casuarinaceae	Netravathi River	Ramachandra et al 2007	NE		
154	13.118	75.170	*Cedrela toona*	Meliaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE		
155	12.896	74.824	*Ceriops decandra*	Rhizophoraceae	Netravathi Esturay	Reddy et al 2015	NT		

156	12.837	75.438	*Chasalia curviflora*	Rubiaceae	Netravathi River	Ramachandra et al 2007	NE		
157	12.586	75.581	*Chionanthus mala-elengi*	Oleaceae	Kumaradhara River	Ramachandra et al 2013	NE		
158	12.838	75.709	*Chionanthus mala-elengi*	Oleaceae	Kumaradhara River	Ramachandra et al 2013	NE		
159	12.680	75.759	*Chloris barbata*	Poaceae	Netravathi River	Ramachandra et al 2007	NE		
160	13.051	75.337	*Chromolaena odorata*	Asteraceae	Netravathi River	Ramachandra et al 2007	NE		
161	12.679	75.686	*Chrysophylum lanceolatum*	Sapotaceae	Uppangala forest	Pascal and Pelissier 1996	NE		
162	13.114	75.324	*Chrysopogon orientalis*	Poaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE		
163	12.709	75.620	*Cinnamom malabaricum*	Lauraceae	Netravathi River	Ramachandra et al 2007	NE		
164	13.076	75.283	*Cinnamomum iners*	Lauraceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE		
165	13.097	75.457	*Cinnamomum macrocarpum*	Lauraceae	Madugundi	Ramesh et al 1997	VU	E/SWG	
166	13.097	75.457	*Cinnamomum macrocarpum*	Lauraceae	Madugundi	Ramesh et al 1997	VU	E/SWG	
167	12.862	75.484	*Cinnamomum sulphuratum*	Lauraceae	Kumaradhara River	Ramachandra et al 2013	VU		
168	12.848	75.702	*Cinnamomum sulphuratum*	Lauraceae	Kumaradhara River	Ramachandra et al 2013	VU		
169	12.913	74.858	*Citrus aurantium*	Rutaceae	Kuloor	Kumar 2015	NE		
170	12.511	75.657	*Cleistanthus malabaricus*	Euphorbiaceae	Aravattu	Ramesh et al 1997	VU	E/WG	
171	12.511	75.657	*Cleistanthus malabaricus*	Euphorbiaceae	Aravattu	Ramesh et al 1997	VU	E/WG	
172	12.899	75.658	*Cleistanthus malabaricus*	Euphorbiaceae	Kadumane	Ramesh et al 1997	VU	E/WG	
173	12.899	75.658	*Cleistanthus malabaricus*	Euphorbiaceae	Kadumane	Ramesh et al 1997	VU	E/WG	
174	12.682	75.693	*Cleistanthus malabaricus*	Euphorbiaceae	Kumaralli	Ramesh et al 1997	VU	E/WG	
175	12.682	75.693	*Cleistanthus malabaricus*	Euphorbiaceae	Kumaralli	Ramesh et al 1997	VU	E/WG	
176	12.721	75.609	*Clerodendrum paniculatum*	Lamiaceae	Netravathi River	Ramachandra et al 2007	NE		
177	12.922	75.477	*Clerodendrum viscosum*	Lamiaceae	Netravathi River	Ramachandra et al 2007	NE		
178	12.496	75.642	*Cliestoma tenuifolia*	Orchidaceae	Kumaradhara River	Ramachandra et al	NE		

						2013			
179	12.861	75.702	*Cliestoma tenuifolia*	Orchidaceae	Kumaradhara River	Ramachandra et al 2013	NE		
180	12.760	75.610	*Colocasia esculenta*	Araceae	Netravathi River	Ramachandra et al 2007	NE		
181	12.886	75.497	*Corchorus capsularis*	Malvaceae	Netravathi River	Ramachandra et al 2007	NE		
182	13.053	75.389	*Costus speciosus*	Costaceae	Netravathi River	Ramachandra et al 2007	NE		
183	12.947	75.363	*Crotalaria juncea*	Fabaceae	Netravathi River	Ramachandra et al 2007	NE		
184	12.853	75.332	*Crotalaria labernifolia*	Fabaceae	Netravathi River	Ramachandra et al 2007	NE		
185	12.789	75.267	*Crotalaria leptostachya*	Fabaceae	Netravathi River	Ramachandra et al 2007	NE		
186	12.816	75.239	*Crotalaria striata*	Fabaceae	Netravathi River	Ramachandra et al 2007	NE		
187	12.679	75.686	*Croton malabaricus*	Euphorbiaceae	Uppangala forest	Pascal and Pelissier 1996	NE	E/SWG	
188	12.663	75.668	*Cryptocarya bourdillonii*	Lauraceae	Kumaralli	Ramesh et al 1997	NE	E/SWG	
189	12.663	75.668	*Cryptocarya bourdillonii*	Lauraceae	Kumaralli	Ramesh et al 1997	NE	E/SWG	
190	12.679	75.686	*Cryptocarya bourdillonii*	Lauraceae	Uppangala forest	Pascal and Pelissier 1996	NE	E/SWG	
191	12.862	75.523	*Cryptocoryne retrospiralis*	Araceae	Kumaradhara River	Ramachandra et al 2013	NE		
192	12.808	75.566	*Cryptocoryne retrospiralis*	Araceae	Kumaradhara River	Ramachandra et al 2013	NE		
193	13.050	75.120	*Cryptolepis buchanani*	Asclepiadaceae	Netravathi River	Ramachandra et al 2007	NE		
194	13.028	75.029	*Curculigo orchioides*	Hypoxidaceae	Netravathi River	Ramachandra et al 2007	NE		
195	12.938	75.629	*Curcuma oligantha*	Zingiberaceae	Netravathi River	Ramachandra et al 2007	NE		
196	12.679	75.686	*Cyathocalyx zeylanicus*	Annonaceae	Uppangala forest	Pascal and Pelissier 1996	NE		
197	12.663	75.759	*Cyclea peltata*	Menispermaceae	Netravathi River	Ramachandra et al 2007	NE		
198	13.155	75.343	Cymbopogon sp	Poaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE		

199	12.680	75.759	*Cyrtococcum oxyphyllum*	Poaceae	Netravathi River	Ramachandra et al 2007	NE		
200	12.709	75.620	*Cyrtococcum patens*	Poaceae	Netravathi River	Ramachandra et al 2007	NE		
201	13.127	75.174	*Dalbergia latifolia*	Fabaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE		
202	12.900	75.548	*Dalbergia sympathetica*	Fabaceae	Kumaradhara River	Ramachandra et al 2013	NE	E/SI	
203	12.961	75.593	*Dalbergia sympathetica*	Fabaceae	Kumaradhara River	Ramachandra et al 2013	NE	E/SI	
204	12.721	75.609	*Dalbergia sympathetica*	Fabaceae	Netravathi River	Ramachandra et al 2007	NE	E/SI	
205	12.754	75.737	*Dalbergia sympethetica*	Fabaceae	Gundia Basin	Gururaj et al 2007	NE	E/SI	Rare
206	12.788	75.767	*Dendrobium aqueum*	Orchidaceae	Gundia Basin	Gururaj et al 2007	NE	E/SI	Rare
207	12.827	74.842	*Derris scandens*	Fabaceae	Netravathi Esturay	Reddy et al 2015	LC		
208	12.639	75.472	*Derris uliginosa*	Fabaceae	Netravathi River	Ramachandra et al 2007	NE		
209	12.703	75.444	*Desmodium triflorum*	Fabaceae	Netravathi River	Ramachandra et al 2007	NE		
210	12.649	75.446	*Desmodium triquetrum*	Fabaceae	Netravathi River	Ramachandra et al 2007	NE		
211	13.107	75.186	*Dillenia pentagyna*	Dilleniaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE		
212	13.143	75.396	*Dimocarpus longan*	Sapindaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NT		
213	12.679	75.686	*Dimocarpus longan*	Sapindaceae	Uppangala forest	Pascal and Pelissier 1996	NT		
214	12.679	75.686	*Dimorphocalyx beddomei*	Euphorbiaceae	Uppangala forest	Pascal and Pelissier 1996	EN	E/SWG	
215	12.718	75.384	*Dioscorea triphylla*	Dioscoreaceae	Netravathi River	Ramachandra et al 2007	NE		
216	12.957	75.569	*Diospyro ccndolleana*	Ebenaceae	Kumaradhara River	Ramachandra et al 2013	NE		
217	12.977	75.602	*Diospyro ccndolleana*	Ebenaceae	Kumaradhara River	Ramachandra et al 2013	NE		
218	12.944	75.563	*Diospyros angustifolium*	Ebenaceae	Kumaradhara River	Ramachandra et al 2013	NE		
219	12.901	75.572	*Diospyros angustifolium*	Ebenaceae	Kumaradhara River	Ramachandra et al 2013	NE		

220	12.946	75.546	*Diospyros assimilis*	Ebenaceae	Kumaradhara River	Ramachandra et al 2013	DD	E/WG	
221	12.910	75.587	*Diospyros assimilis*	Ebenaceae	Kumaradhara River	Ramachandra et al 2013	DD	E/WG	
222	12.679	75.686	*Diospyros assimilis*	Ebenaceae	Uppangala forest	Pascal and Pelissier 1996	DD	E/WG	
223	12.779	75.723	*Diospyros assimilis*	Ebenaceae	Gundia Basin	Gururaj et al 2007	DD	E/WG	Common
224	12.679	75.686	*Diospyros bourdillonii*	Ebenaceae	Uppangala forest	Pascal and Pelissier 1996	NE	E/WG	
225	12.679	75.686	*Diospyros buxifolia*	Ebenaceae	Uppangala forest	Pascal and Pelissier 1996	NE		
226	12.699	75.363	*Diospyros embryopteris*	Ebenaceae	Netravathi River	Ramachandra et al 2007	NE		
227	12.679	75.686	*Diospyros ghatensis*	Ebenaceae	Uppangala forest	Pascal and Pelissier 1996	NE	E/WG	
228	12.775	75.737	*Diospyros nigrescens*	Ebenaceae	Gundia Basin	Gururaj et al 2007	NE	E/SI	Common
229	12.679	75.686	*Diospyros pruriens*	Ebenaceae	Uppangala forest	Pascal and Pelissier 1996	NE	E/WG	
230	12.957	75.557	*Diospyros sylvatica*	Ebenaceae	Kumaradhara River	Ramachandra et al 2013	NE		
231	12.938	75.633	*Diospyros sylvatica*	Ebenaceae	Kumaradhara River	Ramachandra et al 2013	NE		
232	12.679	75.686	*Diospyros sylvatica*	Ebenaceae	Uppangala forest	Pascal and Pelissier 1996	NE		
233	12.679	75.686	*Dipterocarpus bourdillonii*	Dipterocarpaceae	Uppangala forest	Pascal and Pelissier 1996	NE	E/WG	
234	13.083	75.315	*Dipterocarpus indicus*	Dipterocarpaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	EN	E/SI	
235	12.805	75.706	*Dipterocarpus indicus*	Dipterocarpaceae	Gundia Basin	Gururaj et al 2007	EN	E/SI	Rare
236	13.107	75.506	*Drypetes elata*	Euphorbiaceae	Attigere	Ramesh et al 1997	NE	E/WG	
237	13.107	75.506	*Drypetes elata*	Euphorbiaceae	Attigere	Ramesh et al 1997	NE	E/WG	
238	12.624	75.508	*Drypetes elata*	Euphorbiaceae	Guthigaru	Ramesh et al 1997	NE	E/WG	
239	12.624	75.508	*Drypetes elata*	Euphorbiaceae	Guthigaru	Ramesh et al 1997	NE	E/WG	
240	12.854	75.650	*Drypetes elata*	Euphorbiaceae	Heggade	Ramesh et al 1997	NE	E/WG	
241	12.854	75.650	*Drypetes elata*	Euphorbiaceae	Heggade	Ramesh et al 1997	NE	E/WG	
242	12.859	75.681	*Drypetes elata*	Euphorbiaceae	Sakaleshpur	Ramesh et al 1997	NE	E/WG	

243	12.859	75.681	*Drypetes elata*	Euphorbiaceae	Sakaleshpur	Ramesh et al 1997	NE	E/WG	
244	12.679	75.686	*Drypetes elata*	Euphorbiaceae	Uppangala forest	Pascal and Pelissier 1996	NE	E/WG	
245	12.696	75.704	*Drypetes elata*	Euphorbiaceae	Kumaralli	Ramesh et al 1997	NE	E/WG	
246	12.696	75.704	*Drypetes elata*	Euphorbiaceae	Kumaralli	Ramesh et al 1997	NE	E/WG	
247	12.724	75.732	*Drypetes elata*	Euphorbiaceae	Vanagoor	Ramesh et al 1997	NE	E/WG	
248	12.724	75.732	*Drypetes elata*	Euphorbiaceae	Vanagoor	Ramesh et al 1997	NE	E/WG	
249	12.679	75.686	*Drypetes oblongifolia*	Euphorbiaceae	Uppangala forest	Pascal and Pelissier 1996	NE	E/WG	
250	12.922	75.477	*Duranta plumeri*	Verbenaceae	Netravathi River	Ramachandra et al 2007	NE		
251	12.845	75.248	*Dysoxylum binectariferum*	Meliaceae	Uppinangadi	Mohanakumara et al 2010	NE		
252	13.117	75.343	*Dysoxylum malabaricum*	Meliaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	EN	E/WG	
253	12.870	75.658	*Dysoxylum malabaricum*	Meliaceae	Heggade	Ramesh et al 1997	EN	E/WG	
254	12.708	75.705	*Dysoxylum malabaricum*	Meliaceae	Sakaleshpur	Ramesh et al 1997	EN	E/WG	
255	12.679	75.686	*Elaeocarpus serratus*	Elaeocarpaceae	Uppangala forest	Pascal and Pelissier 1996	NE	E	
256	12.826	75.704	*Elaeocarpus serratus*	Elaeocarpaceae	Gundia Basin	Gururaj et al 2007	NE	E	Common
257	13.092	75.195	*Elaeocarpus tuberculatus*	Elaeocarpaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE		
258	13.063	75.279	*Elaeocarpus tuberculatus*	Elaeocarpaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE		
259	12.760	75.610	*Elephantopus scaber*	Asteraceae	Netravathi River	Ramachandra et al 2007	LC		
260	12.886	75.497	*Ensete superbum*	Musaceae	Netravathi River	Ramachandra et al 2007	NE		
261	13.159	75.184	*Eragrostis nigra*	Poaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE		
262	13.053	75.389	*Eragrostis unioloides*	Poaceae	Netravathi River	Ramachandra et al 2007	NE		
263	13.051	75.337	*Eragrostis viscosa*	Poaceae	Netravathi River	Ramachandra et al 2007	NE		
264	12.947	75.363	*Ervatamia heyneana*	Apocynaceae	Netravathi River	Ramachandra et al 2007	NE	E/SI	
265	12.903	75.566	*Ervatamia*	Apocynaceae	Kumaradh	Ramachand	NE	E/SI	

			heyneana		ara River	ra et al 2013			
266	12.791	75.580	*Ervatamia heyneana*	Apocynaceae	Kumaradhara River	Ramachandra et al 2013	NE	E/SI	
267	12.790	75.746	*Ervatamia heyneana*	Apocynaceae	Gundia Basin	Gururaj et al 2007	NE	E/SI	Common
268	13.047	75.294	*Eugenia gardineri*	Myrtaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE		
269	13.104	75.278	Eugenia sp	Myrtaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE		
270	13.138	75.188	Eulalia sp	Poaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE		
271	13.060	75.468	*Euonymus indicus*	Celastraceae	Neriya	Ramesh et al 1997	NE	E/WG	
272	13.060	75.468	*Euonymus indicus*	Celastraceae	Neriya	Ramesh et al 1997	NE	E/WG	
273	12.679	75.686	*Euonymus indicus*	Celastraceae	Uppangala forest	Pascal and Pelissier 1996	NE	E/WG	
274	12.889	75.728	*Euonymus indicus*	Celastraceae	Gundia Basin	Gururaj et al 2007	NE	E/SI	Rare
275	12.921	75.542	*Euphorbia hirta*	Euphorbiaceae	Netravathi River	Ramachandra et al 2007	NE		
276	12.941	74.835	*Excoecaria agallocha*	Euphorbiaceae	Netravathi Esturay	Reddy et al 2015	LC		
277	12.679	75.686	*Fahrenheitia zeylancia*	Euphorbiaceae	Uppangala forest	Pascal and Pelissier 1996	NE		
278	12.933	75.676	*Ficus arnottiana*	Moraceae	Gundia Basin	Gururaj et al 2007	NE	E/SI	Common
279	12.837	75.438	*Ficus asperima*	Moraceae	Netravathi River	Ramachandra et al 2007	NE		
280	12.839	75.399	*Ficus benghalensis*	Moraceae	Uppinangadi	EMP 2011	NE		
281	12.680	75.759	*Ficus hispida*	Moraceae	Netravathi River	Ramachandra et al 2007	NE		
282	12.679	75.686	*Ficus nervosa*	Moraceae	Uppangala forest	Pascal and Pelissier 1996	NE		
283	12.709	75.620	*Ficus racemosa*	Moraceae	Netravathi River	Ramachandra et al 2007	NE		
284	12.851	75.405	*Ficus religiosa*	Moraceae	Kokkada	EMP 2011	NE		
285	12.721	75.609	*Ficus religiosa*	Moraceae	Netravathi River	Ramachandra et al 2007	NE		
286	13.073	75.413	*Flacourtia montana*	Flacourtiaceae	Charmadi	Ramesh et al 1997	NE	E/WG	
287	13.073	75.413	*Flacourtia montana*	Flacourtiaceae	Charmadi	Ramesh et al 1997	NE	E/WG	
288	12.922	75.477	*Flacourtia montana*	Flacourtiaceae	Netravathi River	Ramachandra et al	NE	E/WG	

						2007			
289	12.847	75.555	*Flacourtia montana*	Flacourtiaceae	Shirady	Ramesh et al 1997	NE	E/WG	
290	12.847	75.555	*Flacourtia montana*	Flacourtiaceae	Shirady	Ramesh et al 1997	NE	E/WG	
291	12.939	75.663	*Flacourtia montana*	Flacourtiaceae	Gundia Basin	Gururaj et al 2007	NE	E/WG	Rare
292	12.931	75.670	*Flacourtia montana*	Flacourtiaceae	Kumaradhara River	Ramachandra et al 2013	NE	E/WG	
293	12.679	75.686	*Flacourtia montana*	Flacourtiaceae	Uppangala forest	Pascal and Pelissier 1996	NE	E/WG	
294	12.707	75.705	*Flacourtia montana*	Flacourtiaceae	Kumaradhara River	Ramachandra et al 2013	NE	E/WG	
295	12.610	75.708	*Flacourtia montana*	Flacourtiaceae	Surlabi	Ramesh et al 1997	NE	E/WG	
296	12.610	75.708	*Flacourtia montana*	Flacourtiaceae	Surlabi	Ramesh et al 1997	NE	E/WG	
297	12.953	75.708	*Flickingeria nodosa*	Orchidaceae	Gundia Basin	Gururaj et al 2007	NE	E	common
298	13.148	75.216	*Garcinia cambogia*	Clusiaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE	E/SI	
299	12.952	75.685	*Garcinia cambogia*	Clusiaceae	Gundia Basin	Gururaj et al 2007	NE	E/SI	Common
300	13.120	75.227	*Garcinia gummigutta*	Clusiaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE	E/SWG	
301	12.916	75.584	*Garcinia gummigutta*	Clusiaceae	Kumaradhara River	Ramachandra et al 2013	NE	E/SWG	
302	12.898	75.592	*Garcinia gummigutta*	Clusiaceae	Kumaradhara River	Ramachandra et al 2013	NE	E/SWG	
303	12.679	75.686	*Garcinia gummigutta*	Clusiaceae	Uppangala forest	Pascal and Pelissier 1996	NE	E/SWG	
304	13.104	75.335	*Garcinia indica*	Clusiaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	VU	E/SWG	
305	12.831	75.411	*Garcinia indica*	Clusiaceae	Nelyadi	EMP 2011	VU	E/SWG	
306	13.053	75.458	*Garcinia indica*	Clusiaceae	Neriya	Ramesh et al 1997	VU	E/SWG	
307	13.053	75.458	*Garcinia indica*	Clusiaceae	Neriya	Ramesh et al 1997	VU	E/SWG	
308	12.925	75.606	*Garcinia indica*	Clusiaceae	Kumaradhara River	Ramachandra et al 2013	VU	E/SWG	
309	12.760	75.610	*Garcinia indica*	Clusiaceae	Netravathi River	Ramachandra et al 2007	VU	E/SWG	
310	12.958	75.625	*Garcinia indica*	Clusiaceae	Kumaradhara River	Ramachandra et al 2013	VU	E/SWG	
311	13.149	75.353	*Garcinia morella*	Clusiaceae	Kudremukh Tiger	Ramachandra et al	NE		

					Reserve	2017			
312	12.679	75.686	*Garcinia morella*	Clusiaceae	Uppangala forest	Pascal and Pelissier 1996	NE		
313	13.040	75.279	Garcinia sp	Clusiaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE		
314	12.679	75.686	*Garcinia talbotii*	Clusiaceae	Uppangala forest	Pascal and Pelissier 1996	VU	E/WG	
315	12.759	75.689	*Garcinia talbotii*	Clusiaceae	Yathahalla	Ramesh et al 1997	VU	E/WG	
316	12.759	75.689	*Garcinia talbotii*	Clusiaceae	Yathahalla	Ramesh et al 1997	VU	E/WG	
317	12.950	75.754	*Garcinia talbotii*	Clusiaceae	Gundia Basin	Gururaj et al 2007	VU	E/SI	Rare
318	13.126	75.396	*Garcinia xanthochymus*	Clusiaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE		
319	12.886	75.497	*Garcinia xanthochymus*	Clusiaceae	Netravathi River	Ramachandra et al 2007	NE		
320	13.053	75.389	*Geissaspis cristata*	Fabaceae	Netravathi River	Ramachandra et al 2007	LC		
321	12.947	75.363	*Gliricidia maculata*	Fabaceae	Netravathi River	Ramachandra et al 2007	NE		
322	12.679	75.686	*Glochidion malabaricum*	Euphorbiaceae	Uppangala forest	Pascal and Pelissier 1996	NE		
323	13.096	75.235	Glochidion sp.	Phyllanthaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE		
324	13.051	75.337	*Gloriosa superba*	Colchicaceae	Netravathi River	Ramachandra et al 2007	NE		
325	12.679	75.686	*Glycosmis Macrocarpa*	Rutaceae	Uppangala forest	Pascal and Pelissier 1996	EN	E/SWG	
326	12.843	75.713	*Gnetum ula*	Gnetaceae	Gundia Basin	Gururaj et al 2007	NE	E/SI	Rare
327	12.679	75.686	*Gomphandra tetrandra*	Icacinaceae	Uppangala forest	Pascal and Pelissier 1996	EN	E/SWG	
328	13.132	75.378	*Gordonia obtusa*	Theaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NT	E/SWG	
329	12.831	75.697	*Gordonia obtusa*	Theaceae	Gundia Basin	Gururaj et al 2007	NT	E/SWG	Rare
330	12.696	75.738	*Gordonia obtusa*	Theaceae	Banagare	Ramesh et al 1997	NT	E/SWG	
331	12.696	75.738	*Gordonia obtusa*	Theaceae	Banagare	Ramesh et al 1997	NT	E/SWG	
332	12.696	75.771	*Gordonia obtusa*	Theaceae	Thambalagere	Ramesh et al 1997	NT	E/SWG	
333	12.696	75.771	*Gordonia obtusa*	Theaceae	Thambalagere	Ramesh et al 1997	NT	E/SWG	

334	12.853	75.332	*Grewia microcosm*	Malvaceae	Netravathi River	Ramachandra et al 2007	NE		
335	12.793	75.534	*Gymnacranthera canarica*	Myristicaceae	Kumaradhara River	Ramachandra et al 2013	NE		
336	12.560	75.687	*Gymnacranthera canarica*	Myristicaceae	Kumaradhara River	Ramachandra et al 2013	NE		
337	12.789	75.267	*Gymnostachium febrifugum*	Acanthaceae	Netravathi River	Ramachandra et al 2007	NE		
338	12.679	75.686	*Harpullia arborea*	Sapindaceae	Uppangala forest	Pascal and Pelissier 1996	NE		
339	12.816	75.239	*Hemidesmus indicus*	Apocynaceae	Netravathi River	Ramachandra et al 2007	NE		
340	12.836	75.615	*Heritiera papilio*	Malvaceae	Shirady	Ramesh et al 1997	NT	E/SWG	
341	12.836	75.615	*Heritiera papilio*	Sterculiaceae	Shirady	Ramesh et al 1997	NT	E/SWG	
342	12.859	75.645	*Heritiera papilio*	Malvaceae	Heggade	Ramesh et al 1997	NT	E/SWG	
343	12.859	75.645	*Heritiera papilio*	Sterculiaceae	Heggade	Ramesh et al 1997	NT	E/SWG	
344	12.679	75.686	*Heritiera papilio*	Malvaceae	Uppangala forest	Pascal and Pelissier 1996	NT	E/SWG	
345	13.050	75.120	*Heteropogon contortus*	Poaceae	Netravathi River	Ramachandra et al 2007	NE		
346	13.117	75.179	*Heteropogon contortus*	Poaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE		
347	13.028	75.029	*Hibiscus furcatus*	Malvaceae	Netravathi River	Ramachandra et al 2007	NE		
348	12.892	75.544	*Holigarna arnottiana*	Anacardiaceae	Kumaradhara River	Ramachandra et al 2013	NE	E/WG	
349	12.938	75.629	*Holigarna arnottiana*	Anacardiaceae	Netravathi River	Ramachandra et al 2007	NE	E/WG	
350	12.859	75.633	*Holigarna arnottiana*	Anacardiaceae	Kumaradhara River	Ramachandra et al 2013	NE	E/WG	
351	12.679	75.686	*Holigarna arnottiana*	Anacardiaceae	Uppangala forest	Pascal and Pelissier 1996	NE	E/WG	
352	12.889	75.728	*Holigarna arnottiana*	Anacardiaceae	Gundia Basin	Ramachandra et al 2010	NE	E/WG	Common
353	12.536	75.608	*Holigarna beddomei*	Anacardiaceae	Kalmakaru	Ramesh et al 1997	NE	E/SWG	
354	12.536	75.608	*Holigarna beddomei*	Anacardiaceae	Kalmakaru	Ramesh et al 1997	NE	E/SWG	
355	12.876	75.565	*Holigarna ferruginea*	Anacardiaceae	Kumaradhara River	Ramachandra et al 2013	NE	E/WG	

356	12.851	75.604	*Holigarna ferruginea*	Anacardiaceae	Kumaradhara River	Ramachandra et al 2013	NE	E/WG	
357	12.933	75.676	*Holigarna ferruginea*	Anacardiaceae	Gundia Basin	Ramachandra et al 2010	NE	E/WG	Rare
358	12.679	75.686	*Holigarna ferruginea*	Anacardiaceae	Uppangala forest	Pascal and Pelissier 1996	NE	E/WG	
359	12.947	75.592	*Holigarna grahamii*	Anacardiaceae	Byrapura Estate	Ramesh et al 1997	NT	E/WG	
360	12.945	75.621	*Holigarna grahamii*	Anacardiaceae	Byrapura Estate	Ramesh et al 1997	NT	E/WG	
361	12.523	75.621	*Holigarna grahamii*	Anacardiaceae	Kalmakaru	Ramesh et al 1997	NT	E/WG	
362	12.523	75.621	*Holigarna grahamii*	Anacardiaceae	Kalmakaru	Ramesh et al 1997	NT	E/WG	
363	12.838	75.644	*Holigarna grahamii*	Anacardiaceae	Heggade	Ramesh et al 1997	NT	E/WG	
364	12.838	75.644	*Holigarna grahamii*	Anacardiaceae	Heggade	Ramesh et al 1997	NT	E/WG	
365	12.502	75.657	*Holigarna grahamii*	Anacardiaceae	Aravattu	Ramesh et al 1997	NT	E/WG	
366	12.679	75.686	*Holigarna grahamii*	Anacardiaceae	Uppangala forest	Pascal and Pelissier 1996	NT	E/WG	
367	12.614	75.705	*Holigarna grahamii*	Anacardiaceae	Surlabbi	Ramesh et al 1997	NT	E/WG	
368	12.614	75.705	*Holigarna grahamii*	Anacardiaceae	Surlabbi	Ramesh et al 1997	NT	E/WG	
369	12.873	75.718	*Holigarna grahamii*	Anacardiaceae	Heggade	Ramesh et al 1997	NT	E/WG	
370	12.873	75.718	*Holigarna grahamii*	Anacardiaceae	Heggade	Ramesh et al 1997	NT	E/WG	
371	13.159	75.207	*Holigarna grahmii*	Anacardiaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NT	E/WG	
372	12.834	75.713	*Holigarna grahmii*	Anacardiaceae	Gundia Basin	Gururaj et al 2007	NT	E/WG	Rare
373	12.679	75.686	*Holigarna nigra*	Anacardiaceae	Uppangala forest	Pascal and Pelissier 1996	NE	E/WG	
374	13.064	75.249	*Hopea canarensis*	Dipterocarpaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE	E/SWG	
375	13.172	75.182	*Hopea parviflora*	Dipterocarpaceae	Karkal	Ramesh et al 1997	EN	E/SWG	
376	13.172	75.182	*Hopea parviflora*	Dipterocarpaceae	Karkal	Ramesh et al 1997	EN	E/SWG	
377	12.886	75.337	*Hopea parviflora*	Dipterocarpaceae	Bandaru	EMP 2011	EN	E/SWG	
378	13.078	75.338	*Hopea parviflora*	Dipterocarpaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	EN	E/SWG	
379	12.634	75.479	*Hopea parviflora*	Dipterocarpaceae	Kuthkunja	Ramesh et al 1997	EN	E/SWG	
380	12.634	75.479	*Hopea parviflora*	Dipterocarpaceae	Kuthkunja	Ramesh et al 1997	EN	E/SWG	
381	12.630	75.518	*Hopea*	Dipterocarpa	Guthigaru	Ramesh et	EN	E/SWG	

			parviflora	ceae		al 1997			
382	12.630	75.518	*Hopea parviflora*	Dipterocarpaceae	Guthigaru	Ramesh et al 1997	EN	E/SWG	
383	12.920	75.607	*Hopea parviflora*	Dipterocarpaceae	Kumaradhara River	Ramachandra et al 2013	EN	E/SWG	
384	12.679	75.686	*Hopea parviflora*	Dipterocarpaceae	Uppangala forest	Pascal and Pelissier 1996	EN	E/SWG	
385	12.690	75.723	*Hopea parviflora*	Dipterocarpaceae	Kumaradhara River	Ramachandra et al 2013	EN	E/SWG	
386	12.663	75.759	*Hopea parviflora*	Dipterocarpaceae	Netravathi River	Ramachandra et al 2007	EN	E/SWG	
387	13.091	75.343	*Hopea ponga*	Dipterocarpaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	EN	E/SI	
388	12.860	75.560	*Hopea ponga*	Dipterocarpaceae	Addahole	Anandhi et al 2013	EN	E/SI	Common
389	12.962	75.574	*Hopea ponga*	Dipterocarpaceae	Kumaradhara River	Ramachandra et al 2013	EN	E/SI	
390	12.919	75.578	*Hopea ponga*	Dipterocarpaceae	Kumaradhara River	Ramachandra et al 2013	EN	E/SI	
391	12.679	75.686	*Hopea ponga*	Dipterocarpaceae	Uppangala forest	Pascal and Pelissier 1996	EN	E/SI	
392	12.808	75.719	*Hopea ponga*	Dipterocarpaceae	Gundia Basin	Gururaj et al 2007	EN	E/SI	Common
393	12.680	75.759	*Hopea ponga*	Dipterocarpaceae	Netravathi River	Ramachandra et al 2007	EN	E/SI	
394	13.104	75.388	*Hopea wightiana*	Dipterocarpaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	EN		
395	12.773	75.531	*Hugonia mystax*	Linaceae	Netravathi River	Ramachandra et al 2007	NE		
396	13.121	75.436	*Humboldtia brunonis*	Fabaceae	Madugundi	Ramesh et al 1997	NE	E/SWG	
397	13.111	75.451	*Humboldtia brunonis*	Fabaceae	Madugundi	Ramesh et al 1997	NE	E/SWG	
398	12.636	75.524	*Humboldtia brunonis*	Fabaceae	Guthigaru	Ramesh et al 1997	NE	E/SWG	
399	12.947	75.592	*Humboldtia brunonis*	Fabaceae	Byrapura Estate	Ramesh et al 1997	NE	E/SWG	
400	12.950	75.592	*Humboldtia brunonis*	Fabaceae	Byrapura Estate	Ramesh et al 1997	NE	E/SWG	
401	12.636	75.651	*Humboldtia brunonis*	Fabaceae	Guthigaru	Ramesh et al 1997	NE	E/SWG	
402	12.848	75.651	*Humboldtia brunonis*	Fabaceae	Heggade	Ramesh et al 1997	NE	E/SWG	
403	12.687	75.683	*Humboldtia brunonis*	Fabaceae	Kumaralli	Ramesh et al 1997	NE	E/SWG	
404	12.737	75.687	*Humboldtia brunonis*	Fabaceae	Mankanahalli	Ramesh et al 1997	NE	E/SWG	

405	12.678	75.703	*Humboldtia brunonis*	Fabaceae	Kumaralli	Ramesh et al 1997	NE	E/SWG	
406	12.735	75.718	*Humboldtia brunonis*	Fabaceae	Mankanah alli	Ramesh et al 1997	NE	E/SWG	
407	12.848	75.751	*Humboldtia brunonis*	Fabaceae	Heggadde	Ramesh et al 1997	NE	E/SWG	
408	12.679	75.686	*Hydnocarpus alpina*	Achariaceae	Uppangala forest	Pascal and Pelissier 1996	NE		
409	12.830	75.754	*Hydnocarpus laurifolia*	Flacourtiaceae	Gundia Basin	Gururaj et al 2007	NE	E/SI	Rare
410	12.913	75.643	*Hydnocarpus pentandra*	Flacourtiaceae	Kumaradhara River	Ramachandra et al 2013	NE	E/WG	
411	12.939	75.653	*Hydnocarpus pentandra*	Flacourtiaceae	Kumaradhara River	Ramachandra et al 2013	NE	E/WG	
412	12.679	75.686	*Hydnocarpus pentandra*	Achariaceae	Uppangala forest	Pascal and Pelissier 1996	NE	E/WG	
413	12.826	75.101	*Hyptis suaveolens*	Lamiaceae	Netravathi River	Ramachandra et al 2007	NE		
414	12.963	75.292	*Ichnocarpus frutescens*	Apocynaceae	Netravathi River	Ramachandra et al 2007	NE		
415	12.900	75.563	*Impatiens kleini*	Balsaminaceae	Kumaradhara River	Ramachandra et al 2013	NE		
416	12.876	75.636	*Impatiens kleini*	Balsaminaceae	Kumaradhara River	Ramachandra et al 2013	NE		
417	13.071	75.494	*Ipomoea pentaphylla*	Convolvulaceae	Netravathi River	Ramachandra et al 2007	NE		
418	13.088	75.420	*Ipomoea prescapre*	Convolvulaceae	Netravathi River	Ramachandra et al 2007	NE		
419	13.102	75.489	Ipomoea sp	Convolvulaceae	Netravathi River	Ramachandra et al 2007	NE		
420	13.133	75.209	Isachne sp	Poaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE		
421	13.110	75.446	*Ischaemum indicum*	Poaceae	Netravathi River	Ramachandra et al 2007	NE		
422	12.679	75.686	*Isonandra lanceolata*	Sapotaceae	Uppangala forest	Pascal and Pelissier 1996	NE		
423	12.848	75.730	*Ixora arborea*	Rubiaceae	Gundia Basin	Gururaj et al 2007	NE	E/SI	Rare
424	12.955	75.550	*Ixora brachiata*	Rubiaceae	Netravathi River	Ramachandra et al 2007	NE		
425	12.572	75.635	*Ixora brachiata*	Rubiaceae	Kumaradhara River	Ramachandra et al 2013	NE		
426	12.881	75.694	*Ixora brachiata*	Rubiaceae	Kumaradhara River	Ramachandra et al	NE		

						2013			
427	12.886	75.669	*Ixora coccinea*	Rubiaceae	Netravathi River	Ramachandra et al 2007	NE		
428	12.754	75.533	*Ixora polyantha*	Rubiaceae	Kumaradhara River	Ramachandra et al 2013	NE	E/WG	
429	12.912	75.564	*Ixora polyantha*	Rubiaceae	Kumaradhara River	Ramachandra et al 2013	NE	E/WG	
430	12.651	75.635	*Ixora polyantha*	Rubiaceae	Kumaradhara River	Ramachandra et al 2013	NE	E/WG	
431	12.897	75.657	*Ixora polyantha*	Rubiaceae	Kumaradhara River	Ramachandra et al 2013	NE	E/WG	
432	12.756	75.722	*Ixora polyantha*	Rubiaceae	Athihalli	Ramesh et al 1997	NE	E/WG	
433	12.756	75.722	*Ixora polyantha*	Rubiaceae	Athihalli	Ramesh et al 1997	NE	E/WG	
434	12.921	75.542	*Justicia simplex*	Acanthaceae	Netravathi River	Ramachandra et al 2007	NE		
435	12.836	74.868	*Kandelia candel*	Rhizophoraceae	Netravathi Esturay	Suma et al 2013	LC		
436	13.088	75.416	*Kingiodendron pinnatum*	Fabaceae	Charmadi	Ramesh et al 1997	CR	E/WG	
437	12.892	75.617	*Kingiodendron pinnatum*	Fabaceae	Kumaradhara River	Ramachandra et al 2013	CR	E/WG	
438	12.947	75.623	*Kingiodendron pinnatum*	Fabaceae	Kumaradhara River	Ramachandra et al 2013	CR	E/WG	
439	13.151	75.329	*Knema attenuata*	Myristicaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NT	E/WG	
440	12.636	75.472	*Knema attenuata*	Myristicaceae	Kumaradhara River	Ramachandra et al 2013	NT	E/WG	
441	12.757	75.519	*Knema attenuata*	Myristicaceae	Kumaradhara River	Ramachandra et al 2013	NT	E/WG	
442	12.679	75.686	*Knema attenuata*	Myristicaceae	Uppangala forest	Pascal and Pelissier 1996	NT	E/WG	
443	12.831	75.725	*Knema attenuata*	Myristicaceae	Gundia Basin	Gururaj et al 2007	NT	E/WG	Common
444	12.877	75.540	*Lagenandra ovata*	Araceae	Kumaradhara River	Ramachandra et al 2013	NE		
445	12.857	75.568	*Lagenandra ovata*	Araceae	Kumaradhara River	Ramachandra et al 2013	NE		
446	13.089	75.281	*Lagerstroemia lanceolata*	Lythraceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE		
447	13.090	75.295	*Lagerstroemia lanceolata*	Lythraceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE	E/SI	

448	12.778	75.444	*Lagerstroemia microcarpa*	Lythraceae	Kumaradhara River	Ramachandra et al 2013	NE	E/SI	
449	12.870	75.570	*Lagerstroemia microcarpa*	Lythraceae	Addahole	Anandhi et al 2013	NE	E/SI	Common
450	12.528	75.681	*Lagerstroemia microcarpa*	Lythraceae	Kumaradhara River	Ramachandra et al 2013	NE	E/SI	
451	12.771	75.760	*Lagerstroemia microcarpa*	Lythraceae	Gundia Basin	Gururaj et al 2007	NE	E/SI	Common
452	12.679	75.686	*Laportea crenulata*	Urticaceae	Uppangala forest	Pascal and Pelissier 1996	NE		
453	13.053	75.271	*Leea asiatica*	Vitaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE		
454	13.055	75.257	*Leea indica*	Vitaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE		
455	12.680	75.759	*Leea indica*	Vitaceae	Netravathi River	Ramachandra et al 2007	NE		
456	12.679	75.686	*Leptonychia moacurroides*	Stericulaceae	Uppangala forest	Pascal and Pelissier 1996	NE	E/WG	
457	12.709	75.620	*Leucas linifolia*	Lamiaceae	Netravathi River	Ramachandra et al 2007	NE		
458	12.785	75.745	*Ligustrum gamblei*	Oleaceae	Gundia Basin	Gururaj et al 2007	NE	E/SI	Rare
459	12.739	75.746	*Linociera malabarica*	Oleaceae	Gundia Basin	Gururaj et al 2007	NE	E/SI	Rare
460	12.695	75.760	*Litosanthes capitulatus*	Rubiaceae	Thambalagere	Ramesh et al 1997	VU	E/SWG	
461	12.695	75.760	*Litosanthes capitulatus*	Rubiaceae	Thambalagere	Ramesh et al 1997	VU	E/SWG	
462	13.062	75.474	*Litsea coriacea*	Lauraceae	Neriya	Ramesh et al 1997	NE	E/WG	
463	13.062	75.474	*Litsea coriacea*	Lauraceae	Neriya	Ramesh et al 1997	NE	E/WG	
464	12.679	75.686	*Litsea floribunda*	Lauraceae	Uppangala forest	Pascal and Pelissier 1996	NE	E/WG	
465	13.137	75.360	*Lophopetalum wightianum*	Celastraceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NT		
466	12.679	75.686	*Lophopetalum wightianum*	Celastraceae	Uppangala forest	Pascal and Pelissier 1996	NT		
467	12.721	75.609	*Ludwigia perennis*	Onagraceae	Netravathi River	Ramachandra et al 2007	LC		
468	12.840	75.398	*Macaranga indica*	Euphorbiaceae	Uppinangadi	EMP 2011	NE		
469	13.029	75.293	*Macaranga peltata*	Euphorbiaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE	E/SI	
470	12.922	75.477	*Macaranga peltata*	Euphorbiaceae	Netravathi River	Ramachandra et al	NE	E/SI	

						2007			
471	12.880	75.570	*Macaranga peltata*	Euphorbiaceae	Addahole	Anandhi et al 2013	NE	E/SI	Common
472	12.679	75.686	*Macaranga peltata*	Euphorbiaceae	Uppangala forest	Pascal and Pelissier 1996	NE	E/SI	
473	12.768	75.690	*Macaranga peltata*	Euphorbiaceae	Gundia Basin	Gururaj et al 2007	NE	E/SI	Common
474	12.848	75.256	*Madhuca insignis*	Sapotaceae	Dakshin kannada	Souravi et al 2015	CR	E/SWG	
475	12.924	75.587	*Madhuca insignis*	Sapotaceae	Kumaradhara River	Ramachandra et al 2013	CR	E/SWG	
476	12.694	75.624	*Madhuca insignis*	Sapotaceae	Kumaradhara River	Ramachandra et al 2013	CR	E/SWG	
477	12.760	75.610	*Madhuca latifolia*	Sapotaceae	Netravathi River	Ramachandra et al 2007	NE	E/WG	
478	12.727	75.726	*Madhuca nerifolia*	Sapotaceae	Gundia Basin	Gururaj et al 2007	NE	E/SI	Rare
479	12.679	75.686	*Mallotus philippensis*	Euphorbiaceae	Uppangala forest	Pascal and Pelissier 1996	NE		
480	13.107	75.227	*Mallotus philippinensis*	Euphorbiaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE		
481	12.679	75.686	*Mallotus stenanthus*	Euphorbiaceae	Uppangala forest	Pascal and Pelissier 1996	NE	E/WG	
482	12.679	75.686	*Mallotus tetracoccus*	Euphorbiaceae	Uppangala forest	Pascal and Pelissier 1996	NE		
483	12.886	75.497	*Mammea suriga*	Calophyllaceae	Netravathi River	Ramachandra et al 2007	NE		
484	12.913	74.858	*Mangifera indica*	Anacardiaceae	Kuloor	Kumar 2015	DD	E	
485	12.913	74.858	*Mangifera indica*	Anacardiaceae	Mulki	Kumar 2015	DD	E	
486	13.164	75.192	*Mangifera indica*	Anacardiaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	DD	E	
487	13.053	75.389	*Mangifera indica*	Anacardiaceae	Netravathi River	Ramachandra et al 2007	DD	E	
488	12.880	75.570	*Mangifera indica*	Anacardiaceae	Kabbinale	Anandhi et al 2013	DD	E	Common
489	12.679	75.686	*Mangifera indica*	Anacardiaceae	Uppangala forest	Pascal and Pelissier 1996	DD	E	
490	12.868	75.740	*Mangifera indica*	Anacardiaceae	Gundia Basin	Gururaj et al 2007	DD	E	Common
491	12.679	75.686	*Margaritaria indica*	Euphorbiaceae	Uppangala forest	Pascal and Pelissier 1996	NE		
492	12.679	75.686	*Mastixia arborea*	Cornaceae	Uppangala forest	Pascal and Pelissier 1996	NT	E/WG	

493	13.042	75.490	*Maytenus rothiana*	Celastraceae	Neriya	Ramesh et al 1997	NE	E/WG	
494	13.042	75.490	*Maytenus rothiana*	Celastraceae	Neriya	Ramesh et al 1997	NE	E/WG	
495	12.841	75.679	*Maytenus rothiana*	Celastraceae	Heggade	Ramesh et al 1997	NE	E/WG	
496	12.841	75.679	*Maytenus rothiana*	Celastraceae	Heggade	Ramesh et al 1997	NE	E/WG	
497	12.717	75.732	*Meiogyne ramarowii*	Annonaceae	Vanagoor	Ramesh et al 1997	NE	E/WG	
498	12.717	75.732	*Meiogyne ramarowii*	Annonaceae	Vanagoor	Ramesh et al 1997	NE	E/WG	
499	12.921	75.542	*Melastoma malabathricum*	Melastomaceae	Netravathi River	Ramachandra et al 2007	NE		
500	12.809	75.372	*Memecylon angustiolium*	Melastomaceae	Kumaradhara River	Ramachandra et al 2013	NE		
501	12.518	75.613	*Memecylon angustiolium*	Melastomaceae	Kumaradhara River	Ramachandra et al 2013	NE		
502	13.024	75.278	*Memecylon edule*	Melastomaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE		
503	12.837	75.438	*Memecylon malabaricum*	Melastomaceae	Netravathi River	Ramachandra et al 2007	NE	E/SI	
504	12.880	75.570	*Memecylon malabaricum*	Melastomataceae	Kabbinale	Anandhi et al 2013	NE	E/SI	Common
505	12.870	75.755	*Memecylon malabaricum*	Melastomataceae	Gundia Basin	Gururaj et al 2007	NE	E/SI	Common
506	13.111	75.508	*Memecylon sisparense*	Melastomataceae	Attigere	Ramesh et al 1997	CR	E/WG	
507	13.111	75.508	*Memecylon sisparense*	Melastomataceae	Attigere	Ramesh et al 1997	CR	E/WG	
508	12.788	75.438	*Memecylon talbotianum*	Melastomaceae	Kumaradhara River	Ramachandra et al 2013	NE	E/WG	
509	13.118	75.515	*Memecylon talbotianum*	Melastomataceae	Attigere	Ramesh et al 1997	NE	E/WG	
510	13.118	75.515	*Memecylon talbotianum*	Melastomataceae	Attigere	Ramesh et al 1997	NE	E/WG	
511	12.754	75.628	*Memecylon talbotianum*	Melastomaceae	Kumaradhara River	Ramachandra et al 2013	NE	E/WG	
512	12.680	75.759	*Memecylon talbotii*	Melastomataceae	Netravathi River	Ramachandra et al 2007	NE		
513	12.864	75.714	*Memecylon terminale*	Melastomataceae	Gundia Basin	Gururaj et al 2007	NE	E/SI	Rare
514	12.709	75.620	*Memecylon umbellatum*	Melastomataceae	Netravathi River	Ramachandra et al 2007	NE		
515	12.679	75.686	*Memecylon wightii*	Melastomataceae	Uppangala forest	Pascal and Pelissier 1996	NE		
516	13.051	75.337	*Merremia hastata*	Convolvulaceae	Netravathi River	Ramachandra et al 2007	NE		

517	13.109	75.293	*Mesua ferrea*	Clusiaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE		
518	13.168	75.341	*Mesua ferrea*	Calophyllaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE		
519	12.679	75.686	*Mesua ferrea*	Clusiaceae	Uppangala forest	Pascal and Pelissier 1996	NE		
520	12.843	75.249	*Michelia champaca*	Magnoliaceae	Kuloor	Kumar 2015	LC		
521	12.843	75.249	*Michelia champaca*	Magnoliaceae	Mulki	Kumar 2015	LC		
522	12.721	75.609	*Michelia champaca*	Magnoliaceae	Netravathi River	Ramachandra et al 2007	LC		
523	13.131	75.510	*Microtropis stocksii*	Celastraceae	Balur	Ramesh et al 1997	NE	E/WG	
524	13.131	75.510	*Microtropis stocksii*	Celastraceae	Belur	Ramesh et al 1997	NE	E/WG	
525	12.679	75.686	*Microtropis wallichiana*	Celastraceae	Uppangala forest	Pascal and Pelissier 1996	NE		
526	12.855	75.681	*Miliusa wightiana*	Annonaceae	Sakaleshpur	Ramesh et al 1997	NE	E/WG	
527	12.855	75.681	*Miliusa wightiana*	Annonaceae	Sakaleshpur	Ramesh et al 1997	NE	E/WG	
528	12.855	75.681	*Miliusa wightiana*	Annonaceae	Sakaleshpur	Ramesh et al 1997	NE	E/WG	
529	12.639	75.472	*Mimosa pudica*	Fabaceae	Netravathi River	Ramachandra et al 2007	NE		
530	12.649	75.446	*Mimusops elengi*	Sapotaceae	Netravathi River	Ramachandra et al 2007	NE		
531	12.679	75.686	*Mimusops elengi*	Sapotaceae	Uppangala forest	Pascal and Pelissier 1996	NE		
532	12.920	74.825	*Morinda citrifolia*	Morinda citrifolia	Netravathi Esturay	Suma et al 2013	NE		
533	12.950	75.639	*Moullava spicata*	Fabaceae	Kumaradhara River	Ramachandra et al 2013	NE		
534	12.854	75.661	*Moullava spicata*	Fabaceae	Kumaradhara River	Ramachandra et al 2013	NE		
535	12.935	75.555	*Mussaenda laxa*	Rubiaceae	Kumaradhara River	Ramachandra et al 2013	NE		
536	12.930	75.564	*Mussaenda laxa*	Rubiaceae	Kumaradhara River	Ramachandra et al 2013	NE		
537	12.546	75.662	*Mussaenda laxa*	Rubiaceae	Kumaradhara River	Ramachandra et al 2013	NE		
538	12.886	75.679	*Mussaenda laxa*	Rubiaceae	Kumaradhara River	Ramachandra et al 2013	NE		
539	12.679	75.686	*Myristica*	Myristicaceae	Uppangala	Pascal and	VU	E/WG	

			dactyloides		forest	Pelissier 1996			
540	12.852	75.717	*Myristica dactyloides*	Myristicaceae	Gundia Basin	Gururaj et al 2007	VU	E/SI	Common
541	13.130	75.197	*Myristica malabarica*	Myristicaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	VU	E	
542	13.086	75.247	*Myristica malabarica*	Myristicaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	VU	E	
543	12.623	75.496	*Myristica malabarica*	Myristicaceae	Kumaradhara River	Ramachandra et al 2013	VU	E	
544	12.826	75.639	*Myristica malabarica*	Myristicaceae	Kumaradhara River	Ramachandra et al 2013	VU	E	
545	12.703	75.444	*Naregamia alata*	Meliaceae	Netravathi River	Ramachandra et al 2007	NE		
546	12.679	75.686	*Neonauclea purpurea*	Rubiaceae	Uppangala forest	Pascal and Pelissier 1996	NE		
547	12.905	75.748	*Neonauclea purpurea*	Rubiaceae	Gundia Basin	Gururaj et al 2007	NE	E/SI	Rare
548	12.679	75.686	*Nothopegia beddomei*	Anacardiaceae	Uppangala forest	Pascal and Pelissier 1996	NE	E/WG	
549	12.899	75.699	*Nothopegia colebrookeana*	Anacardiaceae	Gundia Basin	Gururaj et al 2007	NE	E/SI	Rare
550	12.865	75.531	*Nothopegia racemosa*	Anacardiaceae	Kumaradhara River	Ramachandra et al 2013	NE		
551	12.835	75.589	*Nothopegia racemosa*	Anacardiaceae	Kumaradhara River	Ramachandra et al 2013	NE		
552	12.841	75.735	*Ochlandra scriptoria*	Poaceae	Gundia Basin	Gururaj et al 2007	NE	E/SI	Common
553	12.793	75.534	*Ochreinauclea missionis*	Rubiaceae	Kumaradhara River	Ramachandra et al 2013	NE		
554	12.911	75.557	*Ochreinauclea missionis*	Rubiaceae	Kumaradhara River	Ramachandra et al 2013	NE		
555	12.910	75.628	*Ochreinauclea missionis*	Rubiaceae	Kumaradhara River	Ramachandra et al 2013	NE		
556	12.673	75.661	*Ochreinauclea missionis*	Rubiaceae	Kumaradhara River	Ramachandra et al 2013	NE		
557	12.699	75.363	*Ocimum canum*	Lamiaceae	Netravathi River	Ramachandra et al 2007	NE		
558	12.718	75.384	*Odina wodier*	Anacardiaceae	Netravathi River	Ramachandra et al 2007	NE		
559	12.890	75.570	*Olea dioca*	Oleaceae	Kabbinale	Anandhi et al 2013	NE	E/SI	Common
560	12.939	75.663	*Olea dioca*	Oleaceae	Gundia Basin	Ramachandra et al 2010	NE	E/SI	Common

561	12.773	75.531	*Olea dioica*	Oleaceae	Netravathi River	Ramachandra et al 2007	NE	E/SI	
562	12.679	75.686	*Olea dioica*	Oleaceae	Uppangala forest	Pascal and Pelissier 1996	NE	E/SI	
563	12.826	75.101	*Ophiorrhiza harrisiana*	Rubiaceae	Netravathi River	Ramachandra et al 2007	NE		
564	12.963	75.292	*Oplismenus compositus*	Poaceae	Netravathi River	Ramachandra et al 2007	NE		
565	13.070	75.264	*Oroxylum indicum*	Bignoniaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE		
566	12.679	75.686	*Otonephelium stipulaceum*	Sapindaceae	Uppangala forest	Pascal and Pelissier 1996	NE	E/WG	
567	13.098	75.328	*Palaquium ellipticum*	Sapotaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE	E/WG	
568	12.831	75.606	*Palaquium ellipticum*	Sapotaceae	Shirady	Ramesh et al 1997	NE	E/WG	
569	12.831	75.606	*Palaquium ellipticum*	Sapotaceae	Shirady	Ramesh et al 1997	NE	E/WG	
570	12.847	75.675	*Palaquium ellipticum*	Sapotaceae	Sakaleshpur	Ramesh et al 1997	NE	E/WG	
571	12.847	75.675	*Palaquium ellipticum*	Sapotaceae	Sakaleshpur	Ramesh et al 1997	NE	E/WG	
572	12.679	75.686	*Palaquium ellipticum*	Sapotaceae	Uppangala forest	Pascal and Pelissier 1996	NE	E/WG	
573	12.559	75.700	*Palaquium ellipticum*	Sapotaceae	Hammiyala	Ramesh et al 1997	NE	E/WG	
574	12.559	75.700	*Palaquium ellipticum*	Sapotaceae	Hammiyala	Ramesh et al 1997	NE	E/WG	
575	12.699	75.741	*Palaquium ellipticum*	Sapotaceae	Banagere	Ramesh et al 1997	NE	E/WG	
576	12.699	75.741	*Palaquium ellipticum*	Sapotaceae	Banagere	Ramesh et al 1997	NE	E/WG	
577	13.052	75.283	*Palaquium ellipticum*	Sapotaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE	E/WG	
578	12.885	74.840	*Pandanus canaranus*	Pandanaceae	Canara	John 1972	NE		
579	12.680	75.759	*Pandanus furcatus*	Pandanaceae	Netravathi River	Ramachandra et al 2007	NE		
580	12.869	74.884	*Pandanus mangalorensis*	Pandanaceae	Padil	Zanan and Nadaf 2012	CR	E	
581	12.709	75.620	*Passiflora foetida*	Passifloraceae	Netravathi River	Ramachandra et al 2007	NE		
582	12.721	75.609	*Pennisetum polystachyon*	Poaceae	Netravathi River	Ramachandra et al 2007	NE		
583	13.080	75.209	*Persea macrantha*	Lauraceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE	E/SI	

584	13.153	75.385	*Persea macrantha*	Lauraceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE	E/SI	
585	12.679	75.686	*Persea macrantha*	Lauraceae	Uppangala forest	Pascal and Pelissier 1996	NE	E/SI	
586	12.953	75.708	*Persea macrantha*	Lauraceae	Gundia Basin	Ramachandra et al 2010	NE	E/SI	Rare
587	13.081	75.254	*Phoenix humilis*	Arecaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE	E/SI	
588	12.952	75.685	*Phoenix humilis*	Arecaceae	Gundia Basin	Ramachandra et al 2010	NE	E/SI	Common
589	12.639	75.472	*Phoenix sylvestre*	Arecaceae	Netravathi River	Ramachandra et al 2007	NE		
590	12.649	75.446	*Phyllanthus amarus*	Euphorbiaceae	Netravathi River	Ramachandra et al 2007	NE		
591	12.703	75.444	*Phyllanthus urinaria*	Euphorbiaceae	Netravathi River	Ramachandra et al 2007	NE		
592	13.114	75.210	*Pinanaga dicksonii*	Arecaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE	E/WG	
593	13.107	75.449	*Pinanga dicksonii*	Arecaceae	Madugundi	Ramesh et al 1997	NE	E/WG	
594	13.107	75.449	*Pinanga dicksonii*	Arecaceae	Madugundi	Ramesh et al 1997	NE	E/WG	
595	12.624	75.512	*Pinanga dicksonii*	Arecaceae	Guthigaru	Ramesh et al 1997	NE	E/WG	
596	12.624	75.512	*Pinanga dicksonii*	Arecaceae	Guthigaru	Ramesh et al 1997	NE	E/WG	
597	12.599	75.721	*Pinanga dicksonii*	Arecaceae	Surlabi	Ramesh et al 1997	NE	E/WG	
598	12.599	75.721	*Pinanga dicksonii*	Arecaceae	Surlabi	Ramesh et al 1997	NE	E/WG	
599	12.719	75.731	*Pinanga dicksonii*	Arecaceae	Vanagoor	Ramesh et al 1997	NE	E/WG	
600	12.719	75.731	*Pinanga dicksonii*	Arecaceae	Vanagoor	Ramesh et al 1997	NE	E/WG	
601	12.950	75.754	*Piper nigrum*	Piperaceae	Gundia Basin	Ramachandra et al 2010	NE	E/SI	Common
602	12.864	75.745	*Pithecolobium monadelphum*	Fabaceae	Gundia Basin	Gururaj et al 2007	NE	E	Common
603	13.050	75.468	*Pittosporum dasycaulon*	Pittosporaceae	Neriya	Ramesh et al 1997	NE	E/WG	
604	13.050	75.468	*Pittosporum dasycaulon*	Pittosporaceae	Neriya	Ramesh et al 1997	NT	E/WG	
605	12.682	75.722	*Pittosporum dasycaulon*	Pittosporaceae	Kumaralli	Ramesh et al 1997	NE	E/WG	
606	12.682	75.722	*Pittosporum dasycaulon*	Pittosporaceae	Kumaralli	Ramesh et al 1997	NT	E/WG	
607	13.133	75.509	*Pittosporum neelgherrense*	Pittosporaceae	Balur	Ramesh et al 1997	NE	E/WG	
608	13.133	75.509	*Pittosporum*	Pittosporacea	Balur	Ramesh et	NE	E/WG	

			neelgherrense	e		al 1997			
609	13.104	75.192	*Plectronia didyma*	Rubiaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE		
610	12.699	75.363	*Plumeria alba*	Apocynaceae	Netravathi River	Ramachandra et al 2007	NE		
611	13.070	75.281	*Poeciloneuron indicum*	Clusiaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE		
612	13.075	75.292	*Poeciloneuron indicum*	Clusiaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE		
613	12.679	75.686	*Polyalthia coffeoides*	Annonaceae	Uppangala forest	Pascal and Pelissier 1996	NE		
614	12.679	75.686	*Polyalthia fragrans*	Annonaceae	Uppangala forest	Pascal and Pelissier 1996	NE	E/SWG	
615	12.843	75.713	*Polyalthia fragrans*	Annonaceae	Gundia Basin	Ramachandra et al 2017	NE	E/SI	Rare
616	12.718	75.384	*Pothos scandens*	Araceae	Netravathi River	Ramachandra et al 2007	NE		
617	13.039	75.291	*Psychotria dalzelli*	Rubiaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE	E/WG	
618	12.757	75.519	*Psychotria dalzelli*	Rubiaceae	Kumaradhara River	Ramachandra et al 2013	NE	E/WG	
619	12.919	75.557	*Psychotria dalzelli*	Rubiaceae	Kumaradhara River	Ramachandra et al 2013	NE	E/WG	
620	12.916	75.618	*Psychotria dalzelli*	Rubiaceae	Kumaradhara River	Ramachandra et al 2013	NE	E/WG	
621	12.699	75.675	*Psychotria dalzelli*	Rubiaceae	Kumaradhara River	Ramachandra et al 2013	NE	E/WG	
622	13.055	75.475	*Psychotria dalzellii*	Rubiaceae	Neriya	Ramesh et al 1997	NE	E/WG	
623	13.055	75.475	*Psychotria dalzellii*	Rubiaceae	Neriya	Ramesh et al 1997	NE	E/WG	
624	12.773	75.531	*Psychotria flavida*	Rubiaceae	Netravathi River	Ramachandra et al 2007	NE	E/WG	
625	12.928	75.623	*Psychotria flavida*	Rubiaceae	Kumaradhara River	Ramachandra et al 2013	NE	E/WG	
626	12.701	75.692	*Psychotria flavida*	Rubiaceae	Kumaradhara River	Ramachandra et al 2013	NE	E/WG	
627	12.704	75.750	*Psychotria truncata*	Rubiaceae	Sakaleshpur	Ramesh et al 1997	NE	E/WG	
628	12.704	75.750	*Psychotria truncata*	Rubiaceae	Sakaleshpur	Ramesh et al 1997	NE	E/WG	
629	13.054	75.296	*Pterocarpus marsumpium*	Malvaceae	Kudremukh Tiger	Ramachandra et al	NE		

					Reserve	2017			
630	12.679	75.686	*Pterospermum diversifolium*	Malvaceae	Uppangala forest	Pascal and Pelissier 1996	NE		
631	12.923	75.570	*Pterospermum reticulatum*	Sterculiaceae	Kumaradhara River	Ramachandra et al 2013	NE		
632	12.729	75.651	*Pterospermum reticulatum*	Sterculiaceae	Kumaradhara River	Ramachandra et al 2013	NE		
633	12.826	75.101	*Randia dumetorum*	Rubiaceae	Netravathi River	Ramachandra et al 2007	NE		
634	13.128	75.238	*Randia dumetorum*	Rubiaceae	Kudremukh Tiger Reserve	Ramachandra et al 2007	NE		
635	12.963	75.292	*Rauwolfia serpentina*	Apocynaceae	Netravathi River	Ramachandra et al 2007	NE		
636	12.870	75.658	*Reinwardtiodendron anamallayan*	Meliaceae	Heggade	Ramesh et al 1997	NE	E/SWG	
637	12.679	75.686	*Reinwardtiodendron anamallayan*	Meliaceae	Uppangala forest	Pascal and Pelissier 1996	NE	E/SWG	
638	12.831	75.697	*Rhaphidophora laciniata*	Araceae	Gundia Basin	Ramachandra et al 2010	NE	E/SI	Common
639	12.764	74.865	*Rhizophora apiculata*	Rhizophoraceae	Netravathi Esturay	Reddy et al 2015	LC		
640	12.960	74.837	*Rhizophora mucronata*	Rhizophoraceae	Netravathi Esturay	Reddy et al 2015	LC		
641	12.853	75.332	*Ricinus communis*	Euphorbiacea e	Netravathi River	Ramachandra et al 2007	NE		
642	12.883	75.746	*Rubus fockei*	Rosaceae	Gundia Basin	Gururaj et al 2007	NE	E/SI	Common
643	12.789	75.267	*Saccharum spontaneum*	Poaceae	Netravathi River	Ramachandra et al 2007	NE		
644	12.816	75.239	*Santalum album*	Santalaceae	Netravathi River	Ramachandra et al 2007	VU		
645	13.050	75.120	*Sapium insigne*	Euphorbiacea e	Netravathi River	Ramachandra et al 2007	NE		
646	13.028	75.029	*Saraca asoka*	Fabaceae	Netravathi River	Ramachandra et al 2007	VU		
647	13.110	75.248	*Schleichera oleosa*	Sapindaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE		
648	13.120	75.403	*Schleichera oleosa*	Sapindaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE		
649	12.938	75.629	*Scleria lithosperma*	Linnaeus	Netravathi River	Ramachandra et al 2007	NE		

650	12.679	75.686	*Semecarpus auriculata*	Anacardiaceae	Uppangala forest	Pascal and Pelissier 1996	NT	E/SWG	
651	12.663	75.759	*Sida acuta*	Malvaceae	Netravathi River	Ramachandra et al 2007	NE		
652	12.680	75.759	*Sida rhombifolia*	Malvaceae	Netravathi River	Ramachandra et al 2007	NE		
653	12.709	75.620	*Smilax zeylanica*	Smilacaceae	Netravathi River	Ramachandra et al 2007	NE		
654	12.721	75.609	*Solanum torvum*	Solanaceae	Netravathi River	Ramachandra et al 2007	NE		
655	12.960	74.826	*Sonneratia alba*	Sonneratiaceae	Netravathi Esturay	Reddy et al 2015	LC		
656	12.761	74.859	*Sonneratia caseolaris*	Sonneratiaceae	Netravathi Esturay	Reddy et al 2015	LC		
657	12.639	75.472	*Sopubia delphinifolia*	Scrophulariaceae	Netravathi River	Ramachandra et al 2007	NE		
658	12.703	75.444	*Sphaeranthus americanus*	Asteraceae	Netravathi River	Ramachandra et al 2007	NE		
659	12.649	75.446	*Spilanthes acmella*	Asteraceae	Netravathi River	Ramachandra et al 2007	NE		
660	13.144	75.182	*Spondias mangifera*	Anacardiaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE		
661	12.699	75.363	*Spondias pinnata*	Anacardiaceae	Netravathi River	Ramachandra et al 2007	NE		
662	13.111	75.197	*Sterculia foetida*	Sterculiaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE		
663	12.762	75.698	*Sterculia guttata*	Sterculiaceae	Gundia Basin	Gururaj et al 2007	NE	E/SI	Common
664	12.718	75.384	*Streblus asper*	Moraceae	Netravathi River	Ramachandra et al 2007	NE		
665	12.679	75.686	*Strombosia zeylanica*	Strombosiaceae	Uppangala forest	Pascal and Pelissier 1996	NE		
666	12.773	75.531	*Strychnos nuxvomica*	Loganiaceae	Netravathi River	Ramachandra et al 2007	NE		
667	12.913	74.858	*Swietenia trilocularis*	Meliaceae	Kuloor	Kumar 2015	NE		
668	12.826	75.101	*Symplocos racemosa*	Symplocaceae	Netravathi River	Ramachandra et al 2007	NE	E/SI	
669	13.084	75.266	*Symplocos racemosa*	Symplocaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE	E/SI	
670	12.679	75.686	*Symplocos racemosa*	Symplocaceae	Uppangala forest	Pascal and Pelissier 1996	NE	E/SI	

671	12.841	75.735	*Symplocos racemosa*	Symplocaceae	Gundia Basin	Ramachandra et al 2010	NE	E/SI	Common
672	12.963	75.292	*Synedrella nodiflora*	Asteraceae	Netravathi River	Ramachandra et al 2007	NE		
673	13.071	75.494	*Syzygium caryophyllata*	Myrtaceae	Netravathi River	Ramachandra et al 2007	NE		
674	13.088	75.420	*Syzygium cumini*	Myrtaceae	Netravathi River	Ramachandra et al 2007	NE		
675	12.679	75.686	*Syzygium gardneri*	Myrtaceae	Uppangala forest	Pascal and Pelissier 1996	NE	E/SI	
676	12.864	75.745	*Syzygium gardneri*	Myrtaceae	Gundia Basin	Ramachandra et al 2010	NE	E/SI	Common
677	13.137	75.475	*Syzygium laetum*	Myrtaceae	Megur	Ramesh et al 1997	NE	E/WG	
678	12.679	75.686	*Syzygium laetum*	Myrtaceae	Uppangala forest	Pascal and Pelissier 1996	NE	E/WG	
679	12.941	75.735	*Syzygium laetum*	Myrtaceae	Gundia Basin	Gururaj et al 2007	NE	E/WG	Common
680	13.102	75.464	*Syzygium malaccense*	Myrtaceae	Megur	Kumar 2011	EN		
681	12.886	75.313	*Syzygium occidentale*	Myrtaceae	Bandaru	Ramesh et al 1997	EN	E/WG	
682	12.681	75.626	*Syzygium travancoricum*	Myrtaceae	Kumaradhara River	Ramachandra et al 2013	CR	E/WG	
683	12.835	75.657	*Syzygium travancoricum*	Myrtaceae	Kumaradhara River	Ramachandra et al 2013	CR	E/WG	
684	13.102	75.489	*Tacca pinnatifida*	Dioscoreaceae	Netravathi River	Ramachandra et al 2007	NE		
685	13.110	75.446	*Tamarindus indica*	Fabaceae	Netravathi River	Ramachandra et al 2007	NE		
686	12.886	75.337	*Tectona grandis*	Lamiaceae	Bandaru	EMP 2011	NE		
687	12.955	75.550	*Tectona grandis*	Lamiaceae	Netravathi River	Ramachandra et al 2007	NE		
688	12.839	75.399	*Terminalia Arjuna*	Combretaceae	Uppinangadi	EMP 2011	NE		
689	12.851	75.405	*Terminalia bellerica*	Combretaceae	Kokkada	EMP 2011	NE		
690	13.060	75.286	*Terminalia bellirica*	Combretaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE		
691	12.947	75.363	*Terminalia bellirica*	Combretaceae	Netravathi River	Ramachandra et al 2007	NE		
692	12.843	75.249	*Terminalia catappa*	Combretaceae	Mulki	Kumar 2015	NE		
693	12.853	75.332	*Terminalia*	Combretacea	Netravathi	Ramachand	NE		

			catappa	e	River	ra et al 2007			
694	13.081	75.243	*Terminalia paniculata*	Combretaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE	E	
695	12.789	75.267	*Terminalia paniculata*	Combretaceae	Netravathi River	Ramachandra et al 2007	NE	E	
696	12.883	75.746	*Terminalia paniculata*	Combretaceae	Gundia Basin	Ramachandra et al 2010	NE	E	Common
697	13.085	75.220	*Terminalia tomentosa*	Combretaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE		
698	13.100	75.207	Themeda sp	Poaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE		
699	12.816	75.239	*Themeda tremula*	Poaceae	Netravathi River	Ramachandra et al 2007	NE		
700	12.941	74.835	*Thespesia populnea*	Malvaceae	Netravathi Esturay	Reddy et al 2015	LC		
701	13.050	75.120	*Toddalia asiatica*	Rutaceae	Netravathi River	Ramachandra et al 2007	NE		
702	13.028	75.029	*Tragia involucrata*	Euphorbiaceae	Netravathi River	Ramachandra et al 2007	NE		
703	12.943	75.591	*Trewia polycarpa*	Euphorbiaceae	Kumaradhara River	Ramachandra et al 2013	NE		
704	12.913	75.601	*Trewia polycarpa*	Euphorbiaceae	Kumaradhara River	Ramachandra et al 2013	NE		
705	12.739	75.746	*Trias stocksii*	Orchidaceae	Gundia Basin	Ramachandra et al 2010	NE	E/SI	Rare
706	13.138	75.225	*Tripogon bromoides*	Poaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE		
707	12.938	75.629	*Triumfetta rhomboidea*	Malvaceae	Netravathi River	Ramachandra et al 2007	NE		
708	12.663	75.759	*Tylophora asthmatica*	Asclepiadaceae	Netravathi River	Ramachandra et al 2007	NE		
709	12.886	75.669	*Urena lobata*	Malvaceae	Netravathi River	Ramachandra et al 2007	NE		
710	12.680	75.759	*Urena sinuata*	Malvaceae	Netravathi River	Ramachandra et al 2007	NE		
711	12.773	75.531	*Uvaria narum*	Malvaceae	Netravathi River	Ramachandra et al 2007	NE		
712	12.826	75.101	*Vangueria spinosa*	Rubiaceae	Netravathi River	Ramachandra et al 2007	NE		
713	13.161	75.173	*Vateria indica*	Dipterocarpaceae	Karkal	Ramesh et al 1997	CR	E/WG	

714	13.161	75.173	*Vateria indica*	Dipterocarpaceae	Karkal	Ramesh et al 1997	CR	E/WG	
715	13.116	75.262	*Vateria indica*	Dipterocarpaceae	Kudremukh Tiger Reserve	Ramachandra et al 2007	CR	E/WG	
716	12.963	75.292	*Vateria indica*	Dipterocarpaceae	Netravathi River	Ramachandra et al 2007	CR	E/WG	
717	13.115	75.461	*Vateria indica*	Dipterocarpaceae	Madugundi	Ramesh et al 1997	CR	E/WG	
718	13.115	75.461	*Vateria indica*	Dipterocarpaceae	Madugundi	Ramesh et al 1997	CR	E/WG	
719	12.620	75.554	*Vateria indica*	Dipterocarpaceae	Nalkooru	Ramesh et al 1997	CR	E/WG	
720	12.620	75.554	*Vateria indica*	Dipterocarpaceae	Nalkooru	Ramesh et al 1997	CR	E/WG	
721	12.890	75.570	*Vateria indica*	Dipterocarpaceae	Kabbinale	Anandhi et al 2013	CR	E/WG	Common
722	12.934	75.578	*Vateria indica*	Dipterocarpaceae	Kumaradhara River	Ramachandra et al 2013	CR	E/WG	
723	12.904	75.587	*Vateria indica*	Dipterocarpaceae	Kumaradhara River	Ramachandra et al 2013	CR	E/WG	
724	12.928	75.615	*Vateria indica*	Dipterocarpaceae	Sakaleshpur	Ramesh et al 1997	CR	E/WG	
725	12.928	75.615	*Vateria indica*	Dipterocarpaceae	Sakaleshpur	Ramesh et al 1997	CR	E/WG	
726	12.509	75.628	*Vateria indica*	Dipterocarpaceae	Kalmakaru	Ramesh et al 1997	CR	E/WG	
727	12.509	75.628	*Vateria indica*	Dipterocarpaceae	Kalmakaru	Ramesh et al 1997	CR	E/WG	
728	12.821	75.629	*Vateria indica*	Dipterocarpaceae	Sakaleshpur	Ramesh et al 1997	CR	E/WG	
729	12.821	75.629	*Vateria indica*	Dipterocarpaceae	Sakaleshpur	Ramesh et al 1997	CR	E/WG	
730	12.573	75.676	*Vateria indica*	Dipterocarpaceae	Hammiyala	Ramesh et al 1997	CR	E/WG	
731	12.573	75.676	*Vateria indica*	Dipterocarpaceae	Hammiyala	Ramesh et al 1997	CR	E/WG	
732	12.679	75.686	*Vateria indica*	Dipterocarpaceae	Uppangala forest	Pascal and Pelissier 1996	CR	E/WG	
733	12.904	75.694	*Vateria indica*	Dipterocarpaceae	Sakaleshpur	Ramesh et al 1997	CR	E/WG	
734	12.904	75.694	*Vateria indica*	Dipterocarpaceae	Sakaleshpur	Ramesh et al 1997	CR	E/WG	
735	12.854	75.698	*Vateria indica*	Dipterocarpaceae	Heggade	Ramesh et al 1997	CR	E/WG	
736	12.854	75.698	*Vateria indica*	Dipterocarpaceae	Heggade	Ramesh et al 1997	CR	E/WG	
737	12.683	75.710	*Vateria indica*	Dipterocarpaceae	Kumaralli	Ramesh et al 1997	CR	E/WG	
738	12.683	75.710	*Vateria indica*	Dipterocarpaceae	Kumaralli	Ramesh et al 1997	CR	E/WG	
739	12.905	75.720	*Vateria indica*	Dipterocarpaceae	Gundia Basin	Gururaj et al 2007	CR	E/SI	Common
740	12.679	75.686	*Vepris bilocularis*	Rutaceae	Uppangala forest	Pascal and Pelissier	NE	E/SWG	

						1996			
741	12.768	75.690	*Vepris bilocularis*	Rutaceae	Gundia Basin	Ramachandra et al 2010	NE	E/SWG	Rare
742	13.071	75.494	*Vernonia cinerea*	Compositae	Netravathi River	Ramachandra et al 2007	NE		
743	13.088	75.420	*Vitex altissima*	Verbenaceae	Netravathi River	Ramachandra et al 2007	NE	E/SI	
744	12.840	75.560	*Vitex altissima*	Verbenaceae	Kabbinale	Anandhi et al 2013	NE	E/SI	Common
745	12.864	75.745	*Vitex altissima*	Verbenaceae	Gundia Basin	Ramachandra et al 2010	NE	E/SI	Common
746	13.102	75.489	*Vitex negundo*	Verbenaceae	Netravathi River	Ramachandra et al 2007	NE		
747	13.110	75.446	*Wagatea spicata*	Caesalpiniaceae	Netravathi River	Ramachandra et al 2007	NE		
748	12.679	75.686	*Walsura trifoliata*	Meliaceae	Uppangala forest	Pascal and Pelissier 1996	NE		
749	12.955	75.550	*Wattakaka volubilis*	Apocynaceae	Netravathi River	Ramachandra et al 2007	NE		
750	12.886	75.669	*Wrightia tinctoria*	Apocynaceae	Netravathi River	Ramachandra et al 2007	NE		
751	13.118	75.185	*Xylia xylocarpa*	Fabaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE		
752	12.921	75.542	*Zanthoxylum ovalifolium*	Rutaceae	Netravathi River	Ramachandra et al 2007	NE		
753	13.123	75.207	*Zenkeria elegans*	Poaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE		
754	12.939	75.722	*Zeuxine longilabris*	Orchidaceae	Gundia Basin	Gururaj et al 2007	NE	E/SI	Rare
755	12.922	75.477	*Zingiber zerumbett*	Zingiberaceae	Netravathi River	Ramachandra et al 2007	NE		
756	12.709	75.620	*Ziziphus jujuba*	Rhamnaceae	Netravathi River	Ramachandra et al 2007	NE		
757	12.837	75.438	*Ziziphus oenoplia*	Rhamnaceae	Netravathi River	Ramachandra et al 2007	NE		
758	13.074	75.245	*Ziziphus rugosa*	Rhamnaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE		
759	12.680	75.759	*Ziziphus rugosa*	Rhamnaceae	Netravathi River	Ramachandra et al 2007	NE		
760	13.094	75.269	*Ziziphus xylopyrus*	Rhamnaceae	Kudremukh Tiger Reserve	Ramachandra et al 2017	NE		

761	12.721	75.609	*Zornia diphylla*	Leguminosae	Netravathi River	Ramachandra et al 2007	NE		

*Endemism: E-Endemic; E/SWG: Endemic to Southern Western Ghats; E/WG: Endemic to Western Ghats; E/SI: Endemic to Southern India.

*IUCN Status: EN-Endangered; NE-Not Evaluated; LC-Least Concern; VU-Vulnerable; NT-Near Threatened; T- Threatened.

Annexure B

Annexure B: List of Fauna species in Netravathi River Basin.

Sno	Latitude	Longitude	Species Name	Family Name	Location	Source	Type	IUCN status
1	12.872	75.211	*Euphlyctis cyanophlyctis*	Dicroglossidae	Padil	Alam et al 2008	AMPHIBIAN	LC
2	12.963	75.292	*Euphlyctis cyanophlyctis*	Dicroglossidae	Netravathi River	Ramachandra et al 2007	AMPHIBIAN	LC
3	12.994	74.983	*Euphlyctis cyanophlyctis*	Dicroglossidae	Bajipe	Alam et al 2008	AMPHIBIAN	LC
4	12.928	75.162	*Euphlyctis hexadactylus*	Dicroglossidae	Adyar	Alam et al 2008	AMPHIBIAN	LC
5	12.994	74.983	*Euphlyctis hexadactylus*	Dicroglossidae	Bajipe	Alam et al 2008	AMPHIBIAN	LC
6	13.102	75.489	*Hoplobatrachus tigerinus*	Dicroglossidae	Netravathi River	Ramachandra et al 2007	AMPHIBIAN	LC
7	12.844	75.249	*Fejervarya granosa*	Dicroglossidae	Talapu	Dinesh et al 2015	AMPHIBIAN	DD
8	12.826	75.101	*Fejervarya limnocharis*	Dicroglossidae	Netravathi River	Ramachandra et al 2007	AMPHIBIAN	LC
9	12.827	75.573	*Fejervarya Sahyadrensis*	Dicroglossidae	Gundia	Dinesh et al 2015	AMPHIBIAN	LC
10	12.773	75.531	Fejervarya sp	Dicroglossidae	Netravathi River	Ramachandra et al 2007	AMPHIBIAN	LC
11	12.844	75.248	*Gegeneophis krishni*	Indotyphlidae	Dakshina Kannada	Gower et al 2011	AMPHIBIAN	DD
12	12.959	75.115	*Gegeneophis krishni*	Indotyphlidae	Bondanthil	Gower et al 2011	AMPHIBIAN	DD
13	12.872	75.211	*Hoplobatrachus tigerinus*	Dicroglossidae	Padil	Alam et al 2008	AMPHIBIAN	LC
14	12.994	74.983	*Hoplobatrachus tigerinus*	Dicroglossidae	Bajipe	Alam et al 2008	AMPHIBIAN	LC
15	13.071	75.494	*Hoplobatrachus tigerinus*	Dicroglossidae	Netravathi River	Ramachandra et al 2007	AMPHIBIAN	LC
16	12.933	75.700	*Philautus luteolus*	Rhacophoridae	Sakleshpur	Biju and Bossuyt 2009	AMPHIBIAN	LC
17	12.933	75.700	*Philautus tuberohumerus*	Rhacophoridae	Sakleshpur	Biju and Bossuyt 2009	AMPHIBIAN	LC
18	13.110	75.446	*Philautus wynaadensis*	Ranidae	Netravathi River	Ramachandra et al 2007	AMPHIBIAN	EN
19	13.088	75.420	*Sylvirana aurantiaca*	Ranidae	Netravathi River	Ramachandra et al 2007	AMPHIBIAN	VU
20	12.843	75.713	*Bufo brevirostris*	Bufonidae	Gundia Basin	Ramachandra et al 2010	AMPHIBIANS	DD
21	12.950	75.754	*Bufo parietalis*	Bufonidae	Gundia Basin	Ramachandra et al 2010	AMPHIBIANS	NT
22	12.883	75.746	*Clinotarsus curtipes*	Ranidae	Gundia Basin	Gururaj et al 2007	AMPHIBIANS	NT
23	12.868	75.740	*Euphlyctis cyanophlyctis*	Dicroglossidae	Gundia Basin	Ramachandra et al 2010	AMPHIBIANS	LC
24	12.768	75.690	*Fejervarya limnocharis*	Dicroglossidae	Gundia Basin	Ramachandra et al 2010	AMPHIBIANS	LC
25	12.727	75.726	*Fejervarya rufescens*	Dicroglossidae	Gundia Basin	Ramachandra et al 2010	AMPHIBIANS	LC
26	12.864	75.713	Fejervarya sp	Dicroglossidae	Gundia Basin	Ramachandra et al 2010	AMPHIBIANS	DD

27	12.771	75.760	*Indirana gundia*	Ranixalidae	Gundia Basin	Ramachandra et al 2010	AMPHIBIANS	CR
28	12.785	75.745	*Indirana longicrus*	Ranixalidae	Gundia Basin	Ramachandra et al 2010	AMPHIBIANS	DD
29	12.831	75.725	*Indirana semipalmatus*	Ranixalidae	Gundia Basin	Ramachandra et al 2010	AMPHIBIANS	LC
30	12.739	75.746	*Indirana tenuilingua*	Ranixalidae	Gundia Basin	Ramachandra et al 2010	AMPHIBIANS	LC
31	12.848	75.730	*Micrixalus elegans*	Micrixalidae	Gundia Basin	Ramachandra et al 2010	AMPHIBIANS	DD
32	12.830	75.754	*Micrixalus saxicola*	Micrixalidae	Gundia Basin	Ramachandra et al 2010	AMPHIBIANS	VU
33	12.870	75.755	*Minervarya sahyadris*	Dicroglossidae	Gundia Basin	Ramachandra et al 2010	AMPHIBIANS	EN
34	12.899	75.699	*Nyctibatrachus aliciae*	Nyctibatrachidae	Gundia Basin	Gururaj et al 2007	AMPHIBIANS	EN
35	12.841	75.735	*Nyctibatrachus kempholeyensis*	Nyctibatrachidae	Gundia Basin	Gururaj et al 2007	AMPHIBIANS	NE
36	12.864	75.745	*Nyctibatrachus sylvaticus*	Nyctibatrachidae	Gundia Basin	Gururaj et al 2007	AMPHIBIANS	NE
37	12.905	75.748	*Raorchestes flaviventris*	Rhacophoridae	Gundia Basin	Gururaj et al 2007	AMPHIBIANS	DD
38	12.852	75.717	*Philautus leucorhinus*	Rhacophoridae	Gundia Basin	Ramachandra et al 2010	AMPHIBIANS	EX
39	12.807	75.719	*Ramanella minor*	Bufonidae	Gundia Basin	Ramachandra et al 2010	AMPHIBIANS	EN
40	12.831	75.697	*Ramanella mormorata*	Bufonidae	Gundia Basin	Ramachandra et al 2010	AMPHIBIANS	EN
41	12.834	75.713	*Ramanella triangularis*	Bufonidae	Gundia Basin	Ramachandra et al 2010	AMPHIBIANS	VU
42	12.762	75.698	*Sylvirana temporalis*	Ranidae	Gundia Basin	Gururaj et al 2007	AMPHIBIANS	NT
43	12.919	74.859	*Passer domesticus*	Passeridae	Kavoor lake	Ramachandra et al 2007	BIRDS	LC
44	12.535	75.621	*Acridotheres tristis*	Sturnidae	Kumaradhara River	Ramachandra et al 2013	BIRDS	LC
45	12.709	75.620	*Acridotheres tristis*	Sturnidae	Netravathi River	Ramachandra et al 2007	BIRDS	LC
46	12.774	75.726	*Acridotheres tristis*	Sturnidae	Gundia Basin	Ramachandra et al 2010	BIRDS	LC
47	12.943	75.621	*Acridotheres tristis*	Sturnidae	Kumaradhara River	Ramachandra et al 2013	BIRDS	LC
48	12.946	75.248	*Actitis hypoleucos*	Scolopacidae	Dakshina Kannada	Sowmya and Jayappa 2016	BIRDS	LC
49	12.860	75.405	*Alcedo atthis*	Alcedinidae	Kokkada	EMP 2011	BIRDS	LC
50	13.051	75.337	*Alcedo atthis*	Alcedinidae	Netravathi River	Ramachandra et al 2007	BIRDS	LC
51	12.639	75.472	*Amaurornis phoenicurus*	Rallidae	Netravathi River	Ramachandra et al 2007	BIRDS	LC
52	12.746	75.729	*Amaurornis phoenicurus*	Rallidae	Gundia Basin	Gururaj et al 2007	BIRDS	LC
53	12.919	74.860	*Anas crecca*	Anatidae	Kavoor lake	Ramachandra et al 2007	BIRDS	LC
54	12.875	75.405	*Anastomus oscitans*	Ciconiidae	Dakshina Kannada	Sowmya and Jayappa 2016	BIRDS	LC
55	12.920	74.860	*Anastomus oscitans*	Ciconiidae	Kavoor lake	Ramachandra et al 2007	BIRDS	LC
56	12.740	75.733	*Anthracoceros coronatus*	Bucerotidae	Gundia Basin	Gururaj et al 2007	BIRDS	NT

57	13.085	75.220	*Anthracoceros coronatus*	Bucerotidae	Kudremukh Tiger Reserve	Ramachandra et al 2017	BIRDS	NT
58	12.833	75.248	*Anthus rufulus*	Motacillidae	Dakshina Kannada	Sowmya and Jayappa 2016	BIRDS	LC
59	12.764	75.703	*Apus affinis*	Apodidae	Gundia Basin	Gururaj et al 2007	BIRDS	LC
60	12.882	75.313	*Ardea alba*	Ardeidae	Dakshina Kannada	Sowmya and Jayappa 2016	BIRDS	LC
61	12.919	74.859	*Ardea cinerea*	Ardeidae	Kavoor lake	Ramachandra et al 2007	BIRDS	LC
62	12.946	75.248	*Ardea cinerea*	Ardeidae	Dakshina Kannada	Sowmya and Jayappa 2016	BIRDS	LC
63	12.649	75.446	*Ardeola grayii*	Ardeidae	Netravathi River	Ramachandra et al 2007	BIRDS	LC
64	12.747	75.714	*Ardeola grayii*	Ardeidae	Gundia Basin	Gururaj et al 2007	BIRDS	LC
65	12.919	74.860	*Ardeola striatus*	Ardeidae	Kavoor lake	Ramachandra et al 2007	BIRDS	LC
66	12.954	75.550	*Artamus fuscus*	Artamidae	Netravathi River	Ramachandra et al 2007	BIRDS	LC
67	13.028	75.029	*Athene brama*	Strigidae	Netravathi River	Ramachandra et al 2007	BIRDS	LC
68	12.918	74.860	*Bubulcus ibis*	Ardeidae	Kavoor lake	Ramachandra et al 2007	BIRDS	LC
69	12.953	75.185	*Bubulcus ibis*	Ardeidae	Dakshina Kannada	Sowmya and Jayappa 2016	BIRDS	LC
70	12.886	75.497	*Centropus sinensis*	Cuculidae	Netravathi River	Ramachandra et al 2007	BIRDS	LC
71	12.783	75.672	*Chalcophaps indica*	Columbidae	Gundia Basin	Gururaj et al 2007	BIRDS	LC
72	12.831	75.411	*Charadrius dubius*	Charadriidae	Nelyadi	EMP 2011	BIRDS	LC
73	12.918	74.860	*Charadrius dubius*	Charadriidae	Kavoor lake	Ramachandra et al 2007	BIRDS	LC
74	12.938	75.629	*Charadrius dubius*	Charadriidae	Netravathi River	Ramachandra et al 2007	BIRDS	LC
75	12.713	75.316	*Charadrius mongolus*	Charadriidae	Dakshina Kannada	Sowmya and Jayappa 2016	BIRDS	LC
76	12.680	75.759	*Chloropsis aurifrons*	Chloropseidae	Netravathi River	Ramachandra et al 2007	BIRDS	LC
77	12.529	75.660	*Chloropsis cochinchinensis*	Chloropseidae	Kumaradhara River	Ramachandra et al 2013	BIRDS	NT
78	12.812	75.723	*Chloropsis cochinchinensis*	Chloropseidae	Gundia Basin	Ramachandra et al 2010	BIRDS	NT
79	12.931	75.600	*Chloropsis cochinchinensis*	Chloropseidae	Kumaradhara River	Ramachandra et al 2013	BIRDS	NT
80	12.837	75.438	*Columba livia*	Columbidae	Netravathi River	Ramachandra et al 2007	BIRDS	LC
81	12.817	75.436	*Copsychus saularis*	Muscicapidae	Dakshina Kannada	Sowmya and Jayappa 2016	BIRDS	LC
82	12.946	75.248	*Coracias benghalensis*	Coraciidae	Dakshina Kannada	Sowmya and Jayappa 2016	BIRDS	LC
83	12.789	75.267	*Corvus macrorhynchos*	Corvidae	Netravathi River	Ramachandra et al 2007	BIRDS	LC
84	12.840	75.398	*Corvus macrorhynchos*	Corvidae	Uppinangadi	EMP 2011	BIRDS	LC
85	12.530	75.599	*Corvus macrorhynchos*	Corvidae	Kumaradhara River	Ramachandra et al 2013	BIRDS	LC
86	12.794	75.717	*Corvus macrorhynchos*	Corvidae	Gundia Basin	Ramachandra et al 2010	BIRDS	LC

87	12.927	75.614	*Corvus macrorhynchos*	Corvidae	Kumaradhara River	Ramachandra et al 2013	BIRDS	LC
88	12.833	75.248	*Corvus splendens*	Corvidae	Dakshina Kannada	Sowmya and Jayappa 2016	BIRDS	LC
89	13.051	75.337	*Corvus splendens*	Corvidae	Netravathi River	Ramachandra et al 2007	BIRDS	LC
90	12.860	75.405	*Dendrocitta vagabunda*	Corvidae	Kokkada	EMP 2011	BIRDS	LC
91	12.580	75.598	*Dendrocitta vagabunda*	Corvidae	Kumaradhara River	Ramachandra et al 2013	BIRDS	LC
92	12.791	75.731	*Dendrocitta vagabunda*	Corvidae	Gundia Basin	Ramachandra et al 2010	BIRDS	LC
93	12.933	75.618	*Dendrocitta vagabunda*	Corvidae	Kumaradhara River	Ramachandra et al 2013	BIRDS	LC
94	12.953	75.185	*Dendrocitta vagabunda*	Corvidae	Dakshina Kannada	Sowmya and Jayappa 2016	BIRDS	LC
95	12.680	75.759	*Dendrocitta vegabunda*	Corvidae	Netravathi River	Ramachandra et al 2007	BIRDS	LC
96	12.840	75.398	*Dendrocygna javanica*	Anatidae	Uppinangadi	EMP 2011	BIRDS	LC
97	12.663	75.758	*Dicaeum agile*	Dicaeidae	Netravathi River	Ramachandra et al 2007	BIRDS	LC
98	12.721	75.609	*Dicrurus macrocercus*	Dicruridae	Netravathi River	Ramachandra et al 2007	BIRDS	LC
99	12.882	75.313	*Dicrurus macrocercus*	Dicruridae	Dakshina Kannada	Sowmya and Jayappa 2016	BIRDS	LC
100	12.713	75.316	*Dicrurus paradiseus*	Dicruridae	Dakshina Kannada	Sowmya and Jayappa 2016	BIRDS	LC
101	12.760	75.609	*Dicrurus paradiseus*	Dicruridae	Netravathi River	Ramachandra et al 2007	BIRDS	LC
102	12.780	75.748	*Dicrurus paradiseus*	Dicruridae	Gundia Basin	Gururaj et al 2007	BIRDS	LC
103	12.807	75.605	*Dicrurus paradiseus*	Dicruridae	Kumaradhara River	Ramachandra et al 2013	BIRDS	LC
104	12.937	75.605	*Dicrurus paradiseus*	Dicruridae	Kumaradhara River	Ramachandra et al 2013	BIRDS	LC
105	12.755	75.731	*Dinopium benghalense*	Laridae	Gundia Basin	Gururaj et al 2007	BIRDS	LC
106	12.821	75.635	*Dinopium benghalense*	Laridae	Kumaradhara River	Ramachandra et al 2013	BIRDS	LC
107	12.948	75.579	*Dinopium benghalense*	Laridae	Kumaradhara River	Ramachandra et al 2013	BIRDS	LC
108	13.050	75.120	*Dinopium javanense*	Laridae	Netravathi River	Ramachandra et al 2007	BIRDS	LC
109	12.817	75.436	*Dromas ardeola*	Dromadidae	Dakshina Kannada	Sowmya and Jayappa 2016	BIRDS	LC
110	12.701	75.336	*Egretta garzetta*	Ardeidae	Dakshina Kannada	Sowmya and Jayappa 2016	BIRDS	LC
111	13.028	75.029	*Egretta garzetta*	Ardeidae	Netravathi River	Ramachandra et al 2007	BIRDS	LC
112	12.916	75.389	*Egretta intermedia*	Ardeidae	Dakshina Kannada	Sowmya and Jayappa 2016	BIRDS	NE
113	12.816	75.239	*Eudynamys scolopacea*	Cuculidae	Netravathi River	Ramachandra et al 2007	BIRDS	LC
114	12.751	75.701	*Falco tinnunculus*	Falconidae	Gundia Basin	Gururaj et al 2007	BIRDS	LC
115	12.953	75.185	*Galerida cristata*	Alaudidae	Dakshina Kannada	Sowmya and Jayappa 2016	BIRDS	LC
116	12.701	75.336	*Gallinago*	Scolopacidae	Dakshina	Sowmya and	BIRDS	LC

			gallinago		Kannada	Jayappa 2016		
117	12.826	75.101	*Galloperdix spadicea*	Phasianidae	Netravathi River	Ramachandra et al 2007	BIRDS	LC
118	12.747	75.731	*Gallus sonneratii*	Phasianidae	Gundia Basin	Gururaj et al 2007	BIRDS	LC
119	12.768	75.714	*Halcyon smyrnensis*	Alcedinidae	Gundia Basin	Gururaj et al 2007	BIRDS	LC
120	12.896	75.337	*Halcyon smyrnensis*	Alcedinidae	Bandaru	EMP 2011	BIRDS	LC
121	12.721	75.609	*Halcyon smyrnesis*	Alcedinidae	Netravathi River	Ramachandra et al 2007	BIRDS	LC
122	12.946	75.248	*Haliastur indus*	Accipitridae	Dakshina Kannada	Sowmya and Jayappa 2016	BIRDS	LC
123	12.833	75.248	*Hirundo rustica*	Hirundinidae	Dakshina Kannada	Sowmya and Jayappa 2016	BIRDS	LC
124	12.918	74.860	*Hirundo rustica*	Hirundinidae	Kavoor lake	Ramachandra et al 2007	BIRDS	LC
125	12.504	75.621	*Hypsipetes indicus*	Pycnonotidae	Kumaradhara River	Ramachandra et al 2013	BIRDS	NE
126	12.828	75.729	*Hypsipetes indicus*	Pycnonotidae	Gundia Basin	Ramachandra et al 2010	BIRDS	NE
127	12.907	75.610	*Hypsipetes indicus*	Pycnonotidae	Kumaradhara River	Ramachandra et al 2013	BIRDS	NE
128	12.801	75.414	*Ichthyophaga ichthyaetus*	Accipitridae	Dakshina Kannada	Sowmya and Jayappa 2016	BIRDS	NT
129	12.540	75.615	*Irena puella*	Irenidae	Kumaradhara River	Ramachandra et al 2013	BIRDS	LC
130	12.801	75.718	*Irena puella*	Irenidae	Gundia Basin	Ramachandra et al 2010	BIRDS	LC
131	12.932	75.588	*Irena puella*	Irenidae	Kumaradhara River	Ramachandra et al 2013	BIRDS	LC
132	12.760	75.609	*Lanius cristatus*	Laniidae	Netravathi River	Ramachandra et al 2007	BIRDS	LC
133	12.875	75.405	*Larus heuglini*	Laridae	Dakshina Kannada	Sowmya and Jayappa 2016	BIRDS	NE
134	12.851	75.363	*Leptocoma zeylonica*	Nectariniidae	Dakshina Kannada	Sowmya and Jayappa 2016	BIRDS	LC
135	12.942	75.445	*Limosa limosa*	Scolopacidae	Dakshina Kannada	Sowmya and Jayappa 2016	BIRDS	NT
136	12.942	75.445	*Lonchura atricapilla*	Estrildidae	Dakshina Kannada	Sowmya and Jayappa 2016	BIRDS	LC
137	12.599	75.599	*Lonchura malacca*	Estrildidae	Kumaradhara River	Ramachandra et al 2013	BIRDS	LC
138	12.800	75.668	*Lonchura malacca*	Estrildidae	Gundia Basin	Ramachandra et al 2010	BIRDS	LC
139	12.921	75.542	*Lonchura malacca*	Estrildidae	Netravathi River	Ramachandra et al 2007	BIRDS	LC
140	12.934	75.635	*Lonchura malacca*	Estrildidae	Kumaradhara River	Ramachandra et al 2013	BIRDS	LC
141	13.050	75.120	*Lonchura punctulata*	Estrildidae	Netravathi River	Ramachandra et al 2007	BIRDS	LC
142	12.663	75.758	*Loriculus vernalis*	Psittacidae	Netravathi River	Ramachandra et al 2007	BIRDS	LC
143	12.947	75.363	*Megalaima viridis*	Megalaimidae	Netravathi River	Ramachandra et al 2007	BIRDS	LC
144	12.751	75.723	*Megalaima zeylanica*	Megalaimidae	Gundia Basin	Gururaj et al 2007	BIRDS	LC
145	12.763	75.710	*Merops orientalis*	Meropidae	Gundia Basin	Gururaj et al 2007	BIRDS	LC

146	12.801	75.414	*Merops orientalis*	Meropidae	Dakshina Kannada	Sowmya and Jayappa 2016	BIRDS	LC
147	12.853	75.332	*Merops orientalis*	Meropidae	Netravathi River	Ramachandra et al 2007	BIRDS	LC
148	12.713	75.316	*Merops philippinus*	Meropidae	Dakshina Kannada	Sowmya and Jayappa 2016	BIRDS	LC
149	12.789	75.267	*Merops philippinus*	Meropidae	Netravathi River	Ramachandra et al 2007	BIRDS	LC
150	12.680	75.759	*Mesophoyx intermedia*	Ardeidae	Netravathi River	Ramachandra et al 2007	BIRDS	NE
151	12.918	74.860	*Metopidius indicus*	Jacanidae	Kavoor lake	Ramachandra et al 2007	BIRDS	LC
152	12.701	75.336	*Milvus migrans*	Accipitridae	Dakshina Kannada	Sowmya and Jayappa 2016	BIRDS	LC
153	12.721	75.609	*Milvus migrans*	Accipitridae	Netravathi River	Ramachandra et al 2007	BIRDS	LC
154	12.610	75.594	*Monticola cinclorhynchus*	Muscicapidae	Kumaradhara River	Ramachandra et al 2013	BIRDS	NE
155	12.799	75.704	*Monticola cinclorhynchus*	Muscicapidae	Gundia Basin	Ramachandra et al 2010	BIRDS	NE
156	12.900	75.632	*Monticola cinclorhynchus*	Muscicapidae	Kumaradhara River	Ramachandra et al 2013	BIRDS	NE
157	12.709	75.620	*Motacilla alba*	Passeridae	Netravathi River	Ramachandra et al 2007	BIRDS	NE
158	13.053	75.389	*Motacilla cinerea*	Passeridae	Netravathi River	Ramachandra et al 2007	BIRDS	LC
159	12.593	75.553	*Motacilla flava*	Motacillidae	Kumaradhara River	Ramachandra et al 2013	BIRDS	LC
160	12.703	75.444	*Motacilla flava*	Motacillidae	Netravathi River	Ramachandra et al 2007	BIRDS	LC
161	12.805	75.669	*Motacilla flava*	Motacillidae	Gundia Basin	Ramachandra et al 2010	BIRDS	LC
162	12.912	75.636	*Motacilla flava*	Motacillidae	Kumaradhara River	Ramachandra et al 2013	BIRDS	LC
163	12.639	75.472	*Motacilla maderaspatensis*	Motacillidae	Netravathi River	Ramachandra et al 2007	BIRDS	LC
164	12.879	75.304	*Motacilla maderaspatensis*	Motacillidae	Dakshina Kannada	Sowmya and Jayappa 2016	BIRDS	LC
165	12.699	75.363	*Nectarinia asiatica*	Nectariniidae	Netravathi River	Ramachandra et al 2007	BIRDS	LC
166	12.593	75.573	*Nectarinia zeylonica*	Nectariniidae	Kumaradhara River	Ramachandra et al 2013	BIRDS	NE
167	12.703	75.444	*Nectarinia zeylonica*	Nectariniidae	Netravathi River	Ramachandra et al 2007	BIRDS	NE
168	12.804	75.676	*Nectarinia zeylonica*	Nectariniidae	Gundia Basin	Ramachandra et al 2010	BIRDS	NE
169	12.921	75.629	*Nectarinia zeylonica*	Nectariniidae	Kumaradhara River	Ramachandra et al 2013	BIRDS	NE
170	12.946	75.248	*Onychoprion anaethetus*	Laridae	Dakshina Kannada	Sowmya and Jayappa 2016	BIRDS	LC
171	12.922	75.477	*Oriolus oriolus*	Oriolidae	Netravathi River	Ramachandra et al 2007	BIRDS	LC
172	12.882	75.313	*Oriolus xanthornus*	Oriolidae	Dakshina Kannada	Sowmya and Jayappa 2016	BIRDS	LC
173	12.886	75.669	*Oriolus xanthornus*	Oriolidae	Netravathi River	Ramachandra et al 2007	BIRDS	LC
174	12.938	75.629	*Orthotomus sutorius*	Cisticolidae	Netravathi River	Ramachandra et al 2007	BIRDS	LC
175	12.953	75.185	*Passer*	Passeridae	Dakshina	Sowmya and	BIRDS	LC

			domesticus		Kannada	Jayappa 2016		
176	12.963	75.292	*Pavo cristatus*	Phasianidae	Netravathi River	Ramachandra et al 2007	BIRDS	LC
177	12.839	75.399	*Pelargopsis capensis*	Alcedinidae	Uppinangadi	EMP 2011	BIRDS	NE
178	13.053	75.389	*Pericrocotus flammeus*	Campephagidae	Netravathi River	Ramachandra et al 2007	BIRDS	LC
179	12.875	75.405	*Phalacrocorax fuscicollis*	Phalacrocoracidae	Dakshina Kannada	Sowmya and Jayappa 2016	BIRDS	LC
180	12.918	74.860	*Phalacrocorax fuscicollis*	Phalacrocoracidae	Kavoor lake	Ramachandra et al 2007	BIRDS	LC
181	12.754	75.712	*Phalacrocorax niger*	Phalacrocoracidae	Gundia Basin	Gururaj et al 2007	BIRDS	LC
182	12.773	75.531	*Ploceus philippinus*	Ploceidae	Netravathi River	Ramachandra et al 2007	BIRDS	LC
183	12.817	75.436	*Pluvialis squatarola*	Charadriidae	Dakshina Kannada	Sowmya and Jayappa 2016	BIRDS	LC
184	12.792	75.668	*Psittacula cyanocephala*	Psittacidae	Gundia Basin	Gururaj et al 2007	BIRDS	LC
185	12.886	75.497	*Psittacula krameri*	Psittacidae	Netravathi River	Ramachandra et al 2007	BIRDS	LC
186	12.585	75.603	*Pycnonotus cafer*	Pycnonotidae	Kumaradhara River	Ramachandra et al 2013	BIRDS	LC
187	12.823	75.729	*Pycnonotus cafer*	Pycnonotidae	Gundia Basin	Ramachandra et al 2010	BIRDS	LC
188	12.916	75.595	*Pycnonotus cafer*	Pycnonotidae	Kumaradhara River	Ramachandra et al 2013	BIRDS	LC
189	12.717	75.384	*Pycnonotus jocosus*	Pycnonotidae	Netravathi River	Ramachandra et al 2007	BIRDS	LC
190	12.916	75.389	*Pycnonotus jocosus*	Pycnonotidae	Dakshina Kannada	Sowmya and Jayappa 2016	BIRDS	LC
191	12.917	74.860	*Pycnonotus jocosus*	Pycnonotidae	Kavoor lake	Ramachandra et al 2007	BIRDS	LC
192	12.521	75.659	*Rhopocichla atriceps*	Timaliidae	Kumaradhara River	Ramachandra et al 2013	BIRDS	LC
193	12.833	75.705	*Rhopocichla atriceps*	Timaliidae	Gundia Basin	Ramachandra et al 2010	BIRDS	LC
194	12.902	75.621	*Rhopocichla atriceps*	Timaliidae	Kumaradhara River	Ramachandra et al 2013	BIRDS	LC
195	12.879	75.304	*Saxicola caprata*	Muscicapidae	Dakshina Kannada	Sowmya and Jayappa 2016	BIRDS	LC
196	12.947	75.363	*Saxicoloides fulicata*	Muscicapidae	Netravathi River	Ramachandra et al 2007	BIRDS	LC
197	12.801	75.414	*Stercorarius parasiticus*	Stercorariidae	Dakshina Kannada	Sowmya and Jayappa 2016	BIRDS	LC
198	12.701	75.336	*Stercorarius pomarinus*	Stercorariidae	Dakshina Kannada	Sowmya and Jayappa 2016	BIRDS	LC
199	12.946	75.248	*Sterna aurantia*	Laridae	Dakshina Kannada	Sowmya and Jayappa 2016	BIRDS	NT
200	12.882	75.313	*Sterna dougallii*	Laridae	Dakshina Kannada	Sowmya and Jayappa 2016	BIRDS	LC
201	12.759	75.745	*Streptopelia chinensis*	Columbidae	Gundia Basin	Gururaj et al 2007	BIRDS	NE
202	12.816	75.239	*Streptopelia chinensis*	Columbidae	Netravathi River	Ramachandra et al 2007	BIRDS	NE
203	12.709	75.620	*Terpsiphone paradisi*	Monarchidae	Netravathi River	Ramachandra et al 2007	BIRDS	LC
204	12.539	75.686	*Terpsiphone paradisi*	Monarchidae	Kumaradhara River	Ramachandra et al 2013	BIRDS	LC

205	12.713	75.316	*Terpsiphone paradisi*	Monarchidae	Dakshina Kannada	Sowmya and Jayappa 2016	BIRDS	LC
206	12.828	75.701	*Terpsiphone paradisi*	Monarchidae	Gundia Basin	Ramachandra et al 2010	BIRDS	LC
207	12.896	75.635	*Terpsiphone paradisi*	Monarchidae	Kumaradhara River	Ramachandra et al 2013	BIRDS	LC
208	13.107	75.186	*Terpsiphone paradisi*	Monarchidae	Kudremukh Tiger Reserve	Ramachandra et al 2017	BIRDS	LC
209	12.879	75.304	*Thalasseus bengalensis*	Laridae	Dakshina Kannada	Sowmya and Jayappa 2016	BIRDS	LC
210	12.916	75.389	*Thalasseus bergii*	Laridae	Dakshina Kannada	Sowmya and Jayappa 2016	BIRDS	LC
211	12.817	75.436	*Tringa erythropus*	Scolopacidae	Dakshina Kannada	Sowmya and Jayappa 2016	BIRDS	LC
212	12.649	75.446	*Tringa glareola*	Scolopacidae	Netravathi River	Ramachandra et al 2007	BIRDS	NE
213	12.886	75.337	*Actitis hypoleucos*	Scolopacidae	Bandaru	EMP 2011	BIRDS	LC
214	12.953	75.185	*Tringa nebularia*	Scolopacidae	Dakshina Kannada	Sowmya and Jayappa 2016	BIRDS	LC
215	12.875	75.405	*Tringa ochropus*	Scolopacidae	Dakshina Kannada	Sowmya and Jayappa 2016	BIRDS	LC
216	12.699	75.363	*Tringa stagnatilis*	Scolopacidae	Netravathi River	Ramachandra et al 2007	BIRDS	LC
217	12.717	75.384	*Tringa tetanus*	Scolopacidae	Netravathi River	Ramachandra et al 2007	BIRDS	LC
218	12.853	75.332	*Turdoides straitus*	Leiothrichidae	Netravathi River	Ramachandra et al 2007	BIRDS	NE
219	12.946	75.248	*Turdoides striatus*	Leiothrichidae	Dakshina Kannada	Sowmya and Jayappa 2016	BIRDS	NE
220	12.851	75.405	*Vanellus indicus*	Charadriidae	Kokkada	EMP 2011	BIRDS	LC
221	12.922	75.477	*Vanellus indicus*	Charadriidae	Netravathi River	Ramachandra et al 2007	BIRDS	LC
222	12.882	75.313	*Xema sabini*	Laridae	Dakshina Kannada	Sowmya and Jayappa 2016	BIRDS	LC
223	12.833	75.248	*Xenus cinereus*	Scolopacidae	Dakshina Kannada	Sowmya and Jayappa 2016	BIRDS	LC
224	12.875	75.405	*Geokichla citrina*	Turdidae	Dakshina Kannada	Sowmya and Jayappa 2016	BIRDS	LC
225	12.616	75.571	*Geokichla citrina*	Turdidae	Kumaradhara River	Ramachandra et al 2013	BIRDS	LC
226	12.832	75.710	*Geokichla citrina*	Turdidae	Gundia Basin	Ramachandra et al 2010	BIRDS	LC
227	12.888	75.632	*Geokichla citrina*	Turdidae	Kumaradhara River	Ramachandra et al 2013	BIRDS	LC
228	13.089	75.281	*Pavo cristatus*	Phasianidae	Kudremukh Tiger Reserve	Ramachandra et al 2017	BIRDS	LC
229	12.709	75.620	*Acraea violae*	Nymphalidae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE
230	12.868	75.740	*Acytolepis puspa*	Nymphalidae	Gundia Basin	Ramachandra et al 2010	BUTTER FLY	NE
231	12.788	75.783	*Appias albina*	Pieridae	Gundia Basin	Gururaj et al 2007	BUTTER FLY	NE
232	12.703	75.444	*Argyreus hyperbius*	Nymphalidae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE
233	12.841	75.735	*Arhopala amantes*	Nymphalidae	Gundia Basin	Ramachandra et al 2010	BUTTER FLY	NE
234	12.773	75.531	*Ariadne merione*	Nymphalidae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE

235	12.831	75.697	*Ariadne merione*	Nymphalidae	Gundia Basin	Gururaj et al 2007	BUTTER FLY	NE
236	12.950	75.754	*Athyma perius*	Nymphalidae	Gundia Basin	Gururaj et al 2007	BUTTER FLY	NE
237	12.717	75.384	*Borbo cinnara*	Hesperiidae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE
238	12.680	75.759	*Caleta caleta*	Lycaenidae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	LC
239	12.837	75.438	*Castalius rosimon*	Nymphalidae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE
240	12.727	75.726	*Castalius rosimon*	Nymphalidae	Gundia Basin	Ramachandra et al 2010	BUTTER FLY	NE
241	12.760	75.609	*Catopsilia pomona*	Pieridae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE
242	12.776	75.675	*Catopsilia pomona*	Pieridae	Gundia Basin	Gururaj et al 2007	BUTTER FLY	NE
243	12.886	75.497	*Catopsilia pyranthe*	Pieridae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE
244	12.727	75.732	*Cepora nerissa*	Pieridae	Gundia Basin	Gururaj et al 2007	BUTTER FLY	NE
245	12.826	75.704	*Cethosia nietneri*	Nymphalidae	Gundia Basin	Gururaj et al 2007	BUTTER FLY	NE
246	12.703	75.444	*Chilades laius*	Nymphalidae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE
247	12.864	75.713	*Chilades laius*	Nymphalidae	Gundia Basin	Ramachandra et al 2010	BUTTER FLY	NE
248	12.649	75.446	*Cirrochroa thais*	Nymphalidae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE
249	12.939	75.663	*Cirrochroa thais*	Nymphalidae	Gundia Basin	Gururaj et al 2007	BUTTER FLY	NE
250	12.721	75.609	*Cupha erymanthis*	Nymphalidae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE
251	12.790	75.746	*Cupha erymanthis*	Nymphalidae	Gundia Basin	Gururaj et al 2007	BUTTER FLY	NE
252	12.886	75.669	*Danaus chrysippus*	Nymphalidae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE
253	12.739	75.746	*Danaus genutia*	Nymphalidae	Gundia Basin	Ramachandra et al 2010	BUTTER FLY	NE
254	12.947	75.363	*Delias eucharis*	Pieridae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE
255	12.746	75.698	*Delias eucharis*	Pieridae	Gundia Basin	Gururaj et al 2007	BUTTER FLY	NE
256	13.028	75.029	*Elymnias hypermnestra*	Nymphalidae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	EN
257	12.921	75.542	*Euploea core*	Nymphalidae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	LC
258	12.768	75.690	*Euploea core*	Nymphalidae	Gundia Basin	Ramachandra et al 2010	BUTTER FLY	LC
259	13.053	75.389	*Eurema brigitta*	Pieridae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE
260	13.051	75.337	*Eurema hecabe*	Pieridae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE
261	12.748	75.709	*Eurema hecabe*	Pieridae	Gundia Basin	Gururaj et al 2007	BUTTER FLY	NE
262	12.709	75.620	*Everes lacturnus*	Lycaenidae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE
263	12.699	75.363	*Freyeria trochylus*	Lycaenidae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE
264	12.663	75.695	*Graphium*	Papilionidae	Netravathi	Ramachandra et	BUTTER	NE

			agamemnon		River	al 2007	FLY	
265	12.742	75.725	*Graphium agamemnon*	Papilionidae	Gundia Basin	Gururaj et al 2007	BUTTER FLY	NE
266	12.715	75.701	*Graphium doson*	Papilionidae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE
267	12.684	75.667	*Graphium sarpedon*	Papilionidae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE
268	12.774	75.774	*Graphium sarpedon*	Papilionidae	Gundia Basin	Gururaj et al 2007	BUTTER FLY	NE
269	12.709	75.620	*Hasora badra*	Hesperiidae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE
270	12.680	75.759	*Hasora chromus*	Hesperiidae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE
271	12.864	75.745	*Hasora chromus*	Hesperiidae	Gundia Basin	Ramachandra et al 2010	BUTTER FLY	NE
272	12.754	75.737	*Hebomia glaucippe*	Pieridae	Gundia Basin	Gururaj et al 2007	BUTTER FLY	NE
273	12.848	75.730	*Hypolimnas bolina*	Nymphalidae	Gundia Basin	Ramachandra et al 2010	BUTTER FLY	NE
274	13.102	75.489	*Hypolimnas misippus*	Nymphalidae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	EN
275	12.831	75.725	*Hypolimnas misippus*	Nymphalidae	Gundia Basin	Ramachandra et al 2010	BUTTER FLY	EN
276	12.789	75.267	*Ixias pyrene*	Pieridae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE
277	12.773	75.531	*Jamides celeno*	Nymphalidae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE
278	12.905	75.748	*Jamides celeno*	Nymphalidae	Gundia Basin	Ramachandra et al 2010	BUTTER FLY	NE
279	13.071	75.494	*Junonia atlites*	Nymphalidae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE
280	12.807	75.719	*Junonia atlites*	Nymphalidae	Gundia Basin	Ramachandra et al 2010	BUTTER FLY	NE
281	13.088	75.420	*Junonia iphita*	Nymphalidae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE
282	12.830	75.754	*Junonia iphita*	Nymphalidae	Gundia Basin	Ramachandra et al 2010	BUTTER FLY	NE
283	12.963	75.292	*Junonia lemonias*	Nymphalidae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE
284	12.834	75.713	*Junonia lemonias*	Nymphalidae	Gundia Basin	Gururaj et al 2007	BUTTER FLY	NE
285	12.826	75.101	*Junonia orithya*	Nymphalidae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE
286	13.110	75.446	*Kallima horsfieldii*	Nymphalidae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE
287	12.649	75.446	*Lambrix salsala*	Hesperiidae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE
288	12.717	75.384	*Lampides boeticus*	Nymphalidae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE
289	12.852	75.717	*Lampides boeticus*	Nymphalidae	Gundia Basin	Ramachandra et al 2010	BUTTER FLY	NE
290	12.853	75.332	*Leptosia nina*	Pieridae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE
291	12.726	75.718	*Leptosia nina*	Pieridae	Gundia Basin	Gururaj et al 2007	BUTTER FLY	NE
292	13.050	75.120	*Melanitis leda*	Nymphalidae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE
293	12.788	75.767	*Melanitis leda*	Nymphalidae	Gundia Basin	Gururaj et al 2007	BUTTER FLY	NE

294	12.843	75.713	*Moduza procris*	Nymphalidae	Gundia Basin	Gururaj et al 2007	BUTTER FLY	NE
295	12.775	75.737	*Mycalesis patnia*	Nymphalidae	Gundia Basin	Gururaj et al 2007	BUTTER FLY	NE
296	12.938	75.629	*Mycalesis perseus*	Nymphalidae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE
297	12.779	75.723	*Mycalesis perseus*	Nymphalidae	Gundia Basin	Gururaj et al 2007	BUTTER FLY	NE
298	12.721	75.609	*Neopithecops zalmora*	Lycaenidae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE
299	12.953	75.708	*Neptis hylas*	Nymphalidae	Gundia Basin	Gururaj et al 2007	BUTTER FLY	NE
300	12.699	75.363	*Neptis hylas*	Nymphalidae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE
301	12.663	75.758	*Orsotrioena medus*	Nymphalidae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE
302	13.053	75.389	*Pachliopta aristolochiae*	Papilionidae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE
303	12.708	75.675	*Pachliopta hector*	Papilionidae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	EN
304	12.762	75.681	*Pachliopta hector*	Papilionidae	Gundia Basin	Gururaj et al 2007	BUTTER FLY	EN
305	12.717	75.384	*Pantoporia hordonia*	Nymphalidae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE
306	12.951	75.685	*Pantoporia hordonia*	Nymphalidae	Gundia Basin	Gururaj et al 2007	BUTTER FLY	NE
307	12.591	75.669	*Papilio demoleus*	Papilionidae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE
308	12.536	75.683	*Papilio dravidarum*	Papilionidae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE
309	12.922	75.477	*Papilio paris*	Papilionidae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE
310	12.861	75.344	*Papilio polytes*	Papilionidae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE
311	12.796	75.724	*Papilio polytes*	Papilionidae	Gundia Basin	Gururaj et al 2007	BUTTER FLY	NE
312	12.785	75.745	*Parantica aglea*	Nymphalidae	Gundia Basin	Ramachandra et al 2010	BUTTER FLY	NE
313	12.816	75.239	*Pareronia valeria*	Pieridae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE
314	12.639	75.472	*Phalanta phalantha*	Nymphalidae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE
315	12.933	75.676	*Phalanta phalantha*	Nymphalidae	Gundia Basin	Gururaj et al 2007	BUTTER FLY	NE
316	12.889	75.728	*Polyura athamas*	Nymphalidae	Gundia Basin	Gururaj et al 2007	BUTTER FLY	NE
317	12.899	75.699	*Prosotas nora*	Nymphalidae	Gundia Basin	Ramachandra et al 2010	BUTTER FLY	NE
318	12.639	75.472	*Pseudozizeeria maha*	Lycaenidae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE
319	12.963	75.292	*Rapala manea*	Lycaenidae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE
320	12.639	75.472	*Sarangesa dasahara*	Hesperiidae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE
321	12.721	75.609	*Tagiades litigiosa*	Hesperiidae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE
322	12.826	75.101	*Talicada nyseus*	Lycaenidae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE
323	12.699	75.363	*Telicota colon*	Hesperiidae	Netravathi	Ramachandra et	BUTTER	NE

					River	al 2007	FLY	
324	12.703	75.444	*Taractrocera maevius*	Hesperiidae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE
325	12.954	75.550	*Tirumala limniace*	Nymphalidae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE
326	12.771	75.760	*Tirumala limniace*	Nymphalidae	Gundia Basin	Ramachandra et al 2010	BUTTER FLY	NE
327	12.790	75.668	*Troides minos*	Papilionidae	Gundia Basin	Gururaj et al 2007	BUTTER FLY	NE
328	12.680	75.759	*Ypthima asterope*	Nymphalidae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE
329	12.805	75.706	*Ypthima asterope*	Nymphalidae	Gundia Basin	Gururaj et al 2007	BUTTER FLY	NE
330	12.649	75.446	*Zizula hylax*	Nymphalidae	Netravathi River	Ramachandra et al 2007	BUTTER FLY	NE
331	12.870	75.755	*Zizula hylax*	Nymphalidae	Gundia Basin	Ramachandra et al 2010	BUTTER FLY	NE
332	12.723	75.612	*Anguilla bengalensis*	Anguillidae	Kumaradhara River	Ramachandra et al 2013	FISH	NT
333	12.791	75.580	*Anguilla bengalensis*	Anguillidae	Kumaradhara River	Ramachandra et al 2013	FISH	NT
334	12.737	75.646	*Aplocheilus blocki*	Aplocheilidae	Kumaradhara River	Ramachandra et al 2013	FISH	DD
335	12.808	75.566	*Aplocheilus blocki*	Aplocheilidae	Kumaradhara River	Ramachandra et al 2013	FISH	DD
336	12.804	75.604	*Aplocheilus lineatus*	Aplocheilidae	Kumaradhara River	Ramachandra et al 2013	FISH	LC
337	12.857	75.568	*Aplocheilus lineatus*	Aplocheilidae	Kumaradhara River	Ramachandra et al 2013	FISH	LC
338	12.830	75.663	*Barilius bakeri*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	LC
339	12.859	75.633	*Barilius bakeri*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	LC
340	12.809	75.687	*Barilius canarensis*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	DD
341	12.851	75.604	*Barilius canarensis*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	DD
342	12.835	75.588	*Barilius gatensis*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	DD
343	12.892	75.575	*Barilius gatensis*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	DD
344	12.855	75.627	*Brachydanio rerio*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	LC
345	12.876	75.636	*Brachydanio rerio*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	LC
346	12.842	75.578	*Channa orientalis*	Channidae	Kumaradhara River	Ramachandra et al 2013	FISH	NE
347	12.868	75.588	*Channa orientalis*	Channidae	Kumaradhara River	Ramachandra et al 2013	FISH	NE
348	12.884	75.633	*Channa striatus*	Channidae	Kumaradhara River	Ramachandra et al 2013	FISH	LC
349	12.898	75.592	*Channa striatus*	Channidae	Kumaradhara River	Ramachandra et al 2013	FISH	LC
350	12.883	75.514	*Cirrhinus reba*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	LC
351	12.925	75.606	*Cirrhinus reba*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	LC
352	12.868	75.544	*Clarias dussumieri*	Clariidae	Kumaradhara River	Ramachandra et al 2013	FISH	NT

353	12.920	75.607	*Clarias dussumieri*	Clariidae	Kumaradhara River	Ramachandra et al 2013	FISH	NT
354	12.842	75.536	*Cyprinus carpio*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	VU
355	12.919	75.578	*Cyprinus carpio*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	VU
356	12.934	75.578	*Danio aequipinnatus*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	LC
357	12.942	75.574	*Danio aequipinnatus*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	LC
358	12.908	75.535	*Danio malabaricus*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	LC
359	12.944	75.563	*Danio malabaricus*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	LC
360	12.928	75.550	*Esomus thermoicos*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	LC
361	12.946	75.546	*Esomus thermoicos*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	LC
362	12.935	75.660	*Etroplus canarensis*	Cichlidae	Kumaradhara River	Ramachandra et al 2013	FISH	CR
363	12.957	75.569	*Etroplus canarensis*	Cichlidae	Kumaradhara River	Ramachandra et al 2013	FISH	CR
364	12.918	75.662	*Etroplus maculatus*	Cichlidae	Kumaradhara River	Ramachandra et al 2013	FISH	CR
365	12.957	75.557	*Etroplus maculatus*	Cichlidae	Kumaradhara River	Ramachandra et al 2013	FISH	CR
366	12.926	75.653	*Garra gotyla*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	LC
367	12.943	75.591	*Garra gotyla*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	LC
368	12.921	75.635	*Garra mullya*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	LC
369	12.961	75.593	*Garra mullya*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	LC
370	12.903	75.659	*Glossogobius giuris*	Gobiidae	Kumaradhara River	Ramachandra et al 2013	FISH	LC
371	12.947	75.623	*Glossogobius giuris*	Gobiidae	Kumaradhara River	Ramachandra et al 2013	FISH	LC
372	12.871	75.623	*Horabagrus brachysoma*	Bagridae	Kumaradhara River	Ramachandra et al 2013	FISH	CR
373	12.950	75.639	*Horabagrus brachysoma*	Bagridae	Kumaradhara River	Ramachandra et al 2013	FISH	CR
374	12.863	75.648	*Hyporhamphus limbatus*	Hemiramphidae	Kumaradhara River	Ramachandra et al 2013	FISH	LC
375	12.938	75.653	*Hyporhamphus limbatus*	Hemiramphidae	Kumaradhara River	Ramachandra et al 2013	FISH	LC
376	12.837	75.624	*Hypselobarbus kurali*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	LC
377	12.931	75.670	*Hypselobarbus kurali*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	LC
378	12.810	75.440	*Labeo kontius*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	EN
379	12.824	75.613	*Labeo kontius*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	EN
380	12.655	75.477	*Lepidocephalus thermalis*	Cobitidae	Kumaradhara River	Ramachandra et al 2013	FISH	LC
381	12.862	75.484	*Lepidocephalus thermalis*	Cobitidae	Kumaradhara River	Ramachandra et al 2013	FISH	LC
382	12.654	75.425	*Mastacembelus*	Mastacembelid	Kumaradhara	Ramachandra et	FISH	LC

			armatus	ae	River	al 2013		
383	12.778	75.444	*Mastacembelus armatus*	Mastacembelidae	Kumaradhara River	Ramachandra et al 2013	FISH	LC
384	12.700	75.364	*Nemacheilus petrubanarescui*	Balitoridae	Kumaradhara River	Ramachandra et al 2013	FISH	EN
385	12.809	75.372	*Nemacheilus petrubanarescui*	Balitoridae	Kumaradhara River	Ramachandra et al 2013	FISH	EN
386	12.719	75.397	*Mystus cavasius*	Bagridae	Kumaradhara River	Ramachandra et al 2013	FISH	LC
387	12.788	75.438	*Mystus cavasius*	Bagridae	Kumaradhara River	Ramachandra et al 2013	FISH	LC
388	12.780	75.546	*Mystus malabaricus*	Bagridae	Kumaradhara River	Ramachandra et al 2013	FISH	EN
389	12.790	75.245	*Mystus malabaricus*	Bagridae	Kumaradhara River	Ramachandra et al 2013	FISH	EN
390	12.790	75.267	*Oreochromis mossambica*	Cichlidae	Kumaradhara River	Ramachandra et al 2013	FISH	NE
391	12.810	75.524	*Oreochromis mossambica*	Cichlidae	Kumaradhara River	Ramachandra et al 2013	FISH	NE
392	12.698	75.583	*Osteochilichthys nashii*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	LC
393	12.754	75.533	*Osteochilichthys nashii*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	LC
394	12.662	75.602	*Poecilia reticulata*	Poeciliidae	Kumaradhara River	Ramachandra et al 2013	FISH	LC
395	12.793	75.534	*Poecilia reticulata*	Poeciliidae	Kumaradhara River	Ramachandra et al 2013	FISH	LC
396	12.687	75.600	*Pristolepis marginata*	Pristolepididae	Kumaradhara River	Ramachandra et al 2013	FISH	VU
397	12.757	75.519	*Pristolepis marginata*	Pristolepididae	Kumaradhara River	Ramachandra et al 2013	FISH	VU
398	12.697	75.556	*Pseudosphromenus cupanius*	Osphronemidae	Kumaradhara River	Ramachandra et al 2013	FISH	DD
399	12.826	75.639	*Pseudosphromenus cupanius*	Osphronemidae	Kumaradhara River	Ramachandra et al 2013	FISH	DD
400	12.684	75.569	*Puntius amphibius*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	DD
401	12.835	75.657	*Puntius amphibius*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	DD
402	12.707	75.618	*Puntius arulius arulius*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	EN
403	12.838	75.709	*Puntius arulius arulius*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	EN
404	12.626	75.636	*Puntius bimaculatus*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	DD
405	12.861	75.702	*Puntius bimaculatus*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	DD
406	12.635	75.615	*Puntius conchonius*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	DD
407	12.881	75.694	*Puntius conchonius*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	DD
408	12.642	75.750	*Puntius melanampyx*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	LC
409	12.897	75.657	*Puntius melanampyx*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	LC
410	12.624	75.718	*Puntius melanostigma*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	EN
411	12.910	75.628	*Puntius melanostigma*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	EN

412	12.582	75.676	*Puntius sophore*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	LC
413	12.924	75.587	*Puntius sophore*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	LC
414	12.555	75.679	*Puntius ticto*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	VU
415	12.923	75.570	*Puntius ticto*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	VU
416	12.515	75.666	*Puntius vittatus*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	VU
417	12.930	75.564	*Puntius vittatus*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	VU
418	12.670	75.693	*Puntiusfila mentosus*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	LC
419	12.886	75.679	*Puntiusfila mentosus*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	LC
420	12.611	75.702	*Systomus sarana*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	LC
421	12.916	75.618	*Systomus sarana*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	LC
422	12.595	75.680	*Puntiussetnai chhapgar*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	DD
423	12.928	75.623	*Puntiussetnai chhapgar*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	DD
424	12.507	75.644	*Rasbora daniconius*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	LC
425	12.912	75.564	*Rasbora daniconius*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	LC
426	12.559	75.634	*Salmostoma acinaces*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	DD
427	12.911	75.557	*Salmostoma acinaces*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	DD
428	12.611	75.676	*Salmostoma boopis*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	LC
429	12.919	75.557	*Salmostoma boopis*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	LC
430	12.655	75.644	*Schistura denisonii*	Nemacheilidae	Kumaradhara River	Ramachandra et al 2013	FISH	VU
431	12.935	75.555	*Schistura denisonii*	Nemacheilidae	Kumaradhara River	Ramachandra et al 2013	FISH	VU
432	12.650	75.612	*Schistura kodaguensis*	Nemacheilidae	Kumaradhara River	Ramachandra et al 2013	FISH	DD
433	12.920	75.544	*Schistura kodaguensis*	Nemacheilidae	Kumaradhara River	Ramachandra et al 2013	FISH	DD
434	12.691	75.645	*Schistura nilgiriensis*	Nemacheilidae	Kumaradhara River	Ramachandra et al 2013	FISH	EN
435	12.945	75.566	*Schistura nilgiriensis*	Nemacheilidae	Kumaradhara River	Ramachandra et al 2013	FISH	EN
436	12.664	75.628	*Schistura semiarmatus*	Nemacheilidae	Kumaradhara River	Ramachandra et al 2013	FISH	VU
437	12.953	75.560	*Schistura semiarmatus*	Nemacheilidae	Kumaradhara River	Ramachandra et al 2013	FISH	VU
438	12.760	75.649	*Carinotetraodon travancoricus*	Tetraodontidae	Kumaradhara River	Ramachandra et al 2013	FISH	EN
439	12.965	75.568	*Carinotetraodon travancoricus*	Tetraodontidae	Kumaradhara River	Ramachandra et al 2013	FISH	EN
440	12.785	75.648	*Tor khudree*	Cyprinidae	Kumaradhara River	Ramachandra et al 2013	FISH	VU
441	12.968	75.571	*Tor khudree*	Cyprinidae	Kumaradhara	Ramachandra et	FISH	VU

					River	al 2013		
442	12.797	75.623	*Xenentodon cancila*	Belonidae	Kumaradhara River	Ramachandra et al 2013	FISH	LC
443	12.956	75.589	*Xenentodon cancila*	Belonidae	Kumaradhara River	Ramachandra et al 2013	FISH	LC
444	12.851	74.831	*Aetobatus narinari*	Aetobatidae	Netravathi Estuary	Zacharia, 2008	FISH	NT
445	12.918	74.860	*Ambassis ambassis*	Ambassidae	Kavoor lake	Ramachandra et al 2007	FISH	LC
446	12.837	74.849	*Ambassis gymnocephalus*	Ambassidae	Netravathi Estuary	Fishbase	FISH	LC
447	12.829	75.613	*Amblyceps accari*	Amblycipitidae	Netravathi River	Fishbase	FISH	NE
448	12.962	75.433	*Amblyceps accari*	Amblycipitidae	Netravathi River	Fishbase	FISH	NE
449	13.094	75.204	*Amblyceps accari*	Amblycipitidae	Netravathi River	Fishbase	FISH	NE
450	12.754	75.712	*Anguilla bengalensis*	Anguillidae	Gundia Basin	Ramachandra et al 2010	FISH	NT
451	12.840	75.560	*Aploche iluslineatus*	Aplocheilidae	Kabbinale	Anandhi et al 2013	FISH	NE
452	12.747	75.714	*Aplocheilus blocki*	Aplocheilidae	Gundia Basin	Ramachandra et al 2010	FISH	DD
453	12.751	75.701	*Aplocheilus lineatus*	Aplocheilidae	Gundia Basin	Ramachandra et al 2010	FISH	LC
454	12.772	75.746	*Barilius bakeri*	Cyprinidae	Gundia Basin	Ramachandra et al 2010	FISH	LC
455	12.920	74.860	*Barilius barila*	Cyprinidae	Kavoor lake	Ramachandra et al 2007	FISH	LC
456	12.829	75.608	*Barilius canarensis*	Cyprinidae	Netravathi River	Fishbase	FISH	DD
457	12.943	75.432	*Barilius canarensis*	Cyprinidae	Netravathi River	Fishbase	FISH	DD
458	13.031	75.179	*Barilius canarensis*	Cyprinidae	Netravathi River	Fishbase	FISH	DD
459	12.839	75.660	*Barilius gatensis*	Cyprinidae	Netravathi River	Fishbase	FISH	DD
460	12.983	75.428	*Barilius gatensis*	Cyprinidae	Netravathi River	Fishbase	FISH	DD
461	13.117	75.212	*Barilius gatensis*	Cyprinidae	Netravathi River	Fishbase	FISH	DD
462	12.832	75.647	*Barilius malabaricus*	Cyprinidae	Netravathi River	Fishbase	FISH	DD
463	13.000	75.437	*Barilius malabaricus*	Cyprinidae	Netravathi River	Fishbase	FISH	DD
464	13.082	75.206	*Barilius malabaricus*	Cyprinidae	Netravathi River	Fishbase	FISH	DD
465	12.747	75.731	*Barilius bakeri*	Cyprinidae	Gundia Basin	Gururaj et al 2007	FISH	LC
466	12.746	75.729	*Barilius canarensis*	Cyprinidae	Gundia Basin	Gururaj et al 2007	FISH	DD
467	12.759	75.745	*Barilius gatensis*	Cyprinidae	Gundia Basin	Gururaj et al 2007	FISH	DD
468	12.850	75.560	*Bhavania australis*	Balitoridae	Kabbinale	Anandhi et al 2013	FISH	LC
469	12.809	75.746	*Brachydanio rerio*	Cyprinidae	Gundia Basin	Ramachandra et al 2010	FISH	LC
470	12.783	75.672	*Brachydanio rerio*	Cyprinidae	Gundia Basin	Gururaj et al 2007	FISH	LC

471	12.844	74.831	*Carcharhinus dussumieri*	Carcharhinidae	Netravathi Estuary	Zacharia, 2008	FISH	NT
472	12.844	74.831	*Carcharhinus hemiodon*	Carcharhinidae	Netravathi Estuary	Zacharia, 2008	FISH	CR
473	12.846	74.835	*Carcharhinus limbatus*	Carcharhinidae	Netravathi Estuary	Zacharia, 2008	FISH	CR
474	12.839	74.843	*Carcharhinus longimanus*	Carcharhinidae	Netravathi Estuary	Zacharia, 2008	FISH	CR
475	12.846	74.835	*Carcharhinus melanopterus*	Carcharhinidae	Netravathi Estuary	Zacharia, 2008	FISH	CR
476	12.870	75.570	*Carinotetraodon imitator*	Tetraodontidae	Kabbinale	Anandhi et al 2013	FISH	DD
477	12.896	75.337	*Catla catla*	Cyprinidae	Bandaru	EMP 2011	FISH	NE
478	12.860	75.560	*Channa gachua*	Channidae	Kabbinale	Anandhi et al 2013	FISH	NE
479	12.851	75.751	*Channa striatus*	Channidae	Gundia Basin	Ramachandra et al 2010	FISH	NE
480	12.792	75.668	*Channa orientalis*	Channidae	Gundia Basin	Gururaj et al 2007	FISH	VU
481	12.764	75.703	*Channa striatus*	Channidae	Gundia Basin	Gururaj et al 2007	FISH	LC
482	12.846	74.831	*Chiloscyllium griseum*	Hemiscylliidae	Netravathi Estuary	Zacharia, 2008	FISH	NT
483	12.768	75.714	*Cirrhinus reba*	Cyprinidae	Gundia Basin	Gururaj et al 2007	FISH	LC
484	12.763	75.710	*Clarias dussumieri*	Clariidae	Gundia Basin	Gururaj et al 2007	FISH	NT
485	12.829	75.634	*Crossocheilus latius*	Cyprinidae	Netravathi River	Fishbase	FISH	DD
486	12.995	75.456	*Crossocheilus latius*	Cyprinidae	Netravathi River	Fishbase	FISH	DD
487	13.031	75.060	*Crossocheilus latius*	Cyprinidae	Netravathi River	Fishbase	FISH	DD
488	12.919	74.859	*Cyprinus carpio*	Cyprinidae	Kavoor lake	Ramachandra et al 2007	FISH	VU
489	12.740	75.733	*Cyprinus carpio*	Cyprinidae	Gundia Basin	Gururaj et al 2007	FISH	VU
490	12.762	75.698	*Danio aequipinnatus*	Cyprinidae	Gundia Basin	Ramachandra et al 2010	FISH	LC
491	12.751	75.723	*Danio aequipinnatus*	Cyprinidae	Gundia Basin	Gururaj et al 2007	FISH	LC
492	12.755	75.731	*Danio malabaricus*	Cyprinidae	Gundia Basin	Gururaj et al 2007	FISH	LC
493	12.870	75.570	*Danio aequipinnatus*	Cyprinidae	Addahole	Anandhi et al 2013	FISH	LC
494	12.842	75.678	*Dawkinsia filamentosa*	Cyprinidae	Netravathi River	Fishbase	FISH	DD
495	13.003	75.511	*Dawkinsia filamentosa*	Cyprinidae	Netravathi River	Fishbase	FISH	DD
496	13.070	75.188	*Dawkinsia filamentosa*	Cyprinidae	Netravathi River	Fishbase	FISH	DD
497	12.919	74.860	*Esomus barbatus*	Cyprinidae	Kavoor lake	Ramachandra et al 2007	FISH	LC
498	12.780	75.748	*Esomus thermoicos*	Cyprinidae	Gundia Basin	Gururaj et al 2007	FISH	LC
499	12.847	75.698	*Etroplus canarensis*	Cichlidae	Netravathi River	Fishbase	FISH	CR
500	12.994	75.509	*Etroplus canarensis*	Cichlidae	Netravathi River	Fishbase	FISH	CR
501	13.081	75.222	*Etroplus*	Cichlidae	Netravathi	Fishbase	FISH	CR

			canarensis		River			
502	12.855	75.707	*Etroplus maculatus*	Cichlidae	Netravathi River	Fishbase	FISH	CR
503	13.008	75.528	*Etroplus maculatus*	Cichlidae	Netravathi River	Fishbase	FISH	CR
504	13.028	75.156	*Etroplus maculatus*	Cichlidae	Netravathi River	Fishbase	FISH	CR
505	12.774	75.726	*Etroplus maculatus*	Cichlidae	Gundia Basin	Gururaj et al 2007	FISH	CR
506	12.791	75.731	*Etroplus maculatus*	Cichlidae	Gundia Basin	Gururaj et al 2007	FISH	CR
507	12.846	74.831	*Galeocerdo cuvier*	Carcharhinidae	Netravathi Estuary	Zacharia, 2008	FISH	NT
508	12.919	74.860	*Garra gotyla*	Cyprinidae	Kavoor lake	Ramachandra et al 2007	FISH	LC
509	12.821	75.707	*Garra gotyla*	Cyprinidae	Gundia Basin	Ramachandra et al 2010	FISH	LC
510	12.860	75.560	*Garra mullya*	Cyprinidae	Addahole	Anunchi et al 2013	FISH	LC
511	12.794	75.717	*Garra gotyla*	Cyprinidae	Gundia Basin	Gururaj et al 2007	FISH	LC
512	12.812	75.723	*Garra mullya*	Cyprinidae	Gundia Basin	Gururaj et al 2007	FISH	LC
513	12.743	75.703	*Glossogobius giuris*	Gobiidae	Gundia Basin	Ramachandra et al 2010	FISH	LC
514	12.801	75.718	*Glossogobius giuris*	Gobiidae	Gundia Basin	Gururaj et al 2007	FISH	LC
515	12.859	75.712	*Hemibagrus punctatus*	Bagridae	Netravathi River	Fishbase	FISH	CR
516	13.014	75.531	*Hemibagrus punctatus*	Bagridae	Netravathi River	Fishbase	FISH	CR
517	13.114	75.173	*Hemibagrus punctatus*	Bagridae	Netravathi River	Fishbase	FISH	CR
518	12.861	75.715	*Heteropneustes fossilis*	Heteropneustidae	Netravathi River	Fishbase	FISH	VU
519	13.019	75.536	*Heteropneustes fossilis*	Heteropneustidae	Netravathi River	Fishbase	FISH	VU
520	13.116	75.173	*Heteropneustes fossilis*	Heteropneustidae	Netravathi River	Fishbase	FISH	VU
521	12.840	75.248	*Horabagrus brachysoma*	Bagridae	Netravathi River	Raghavan et al 2016	FISH	VU
522	12.823	75.729	*Horabagrus brachysoma*	Bagridae	Gundia Basin	Gururaj et al 2007	FISH	CR
523	12.828	75.729	*Hyporhamphus limbatus*	Cyprinidae	Gundia Basin	Gururaj et al 2007	FISH	DD
524	12.828	75.684	*Hypselobarbus jerdoni*	Cyprinidae	Netravathi River	Fishbase	FISH	EN
525	13.030	75.534	*Hypselobarbus jerdoni*	Cyprinidae	Netravathi River	Fishbase	FISH	EN
526	13.123	75.185	*Hypselobarbus jerdoni*	Cyprinidae	Netravathi River	Fishbase	FISH	EN
527	12.832	75.700	*Hypselobarbus pulchellus*	Cyprinidae	Netravathi River	Fishbase	FISH	EN
528	13.106	75.151	*Hypselobarbus pulchellus*	Cyprinidae	Netravathi River	Fishbase	FISH	EN
529	13.109	75.208	*Hypselobarbus pulchellus*	Cyprinidae	Netravathi River	Fishbase	FISH	EN
530	12.845	75.563	*Hypselobarbus thomassi*	Cyprinidae	Netravathi River	Fishbase	FISH	EN

531	13.018	75.112	*Hypselobarbus thomassi*	Cyprinidae	Netravathi River	Fishbase	FISH	EN
532	13.137	75.166	*Hypselobarbus thomassi*	Cyprinidae	Netravathi River	Fishbase	FISH	EN
533	12.833	75.705	*Hypselobarbus kurali*	Cyprinidae	Gundia Basin	Gururaj et al 2007	FISH	EN
534	12.836	74.845	*Ilisha indica*	Pristigasteridae	Netravathi Estuary	Fishbase	FISH	NE
535	12.939	74.817	*Ilisha indica*	Pristigasteridae	Gurupura Estuary	Fishbase	FISH	NE
536	12.836	74.853	*Kowala coval*	Clupeidae	Netravathi Estuary	Fishbase	FISH	NE
537	12.938	74.828	*Kowala coval*	Clupeidae	Gurupura Estuary	Fishbase	FISH	NE
538	12.829	75.493	*Labeo rohita*	Cyprinidae	Netravathi River	Fishbase	FISH	LC
539	12.838	75.563	*Labeo rohita*	Cyprinidae	Netravathi River	Fishbase	FISH	LC
540	13.135	75.167	*Labeo rohita*	Cyprinidae	Netravathi River	Fishbase	FISH	LC
541	12.828	75.701	*Labeo kontius*	Cyprinidae	Gundia Basin	Gururaj et al 2007	FISH	EN
542	12.762	75.686	*Lepidocephalus thermalis*	Cobitidae	Gundia Basin	Ramachandra et al 2010	FISH	LC
543	12.832	75.710	*Lepidocephalus thermalis*	Cobitidae	Gundia Basin	Gururaj et al 2007	FISH	LC
544	12.799	75.704	*Mastacembelus armatus*	Mastacembelidae	Gundia Basin	Gururaj et al 2007	FISH	LC
545	12.863	75.563	*Megalops cyprinoides*	Megalopidae	Netravathi River	Fishbase	FISH	DD
546	12.912	74.961	*Megalops cyprinoides*	Megalopidae	Netravathi River	Fishbase	FISH	DD
547	13.107	75.133	*Megalops cyprinoides*	Megalopidae	Netravathi River	Fishbase	FISH	DD
548	12.805	75.669	*Nemacheilus petrubanarescu*	Balitoridae	Gundia Basin	Gururaj et al 2007	FISH	EN
549	12.851	74.831	*Mobula mobular*	Mobulidae	Netravathi Estuary	Zacharia, 2008	FISH	EN
550	12.858	75.560	*Mystus malabaricus*	Bagridae	Netravathi River	Fishbase	FISH	EN
551	12.878	75.097	*Mystus malabaricus*	Bagridae	Netravathi River	Fishbase	FISH	EN
552	13.014	75.030	*Mystus malabaricus*	Bagridae	Netravathi River	Fishbase	FISH	EN
553	12.804	75.676	*Mystus cavasius*	Bagridae	Gundia Basin	Gururaj et al 2007	FISH	LC
554	12.800	75.668	*Mystus malabaricus*	Bagridae	Gundia Basin	Gururaj et al 2007	FISH	EN
555	12.765	75.371	*Nemacheilus denisoni*	Balitoridae	Netravathi River	Fishbase	FISH	LC
556	12.962	75.433	*Nemacheilus denisoni*	Balitoridae	Netravathi River	Fishbase	FISH	LC
557	13.018	75.112	*Nemacheilus denisoni*	Balitoridae	Netravathi River	Fishbase	FISH	LC
558	12.775	75.451	*Nemacheilus kodaguensis*	Balitoridae	Netravathi River	Fishbase	FISH	EN
559	13.000	75.437	*Nemacheilus kodaguensis*	Balitoridae	Netravathi River	Fishbase	FISH	EN
560	13.107	75.133	*Nemacheilus kodaguensis*	Balitoridae	Netravathi River	Fishbase	FISH	EN

561	12.905	75.587	*Nemacheilus petrubanarescui*	Balitoridae	Netravathi River	Fishbase	FISH	EN
562	12.943	75.432	*Nemacheilus petrubanarescui*	Balitoridae	Netravathi River	Fishbase	FISH	EN
563	13.106	75.151	*Nemacheilus petrubanarescui*	Balitoridae	Netravathi River	Fishbase	FISH	EN
564	12.808	75.459	*Nemacheilus pulchellus*	Balitoridae	Netravathi River	Fishbase	FISH	EN
565	12.995	75.456	*Nemacheilus pulchellus*	Balitoridae	Netravathi River	Fishbase	FISH	EN
566	13.014	75.030	*Nemacheilus pulchellus*	Balitoridae	Netravathi River	Fishbase	FISH	EN
567	12.822	75.468	*Nemacheilus semiarmatus*	Balitoridae	Netravathi River	Fishbase	FISH	EN
568	12.829	75.497	*Nemacheilus semiarmatus*	Balitoridae	Netravathi River	Fishbase	FISH	EN
569	13.003	75.511	*Nemacheilus semiarmatus*	Balitoridae	Netravathi River	Fishbase	FISH	EN
570	12.744	75.407	*Neolissochilus bovanicus*	Cyprinidae	Netravathi River	Fishbase	FISH	CR
571	12.829	75.493	*Neolissochilus bovanicus*	Cyprinidae	Netravathi River	Fishbase	FISH	CR
572	12.983	75.428	*Neolissochilus bovanicus*	Cyprinidae	Netravathi River	Fishbase	FISH	CR
573	12.696	75.668	*Notopterus notopterus*	Notopteridae	Netravathi River	Fishbase	FISH	DD
574	12.828	75.484	*Notopterus notopterus*	Notopteridae	Netravathi River	Fishbase	FISH	DD
575	12.994	75.509	*Notopterus notopterus*	Notopteridae	Netravathi River	Fishbase	FISH	DD
576	12.706	75.704	*Ompok bimaculatus*	Siluridae	Netravathi River	Fishbase	FISH	EN
577	12.831	75.538	*Ompok bimaculatus*	Siluridae	Netravathi River	Fishbase	FISH	EN
578	13.008	75.528	*Ompok bimaculatus*	Siluridae	Netravathi River	Fishbase	FISH	EN
579	12.690	75.720	*Ompok malabaricus*	Siluridae	Netravathi River	Fishbase	FISH	CR
580	12.826	75.532	*Ompok malabaricus*	Siluridae	Netravathi River	Fishbase	FISH	CR
581	13.014	75.531	*Ompok malabaricus*	Siluridae	Netravathi River	Fishbase	FISH	CR
582	12.917	74.860	*Oreochromis mossambicus*	Cichlidae	Kavoor lake	Ramachandra et al 2007	FISH	NE
583	12.800	75.743	*Oreochromis mossambicus*	Cichlidae	Gundia Basin	Gururaj et al 2007	FISH	NE
584	12.825	75.558	*Osteochilichthys brevidorsalis*	Cyprinidae	Netravathi River	Fishbase	FISH	LC
585	13.019	75.536	*Osteochilichthys brevidorsalis*	Cyprinidae	Netravathi River	Fishbase	FISH	LC
586	13.074	75.238	*Osteochilichthys brevidorsalis*	Cyprinidae	Netravathi River	Fishbase	FISH	LC
587	12.806	75.744	*Osteochilichthys nashii*	Cyprinidae	Gundia Basin	Gururaj et al 2007	FISH	LC
588	12.825	75.558	*Pangio ammophila*	Cobitidae	Netravathi River	Fishbase	FISH	DD
589	12.899	75.579	*Pangio ammophila*	Cobitidae	Netravathi River	Fishbase	FISH	DD
590	12.932	75.404	*Pangio*	Cobitidae	Netravathi	Fishbase	FISH	DD

			ammophila		River			
591	12.830	75.561	*Pethia narayani*	Cyprinidae	Netravathi River	Fishbase	FISH	CR
592	13.030	75.534	*Pethia narayani*	Cyprinidae	Netravathi River	Fishbase	FISH	CR
593	13.037	75.168	*Pethia narayani*	Cyprinidae	Netravathi River	Fishbase	FISH	CR
594	12.660	75.610	*Pethia setnai*	Cyprinidae	Kukke Subramanya	Alam et al 2008	FISH	VU
595	12.730	75.660	*Pethia setnai*	Cyprinidae	Gundia	Alam et al 2008	FISH	VU
596	12.763	75.302	*Pethia striata*	Cyprinidae	Netravathi River	Fishbase	FISH	CR
597	12.826	75.569	*Pethia striata*	Cyprinidae	Netravathi River	Fishbase	FISH	CR
598	13.086	75.245	*Pethia striata*	Cyprinidae	Netravathi River	Fishbase	FISH	CR
599	12.830	75.589	*Pethia ticto*	Cyprinidae	Netravathi River	Fishbase	FISH	LC
600	12.863	75.329	*Pethia ticto*	Cyprinidae	Netravathi River	Fishbase	FISH	LC
601	13.090	75.224	*Pethia ticto*	Cyprinidae	Netravathi River	Fishbase	FISH	LC
602	12.840	74.861	*Platycephalus scaber*	Platycephalidae	Netravathi Estuary	Fishbase	FISH	NE
603	12.927	74.833	*Platycephalus scaber*	Platycephalidae	Gurupura Estuary	Fishbase	FISH	NE
604	12.919	74.859	*Poecilia reticulata*	Poeciliidae	Kavoor lake	Ramachandra et al 2007	FISH	LC
605	12.816	75.738	*Poecilia reticulata*	Poeciliidae	Gundia Basin	Gururaj et al 2007	FISH	LC
606	12.827	75.581	*Pristolepis marginata*	Pristolepididae	Netravathi River	Fishbase	FISH	VU
607	12.927	75.365	*Pristolepis marginata*	Pristolepididae	Netravathi River	Fishbase	FISH	VU
608	13.044	75.183	*Pristolepis marginata*	Pristolepididae	Netravathi River	Fishbase	FISH	VU
609	12.820	75.745	*Pristolepis marginata*	Pristolepididae	Gundia Basin	Gururaj et al 2007	FISH	VU
610	12.829	75.242	*Pseudolaguvia lapillicola*	Erethistidae	Netravathi River	Fishbase	FISH	NE
611	12.829	75.497	*Pseudolaguvia lapillicola*	Erethistidae	Netravathi River	Fishbase	FISH	NE
612	12.867	75.568	*Pseudolaguvia lapillicola*	Erethistidae	Netravathi River	Fishbase	FISH	NE
613	12.827	75.598	*Pseudosphromenus cupanus*	Osphronemidae	Netravathi River	Fishbase	FISH	DD
614	12.932	75.404	*Pseudosphromenus cupanus*	Osphronemidae	Netravathi River	Fishbase	FISH	DD
615	13.053	75.179	*Pseudosphromenus cupanus*	Osphronemidae	Netravathi River	Fishbase	FISH	DD
616	12.790	75.668	*Pseudosphromenus cupanius*	Osphronemidae	Gundia Basin	Gururaj et al 2007	FISH	DD
617	12.779	75.683	*Puntius amphibius*	Cyprinidae	Gundia Basin	Ramachandra et al 2010	FISH	DD
618	12.918	74.860	*Puntius chola*	Cyprinidae	Kavoor lake	Ramachandra et al 2007	FISH	DD
619	12.941	75.735	*Puntius fasciatus*	Cyprinidae	Gundia Basin	Ramachandra et al 2010	FISH	LC

620	12.840	75.560	*Puntius fasciatus*	Cyprinidae	Addahole	Anandhi et al 2013	FISH	LC
621	12.851	75.405	*Puntius filamentosus*	Cyprinidae	Kokkada	EMP 2011	FISH	LC
622	12.850	75.560	*Puntius filamentosus*	Cyprinidae	Addahole	Anandhi et al 2013	FISH	LC
623	12.839	75.399	*Puntius narayani*	Cyprinidae	Uppinangadi	EMP 2011	FISH	LC
624	12.850	75.560	*Puntius narayani*	Cyprinidae	Kabbinale	Anandhi et al 2013	FISH	LC
625	12.763	75.302	*Puntius parrah*	Cyprinidae	Netravathi River	Fishbase	FISH	EN
626	12.828	75.484	*Puntius parrah*	Cyprinidae	Netravathi River	Fishbase	FISH	EN
627	12.876	75.569	*Puntius parrah*	Cyprinidae	Netravathi River	Fishbase	FISH	EN
628	12.860	75.560	*Puntius sophore*	Cyprinidae	Addahole	Anandhi et al 2013	FISH	LC
629	12.939	75.722	*Puntius sophore*	Cyprinidae	Gundia Basin	Ramachandra et al 2010	FISH	LC
630	12.905	75.719	*Puntius ticto*	Cyprinidae	Gundia Basin	Ramachandra et al 2010	FISH	VU
631	12.918	74.860	*Puntius ticto*	Cyprinidae	Kavoor lake	Ramachandra et al 2007	FISH	VU
632	12.831	75.538	*Puntius vittatus*	Cyprinidae	Netravathi River	Fishbase	FISH	VU
633	12.863	75.329	*Puntius vittatus*	Cyprinidae	Netravathi River	Fishbase	FISH	VU
634	12.884	75.572	*Puntius vittatus*	Cyprinidae	Netravathi River	Fishbase	FISH	VU
635	12.762	75.681	*Puntius amphibius*	Cyprinidae	Gundia Basin	Gururaj et al 2007	FISH	LC
636	12.774	75.774	*Puntius arulius*	Cyprinidae	Gundia Basin	Gururaj et al 2007	FISH	EN
637	12.742	75.725	*Puntius bimaculatus*	Cyprinidae	Gundia Basin	Gururaj et al 2007	FISH	DD
638	12.796	75.724	*Puntius conchonius*	Cyprinidae	Gundia Basin	Gururaj et al 2007	FISH	VU
639	12.776	75.675	*Puntius filamentosus*	Cyprinidae	Gundia Basin	Gururaj et al 2007	FISH	DD
640	12.748	75.709	*Puntius melanampyx*	Cyprinidae	Gundia Basin	Gururaj et al 2007	FISH	LC
641	12.746	75.698	*Puntius melanostigma*	Cyprinidae	Gundia Basin	Gururaj et al 2007	FISH	EN
642	12.726	75.718	*Puntius sarana*	Cyprinidae	Gundia Basin	Gururaj et al 2007	FISH	LC
643	12.727	75.732	*Puntius setnai*	Cyprinidae	Gundia Basin	Gururaj et al 2007	FISH	DD
644	12.788	75.783	*Puntius sophore*	Cyprinidae	Gundia Basin	Gururaj et al 2007	FISH	LC
645	12.754	75.737	*Puntius ticto*	Cyprinidae	Gundia Basin	Gururaj et al 2007	FISH	LC
646	12.788	75.767	*Puntius vittatus*	Cyprinidae	Gundia Basin	Gururaj et al 2007	FISH	VU
647	12.883	75.746	*Rasbora daniconius*	Cyprinidae	Gundia Basin	Ramachandra et al 2010	FISH	LC
648	12.880	75.570	*Rasbora daniconius*	Cyprinidae	Addahole	Anandhi et al 2013	FISH	LC
649	12.918	74.860	*Rasbora rasbora*	Cyprinidae	Kavoor lake	Ramachandra et al 2007	FISH	LC
650	12.779	75.723	*Rasbora daniconius*	Cyprinidae	Gundia Basin	Gururaj et al 2007	FISH	LC

651	12.886	75.337	*Rasbora daniconius*	Cyprinidae	Bandaru	EMP 2011	FISH	LC
652	12.839	74.843	*Rhina ancylostoma*	Rhinidae	Netravathi Estuary	Zacharia, 2008	FISH	VU
653	12.826	75.532	*Salmostoma acinaces*	Cyprinidae	Netravathi River	Fishbase	FISH	DD
654	12.890	75.574	*Salmostoma acinaces*	Cyprinidae	Netravathi River	Fishbase	FISH	DD
655	12.927	75.365	*Salmostoma acinaces*	Cyprinidae	Netravathi River	Fishbase	FISH	DD
656	12.775	75.737	*Salmostoma acinaces*	Cyprinidae	Gundia Basin	Gururaj et al 2007	FISH	LC
657	12.831	75.411	*Salmostoma acinaces*	Cyprinidae	Nelyadi	EMP 2011	FISH	LC
658	12.805	75.706	*Salmostoma boopis*	Cyprinidae	Gundia Basin	Gururaj et al 2007	FISH	LC
659	12.836	74.865	*Sardinella jussieui*	Clupeidae	Netravathi Estuary	Fishbase	FISH	NE
660	12.939	74.824	*Sardinella jussieui*	Clupeidae	Gurupura Estuary	Fishbase	FISH	NE
661	12.831	74.839	*Sardinella longiceps*	Clupeidae	Netravathi Estuary	Fishbase	FISH	NE
662	12.931	74.834	*Sardinella longiceps*	Clupeidae	Gurupura Estuary	Fishbase	FISH	NE
663	12.859	75.730	*Schistura denisonii*	Nemacheilidae	Gundia Basin	Ramachandra et al 2010	FISH	VU
664	12.880	75.570	*Schistura nagodiensis*	Nemacheilidae	Kabbinale	Anandhi et al 2013	FISH	EN
665	12.826	75.704	*Schistura denisonii*	Nemacheilidae	Gundia Basin	Gururaj et al 2007	FISH	VU
666	12.790	75.746	*Schistura kodaguensis*	Nemacheilidae	Gundia Basin	Gururaj et al 2007	FISH	DD
667	12.889	75.728	*Schistura nilgiriensis*	Nemacheilidae	Gundia Basin	Gururaj et al 2007	FISH	EN
668	12.933	75.676	*Schistura semiarmatus*	Nemacheilidae	Gundia Basin	Gururaj et al 2007	FISH	VU
669	12.840	74.868	*Sillago sihama*	Sillaginidae	Netravathi Estuary	Fishbase	FISH	LC
670	12.936	74.829	*Sillago sihama*	Sillaginidae	Gurupura Estuary	Fishbase	FISH	LC
671	12.832	74.835	*Sillago sihama*	Sillaginidae	Netravathi Estuary	Fishbase	FISH	LC
672	12.928	74.814	*Sillago sihama*	Sillaginidae	Gurupura Estuary	Fishbase	FISH	LC
673	12.844	74.831	*Sphyrna mokarran*	Sphyrnidae	Netravathi Estuary	Zacharia, 2008	FISH	EN
674	12.846	74.835	*Stegostoma fasciatum*	Stegostomidae	Netravathi Estuary	Zacharia, 2008	FISH	EN
675	12.939	75.663	*Carinotetraodon travancoricus*	Tetraodontidae	Gundia Basin	Gururaj et al 2007	FISH	EN
676	12.842	74.834	*Teuthis oramin*	Siganidae	Netravathi Estuary	Fishbase	FISH	NE
677	12.932	74.812	*Teuthis oramin*	Siganidae	Gurupura Estuary	Fishbase	FISH	NE
678	12.829	75.731	*Tor khudree*	Cyprinidae	Gundia Basin	Ramachandra et al 2010	FISH	EN
679	12.953	75.708	*Tor khudree*	Cyprinidae	Gundia Basin	Gururaj et al 2007	FISH	VU
680	12.951	75.685	*Xenentodon cancila*	Belonidae	Gundia Basin	Gururaj et al 2007	FISH	LC

681	12.664	75.690	*Amblonyx cinereus*	Mustelidae	Pushpagiri WLS	Kumara et al 2010	MAMMALS	VU
682	12.664	75.690	*Axis axis*	Cervidae	Pushpagiri WLS	Kumara et al 2010	MAMMALS	LC
683	13.110	75.446	*Axis axis*	Cervidae	Netravathi River	Ramachandra et al 2007	MAMMALS	LC
684	12.851	74.831	*Balaenoptera musculus*	Balaenopteridae	Netravathi Estuary	Zacharia, 2008	MAMMALS	EN
685	12.560	75.590	*Bos gaurus*	Bovidae	Kumaradhara River	Ramachandra et al 2013	MAMMALS	VU
686	12.664	75.690	*Bos gaurus*	Bovidae	Pushpagiri WLS	Kumara et al 2010	MAMMALS	LC
687	12.715	75.701	*Bos gaurus*	Bovidae	Netravathi River	Kumara et al 2007	Mammals	VU
688	12.800	75.743	*Bos gaurus*	Bovidae	Gundia Basin	Ramachandra et al 2010	MAMMALS	VU
689	12.945	75.636	*Bos gaurus*	Bovidae	Kumaradhara River	Ramachandra et al 2013	MAMMALS	VU
690	13.071	75.494	*Bos gaurus*	Bovidae	Netravathi River	Ramachandra et al 2007	MAMMALS	VU
691	13.138	75.178	*Bos gaurus*	Bovidae	Kudremukh Tiger Reserve	Ramachandra et al 2017	MAMMALS	VU
692	12.664	75.690	*Canis aureus*	Canidae	Pushpagiri WLS	Kumara et al 2010	MAMMALS	LC
693	12.585	75.655	*Cervus unicolor*	Cervidae	Kumaradhara River	Ramachandra et al 2013	MAMMALS	VU
694	12.699	75.363	*Cervus unicolor*	Cervidae	Netravathi River	Kumara et al 2007	Mammals	VU
695	12.806	75.744	*Cervus unicolor*	Cervidae	Gundia Basin	Ramachandra et al 2010	MAMMALS	VU
696	12.922	75.477	*Cervus unicolor*	Cervidae	Netravathi River	Kumara et al 2007	Mammals	VU
697	12.945	75.628	*Cervus unicolor*	Cervidae	Kumaradhara River	Ramachandra et al 2013	MAMMALS	VU
698	12.954	75.550	*Cervus unicolor*	Cervidae	Netravathi River	Kumara et al 2007	Mammals	VU
699	13.050	75.120	*Cervus unicolor*	Cervidae	Netravathi River	Kumara et al 2007	Mammals	VU
700	13.104	75.278	*Cervus unicolor*	Cervidae	Kudremukh Tiger Reserve	Ramachandra et al 2017	MAMMALS	VU
701	12.664	75.690	*Cuon alpinus*	Canidae	Pushpagiri WLS	Kumara et al 2010	MAMMALS	EN
702	13.144	75.182	*Cuon alpinus*	Canidae	Kudremukh Tiger Reserve	Ramachandra et al 2017	MAMMALS	EN
703	12.544	75.591	*Elephas maximus*	Elephantidae	Kumaradhara River	Ramachandra et al 2013	MAMMALS	EN
704	12.664	75.690	*Elephas maximus*	Elephantidae	Pushpagiri WLS	Kumara et al 2010	MAMMALS	EN
705	12.684	75.667	*Elephas maximus*	Elephantidae	Netravathi River	Kumara et al 2007	Mammals	EN
706	12.816	75.738	*Elephas maximus*	Elephantidae	Gundia Basin	Ramachandra et al 2010	MAMMALS	EN
707	12.933	75.611	*Elephas maximus*	Elephantidae	Kumaradhara River	Ramachandra et al 2013	MAMMALS	EN
708	13.164	75.192	*Elephas maximus*	Elephantidae	Kudremukh Tiger Reserve	Ramachandra et al 2017	MAMMALS	EN
709	12.608	75.587	*Felis chaus*	Felidae	Kumaradhara River	Ramachandra et al 2013	MAMMALS	LC
710	12.657	75.291	*Felis chaus*	Felidae	Kumaradhara	Ramachandra et	MAMMA	LC

					River	al 2013	LS	
711	12.664	75.690	*Felis chaus*	Felidae	Pushpagiri WLS	Kumara et al 2010	MAMMA LS	LC
712	12.680	75.759	*Felis chaus*	Felidae	Netravathi River	Kumara et al 2007	Mammals	LC
713	12.773	75.531	*Felis chaus*	Felidae	Netravathi River	Kumara et al 2007	Mammals	LC
714	12.820	75.745	*Felis chaus*	Felidae	Gundia Basin	Gururaj et al 2007	MAMMA LS	LC
715	12.963	75.292	*Felis chaus*	Felidae	Netravathi River	Kumara et al 2007	Mammals	LC
716	13.051	75.337	*Felis chaus*	Felidae	Netravathi River	Kumara et al 2007	Mammals	LC
717	12.643	75.306	*Funambulus palmarum*	Sciuridae	Kumaradhara River	Ramachandra et al 2013	MAMMA LS	LC
718	12.801	75.718	*Funambulus palmarum*	Sciuridae	Gundia Basin	Gururaj et al 2007	MAMMA LS	LC
719	12.664	75.690	*Herpestes brachyurus*	Herpestidae	Pushpagiri WLS	Kumara et al 2010	MAMMA LS	NT
720	12.677	75.292	*Herpestes edwardsi*	Herpestidae	Kumaradhara River	Ramachandra et al 2013	MAMMA LS	LC
721	12.823	75.729	*Herpestes edwardsi*	Herpestidae	Gundia Basin	Gururaj et al 2007	MAMMA LS	LC
722	12.664	75.690	*Herpestes edwardsii*	Herpestidae	Pushpagiri WLS	Kumara et al 2010	MAMMA LS	LC
723	12.773	75.531	*Herpestes edwardsii*	Herpestidae	Netravathi River	Kumara et al 2007	Mammals	LC
724	12.886	75.497	*Herpestes edwardsii*	Herpestidae	Netravathi River	Kumara et al 2007	Mammals	LC
725	12.921	75.542	*Herpestes edwardsii*	Herpestidae	Netravathi River	Kumara et al 2007	Mammals	LC
726	12.938	75.629	*Herpestes edwardsii*	Herpestidae	Netravathi River	Kumara et al 2007	Mammals	LC
727	12.591	75.669	*Herpestes fuscus*	Herpestidae	Netravathi River	Kumara et al 2007	Mammals	LC
728	12.639	75.472	*Herpestes fuscus*	Herpestidae	Netravathi River	Kumara et al 2007	Mammals	LC
729	12.853	75.332	*Herpestes fuscus*	Herpestidae	Netravathi River	Kumara et al 2007	Mammals	LC
730	13.088	75.420	*Herpestes fuscus*	Herpestidae	Netravathi River	Kumara et al 2007	Mammals	LC
731	12.664	75.690	*Herpestes vitticollis*	Herpestidae	Pushpagiri WLS	Kumara et al 2010	MAMMA LS	LC
732	12.886	75.669	Herpestes sp	Herpestidae	Netravathi River	Ramachandra et al 2007	MAMMA LS	NE
733	12.973	75.125	*Hipposideros pomona*	Hipposideridae	Karnataka	Korad et al 2007	MAMMA LS	LC
734	12.664	75.690	*Hyaena hyaena*	Hyaenidae	Pushpagiri WLS	Kumara et al 2010	MAMMA LS	NT
735	12.664	75.690	*Hystrix indica*	Hystricidae	Pushpagiri WLS	Kumara et al 2010	MAMMA LS	LC
736	12.739	75.297	*Hystrix indica*	Hystricidae	Puttur	Crook et al 2015	MAMMA LS	LC
737	12.772	75.284	*Hystrix indica*	Hystricidae	Kumaradhara River	Ramachandra et al 2013	MAMMA LS	LC
738	12.828	75.729	*Hystrix indica*	Hystricidae	Gundia Basin	Gururaj et al 2007	MAMMA LS	LC
739	12.954	75.550	*Hystrix indica*	Hystricidae	Netravathi River	Ramachandra et al 2007	MAMMA LS	LC

740	12.993	75.204	*Hystrix indica*	Hystricidae	Bantwal	Crook et al 2015	MAMMALS	LC
741	13.102	75.489	*Lepus nigricollis*	Leporidae	Netravathi River	Ramachandra et al 2007	MAMMALS	LC
742	12.664	75.690	*Lepus nigricollis*	Leporidae	Pushpagiri WLS	Kumara et al 2010	MAMMALS	LC
743	12.833	75.705	*Lepus nigricollis*	Leporidae	Gundia Basin	Gururaj et al 2007	MAMMALS	LC
744	12.835	75.513	*Lepus nigricollis*	Leporidae	Kumaradhara River	Ramachandra et al 2013	MAMMALS	LC
745	12.664	75.690	*Loris lydekkerianus*	Lorisidae	Pushpagiri WLS	Kumara et al 2010	MAMMALS	LC
746	12.664	75.690	*Lutra lutra*	Mustelidae	Pushpagiri WLS	Kumara et al 2010	MAMMALS	NT
747	12.664	75.690	*Lutrogale perspicillata*	Viverridae	Pushpagiri WLS	Kumara et al 2010	MAMMALS	VU
748	12.664	75.690	*Macaca radiata*	Cercopithecidae	Pushpagiri WLS	Kumara et al 2010	MAMMALS	LC
749	12.820	75.535	*Macaca radiata*	Cercopithecidae	Kumaradhara River	Ramachandra et al 2013	MAMMALS	LC
750	12.828	75.701	*Macaca radiata*	Cercopithecidae	Gundia Basin	Gururaj et al 2007	MAMMALS	LC
751	12.664	75.690	*Macaca silenus*	Cercopithecidae	Pushpagiri WLS	Kumara et al 2010	MAMMALS	EN
752	12.703	75.444	*Viverra civettina*	Viverridae	Netravathi River	Kumara et al 2007	Mammals	CR
753	12.816	75.239	*Viverra civettina*	Viverridae	Netravathi River	Kumara et al 2007	Mammals	CR
754	12.861	75.344	*Viverra civettina*	Viverridae	Netravathi River	Kumara et al 2007	Mammals	CR
755	13.110	75.446	*Viverra civettina*	Viverridae	Netravathi River	Kumara et al 2007	Mammals	CR
756	13.127	75.174	*Viverra civettina*	Viverridae	Kudremukh Tiger Reserve	Ramachandra et al 2017	MAMMALS	CR
757	12.664	75.690	*Manis crassicaudata*	Pholidota	Pushpagiri WLS	Kumara et al 2010	MAMMALS	EN
758	12.819	75.575	*Manis crassicaudata*	Pholidota	Kumaradhara River	Ramachandra et al 2013	MAMMALS	NT
759	12.832	75.710	*Manis crassicaudata*	Pholidota	Gundia Basin	Ramachandra et al 2010	MAMMALS	NT
760	12.536	75.683	*Martes gwatkinsii*	Mustelidae	Netravathi River	Kumara et al 2007	Mammals	VU
761	12.649	75.446	*Martes gwatkinsii*	Mustelidae	Netravathi River	Kumara et al 2007	Mammals	VU
762	12.664	75.690	*Martes gwatkinsii*	Mustelidae	Pushpagiri WLS	Kumara et al 2010	MAMMALS	VU
763	12.789	75.267	*Martes gwatkinsii*	Mustelidae	Netravathi River	Kumara et al 2007	Mammals	VU
764	13.102	75.489	*Martes gwatkinsii*	Mustelidae	Netravathi River	Kumara et al 2007	Mammals	VU
765	12.664	75.690	*Melursus ursinus*	Ursidae	Pushpagiri WLS	Kumara et al 2010	MAMMALS	VU
766	12.762	75.681	*Melursus ursinus*	Ursidae	Gundia Basin	Ramachandra et al 2010	MAMMALS	VU
767	12.818	75.608	*Melursus ursinus*	Ursidae	Kumaradhara River	Ramachandra et al 2013	MAMMALS	VU
768	12.663	75.695	*Melurus ursinus*	Ursidae	Netravathi River	Kumara et al 2007	Mammals	VU
769	13.159	75.207	*Melurus ursinus*	Ursidae	Kudremukh	Ramachandra et	MAMMA	VU

					Tiger Reserve	al 2017	LS	
770	12.664	75.690	*Moschiola meminna*	Tragulidae	Pushpagiri WLS	Kumara et al 2010	MAMMA LS	LC
771	12.664	75.690	*Muntiacus muntjak*	Cervidae	Pushpagiri WLS	Kumara et al 2010	MAMMA LS	LC
772	12.774	75.774	*Muntiacus muntjak*	Cervidae	Gundia Basin	Gururaj et al 2007	MAMMA LS	LC
773	12.819	75.639	*Muntiacus muntjak*	Cervidae	Kumaradhara River	Ramachandra et al 2013	MAMMA LS	LC
774	12.664	75.690	*Panthera pardus*	Felidae	Pushpagiri WLS	Kumara et al 2010	MAMMA LS	VU
775	12.742	75.725	*Panthera pardus*	Felidae	Gundia Basin	Gururaj et al 2007	MAMMA LS	VU
776	12.828	75.673	*Panthera pardus*	Felidae	Kumaradhara River	Ramachandra et al 2013	MAMMA LS	VU
777	13.111	75.197	*Panthera pardus*	Felidae	Kudremukh Tiger Reserve	Ramachandra et al 2017	MAMMA LS	VU
778	12.664	75.690	*Panthera tigris*	Felidae	Pushpagiri WLS	Kumara et al 2010	MAMMA LS	EN
779	12.796	75.724	*Panthera tigris*	Felidae	Gundia Basin	Gururaj et al 2007	MAMMA LS	EN
780	12.811	75.666	*Panthera tigris*	Felidae	Kumaradhara River	Ramachandra et al 2013	MAMMA LS	EN
781	13.090	75.295	*Panthera tigris*	Felidae	Kudremukh Tiger Reserve	Ramachandra et al 2017	MAMMA LS	EN
782	12.664	75.690	*Paradoxurus hermaphroditus*	Viverridae	Pushpagiri WLS	Kumara et al 2010	MAMMA LS	LC
783	12.664	75.690	*Paradoxurus jerdoni*	Viverridae	Pushpagiri WLS	Kumara et al 2010	MAMMA LS	LC
784	12.708	75.675	*Paradoxurus jerdoni*	Viverridae	Netravathi River	Kumara et al 2007	Mammals	VU
785	12.721	75.609	*Paradoxurus jerdoni*	Viverridae	Netravathi River	Kumara et al 2007	Mammals	VU
786	12.963	75.292	*Paradoxurus jerdoni*	Viverridae	Netravathi River	Kumara et al 2007	Mammals	VU
787	12.664	75.690	*Petaurista philippensis*	Sciuridae	Pushpagiri WLS	Kumara et al 2010	MAMMA LS	LC
788	12.921	75.542	*Petaurista philippensis*	Sciuridae	Netravathi River	Ramachandra et al 2007	MAMMA LS	LC
789	12.664	75.690	*Petinomys fuscocapillus*	Sciuridae	Pushpagiri WLS	Kumara et al 2010	MAMMA LS	LC
790	12.804	75.679	*Pipistrellus coromandra*	Vespertilionidae	Karnataka	Korad et al 2007	MAMMA LS	LC
791	12.776	75.675	*Presbytis entellus*	Cercopithecidae	Gundia Basin	Ramachandra et al 2010	MAMMA LS	NE
792	12.807	75.653	*Presbytis entellus*	Cercopithecidae	Kumaradhara River	Ramachandra et al 2013	MAMMA LS	NE
793	12.663	75.758	*Prionailurus bengalensis*	Felidae	Netravathi River	Kumara et al 2007	Mammals	LC
794	12.664	75.690	*Prionailurus bengalensis*	Felidae	Pushpagiri WLS	Kumara et al 2010	MAMMA LS	LC
795	12.826	75.101	*Prionailurus bengalensis*	Felidae	Netravathi River	Kumara et al 2007	Mammals	LC
796	12.837	75.438	*Prionailurus bengalensis*	Felidae	Netravathi River	Kumara et al 2007	Mammals	LC
797	13.053	75.389	*Prionailurus bengalensis*	Felidae	Netravathi River	Kumara et al 2007	Mammals	LC
798	12.664	75.690	*Ratufa indica*	Sciuridae	Pushpagiri WLS	Kumara et al 2010	MAMMA LS	LC

799	12.748	75.709	*Ratufa indica*	Sciuridae	Gundia Basin	Ramachandra et al 2010	MAMMALS	LC
800	12.812	75.654	*Ratufa indica*	Sciuridae	Kumaradhara River	Ramachandra et al 2013	MAMMALS	LC
801	12.664	75.690	*Rusa unicolor*	Cervidae	Pushpagiri WLS	Kumara et al 2010	MAMMALS	VU
802	12.664	75.690	*Semnopithecus entellus*	Cercopithecidae	Pushpagiri WLS	Kumara et al 2010	MAMMALS	LC
803	12.839	74.843	*Stenella longirostris*	Delphinidae	Netravathi Estuary	Zacharia, 2008	MAMMALS	DD
804	12.633	75.388	*Sus scrofa*	Suidae	Sullia	Crook et al 2015	MAMMALS	LC
805	12.664	75.690	*Sus scrofa*	Suidae	Pushpagiri WLS	Kumara et al 2010	MAMMALS	LC
806	12.779	75.251	*Sus scrofa*	Suidae	Puttur	Crook et al 2015	MAMMALS	LC
807	12.960	75.184	*Sus scrofa*	Suidae	Bantwal	Crook et al 2015	MAMMALS	LC
808	13.088	75.420	*Sus scrofa*	Suidae	Netravathi River	Ramachandra et al 2007	MAMMALS	LC
809	12.746	75.698	*Sus scrofa*	Suidae	Gundia Basin	Gururaj et al 2007	MAMMALS	LC
810	12.806	75.639	*Sus scrofa*	Suidae	Kumaradhara River	Ramachandra et al 2013	MAMMALS	LC
811	12.726	75.718	*Tragulus meminna*	Tragulidae	Gundia Basin	Gururaj et al 2007	MAMMALS	NT
812	12.810	75.629	*Tragulus meminna*	Tragulidae	Kumaradhara River	Ramachandra et al 2013	MAMMALS	NT
813	12.846	74.831	*Tursiops truncatus*	Delphinidae	Netravathi Estuary	Zacharia, 2008	MAMMALS	LC
814	12.664	75.690	*Viverra civettina*	Viverridae	Pushpagiri WLS	Kumara et al 2010	MAMMALS	CR
815	12.664	75.690	*Viverricula indica*	Viverridae	Pushpagiri WLS	Kumara et al 2010	MAMMALS	LC
816	12.709	75.620	*Viverricula indica*	Viverridae	Netravathi River	Kumara et al 2007	Mammals	LC
817	12.826	75.101	*Viverricula indica*	Viverridae	Netravathi River	Kumara et al 2007	Mammals	LC
818	12.947	75.363	*Viverricula indica*	Viverridae	Netravathi River	Kumara et al 2007	Mammals	LC
819	13.071	75.494	*Viverricula indica*	Viverridae	Netravathi River	Kumara et al 2007	Mammals	LC
820	12.727	75.732	Viverricula sp	Viverridae	Gundia Basin	Gururaj et al 2007	MAMMALS	EN
821	12.812	75.616	Viverricula sp	Viverridae	Kumaradhara River	Ramachandra et al 2013	MAMMALS	EN
822	12.717	75.384	*Ratufa indica*	Sciuridae	Netravathi River	Kumara et al 2007	Mammals	LC
823	12.760	75.609	*Ratufa indica*	Sciuridae	Netravathi River	Kumara et al 2007	Mammals	LC
824	12.886	75.669	*Ratufa indica*	Sciuridae	Netravathi River	Kumara et al 2007	Mammals	LC
825	13.028	75.029	*Ratufa indica*	Sciuridae	Netravathi River	Kumara et al 2007	Mammals	LC
826	13.054	75.296	*Tragulus kanchil*	Tragulidae	Kudremukh Tiger Reserve	Ramachandra et al 2017	MAMMALS	LC
827	13.060	75.286	*Muntiacus muntjak*	Cervidae	Kudremukh Tiger Reserve	Ramachandra et al 2017	MAMMALS	LC
828	13.075	75.292	*Sus scrofa*	Suidae	Kudremukh	Ramachandra et	MAMMA	LC

					Tiger Reserve	al 2017	LS	
829	13.078	75.338	*Ratufa indica*	Sciuridae	Kudremukh Tiger Reserve	Ramachandra et al 2017	MAMMALS	LC
830	13.083	75.315	*Macaca radiata*	Cercopithecidae	Kudremukh Tiger Reserve	Ramachandra et al 2017	MAMMALS	LC
831	13.109	75.293	*Presbytis entellus*	Cercopithecidae	Kudremukh Tiger Reserve	Ramachandra et al 2017	MAMMALS	NE
832	12.859	75.730	*Ahaetulla nasuta*	Colubridae	Gundia Basin	Gururaj et al 2007	REPTILES	LC
833	13.083	75.150	*Ahaetulla nasuta*	Colubridae	Narvi	Balaji et al 2014	REPTILES	LC
834	13.083	75.150	*Amphiesma beddomei*	Colubridae	Narvi	Balaji et al 2014	REPTILES	LC
835	13.083	75.150	*Calotes rouxii*	Agamidae	Narvi	Balaji et al 2014	REPTILES	LC
836	12.905	75.719	Calotes sp	Agamidae	Gundia Basin	Gururaj et al 2007	REPTILES	NE
837	12.829	75.731	*Chrysopelea ornata*	Colubridae	Gundia Basin	Gururaj et al 2007	REPTILES	NE
838	13.098	75.328	*Chrysopelea ornata*	Colubridae	Kudremukh Tiger Reserve	Ramachandra et al 2017	REPTILES	NE
839	13.083	75.150	*Cnemaspis heteropholis*	Gekkonidae	Narvi	Balaji et al 2014	REPTILES	NT
840	13.083	75.150	*Cnemaspis indraneildasii*	Gekkonidae	Narvi	Balaji et al 2014	REPTILES	VU
841	13.091	75.343	*Draco dussumieri*	Agamidae	Kudremukh Tiger Reserve	Ramachandra et al 2017	REPTILES	LC
842	12.821	75.707	*Echis carinatus*	Viperidae	Gundia Basin	Gururaj et al 2007	REPTILES	NE
843	13.070	75.281	*Geoemyda silvatica*	Geoemydidae	Kudremukh Tiger Reserve	Ramachandra et al 2017	REPTILES	EN
844	12.772	75.746	*Hypnale hypnale*	Viperidae	Gundia Basin	Gururaj et al 2007	REPTILES	NE
845	13.063	75.279	*Indotestudo forsteniI*	Testudinidae	Kudremukh Tiger Reserve	Ramachandra et al 2017	REPTILES	EN
846	13.083	75.150	*Mabuya carinata*	Scincidae	Narvi	Balaji et al 2014	REPTILES	LC
847	13.083	75.150	*Mabuya macularia*	Scincidae	Narvi	Balaji et al 2014	REPTILES	LC
848	12.766	75.210	*Naja naja*	Elapidae	Puttur	Crook et al 2015	REPTILES	NE
849	12.779	75.683	*Naja naja*	Elapidae	Gundia Basin	Gururaj et al 2007	REPTILES	NE
850	12.918	75.182	*Naja naja*	Elapidae	Bantwal	Crook et al 2015	REPTILES	NE
851	12.766	75.210	*Ophiophagus hannah*	Elapidae	Puttur	Crook et al 2015	REPTILES	VU
852	12.918	75.182	*Ophiophagus hannah*	Elapidae	Bantwal	Crook et al 2015	REPTILES	VU
853	12.939	75.722	*Ophiophagus hannah*	Elapidae	Gundia Basin	Gururaj et al 2007	REPTILES	VU
854	13.091	75.401	*Ophiophagus hannah*	Elapidae	Kudremukh Tiger Reserve	Ramachandra et al 2017	REPTILES	VU
855	12.762	75.686	*Ptyas mucosus*	Colubridae	Gundia Basin	Gururaj et al 2007	REPTILES	NE
856	12.743	75.703	*Python molurus*	Pythonidae	Gundia Basin	Gururaj et al 2007	REPTILES	NT
857	12.766	75.210	*Python molurus*	Pythonidae	Puttur	Crook et al 2015	REPTILES	VU

858	12.918	75.182	*Python molurus*	Pythonidae	Bantwal	Crook et al 2015	REPTILES	VU
859	13.083	75.150	*Ristella beddomii*	Scincidae	Narvi	Balaji et al 2014	REPTILES	LC
860	12.809	75.746	*Trimeresurus malabaricus*	Viperidae	Gundia Basin	Gururaj et al 2007	REPTILES	LC
861	13.064	75.249	*Uropeltidae spp*	Uropeltidae	Kudremukh Tiger Reserve	Ramachandra et al 2017	REPTILES	NE
862	12.941	75.735	*Varnus bengalensis*	Varanidae	Gundia Basin	Gururaj et al 2007	REPTILES	LC
863	12.851	75.751	*Xenochrophis piscator*	Colubridae	Gundia Basin	Gururaj et al 2007	REPTILES	LC
864	13.081	75.243	*Python molurus*	Pythonidae	Kudremukh Tiger Reserve	Ramachandra et al 2017	REPTILES	VU

*Endemism: E-Endemic; E/SWG: Endemic to Southern Western Ghats; E/WG: Endemic to Western Ghats; E/SI: Endemic to Southern India.

*IUCN Status: EN-Endangered; NE-Not Evaluated; LC-Least Concern; VU-Vulnerable; NT-Near Threatened; T- Threatened.

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Annexure C: HYDROLOGICAL ASSESMENT

Rainfall Dynamics: Rainfall data from 1901 to 2013 were collected from Directorate of Economics and Statistics, and District at a Glance. About 65 Rain Gauge stations from Mangalore, Udupi, Hassan, Kodagu and Chikmagaluru were analysed for understanding the spatial and Temporal variability of rainfall. Figure 1 depicts the method involved in understanding the temporal dynamics of precipitation. Distribution of Rain Gauge Stations and Spatial Rainfall variability across the catchments are as depicted in Figure 2.

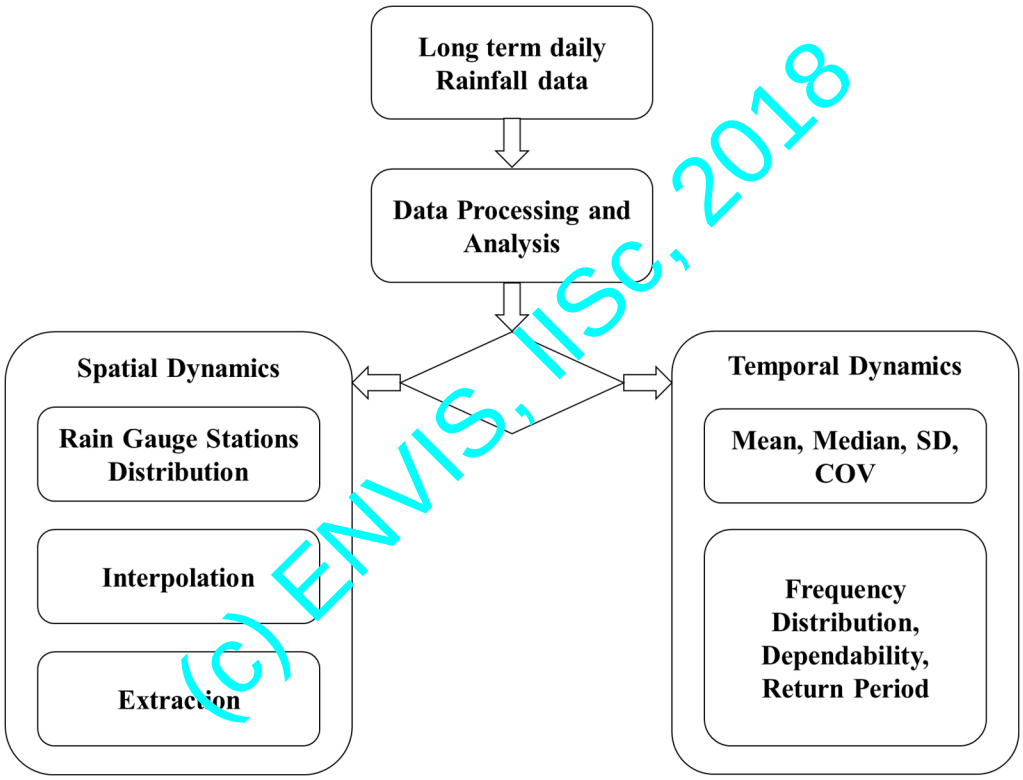

Figure 1: Method involved in understanding temporal dynamics of precipitation data.

Data Preprocessing and Analysis: Rainfall data collected from the Directorate of Economics and Statistics were preprocessed in order to rectify missing/erroneous rainfall records considering rainfall in neighboring rain gauge stations. Rectified data were further analysed for spatio-temporal variations.

Spatial Analysis*:* Rain Gauge stations were identified and located using Google earth and Karnataka State Rain gauge station map. Interpolation was carried out understand the spatial

dynamics of rainfall across the catchment. Post-processing (extraction) was carried out to quantify rainfall within the catchment.

Temporal Analysis: Temporal analysis was carried out to understand the variability, dependability, return period of rainfall at each taluk. India Meteorological Department classifies rainfall at regional scale as Excess, Normal, Deficient/Drought, Scanty/Severe Drought conditions as below.

i) Excess: Rainfall > + 20% average annual rainfall
ii) Normal: - 20% average annual rainfall < Rainfall < + 20% average annual rainfall
iii) Deficient: - 60% average annual rainfall < Rainfall < - 20% average annual rainfall
iv) Scanty: - 99% average annual rainfall < Rainfall < - 60% average annual rainfall

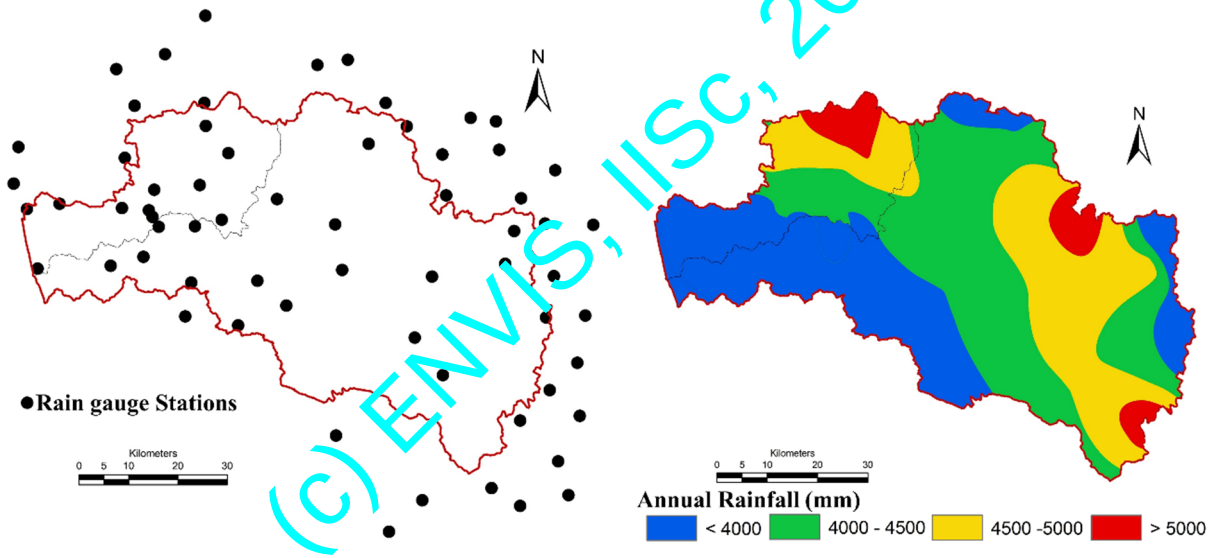

Figure 2: Rain Gauge Stations and Spatial Rainfall variability.

Annual Average Rainfall in the catchment is about 4047mm. Spatial variability analyses indicate that Ghats receive highest rainfall in the catchment of about Average Annual rainfall of 5200 mm, whereas the transition zones receive rainfall in the range of 4000 mm to 4500 mm, lowest rainfall is observed in the plains of Mudigere and Sakleshpura Taluks ranging between 2800 mm to 4000 mm. Temporal Variability across each taluk in the catchment is as explained below:

1) **Karkala**: Karkala taluk is a part of Udupi District. Average Annual rainfall measured between 1901-2013 in the taluk is about 4959 ± 836 mm (COV 0.17). Highest and

lowest rainfall recorded in the taluk were 6900 mm and 3242 mm respectively. Variability of rainfall across last 50 years is as depicted in Table 1 and Figure 3. Trend line shows increasing rainfall in the catchment. Normal rainfall has a dependability of 84% with return period of 1.3 years. No cases of severe Meteorological drought have been recorded in Karkala Taluk, whereas moderate droughts can be expected once in 6.4 years, and excess rain once in 10.2 years.

Table 1: Temporal Variations in Karkala

IMD Classification	Rainfall	Frequency	Probability	Dependability	Return Period (Years)
Severe Drought	< 2975	0	0		
Moderate Drought	2975 to 3967	8	0.157	100%	6.4
Normal Rainfall	3967 to 5950	38	0.745	84%	1.3
Excess Rainfall	> 5950	5	0.098	10%	10.2

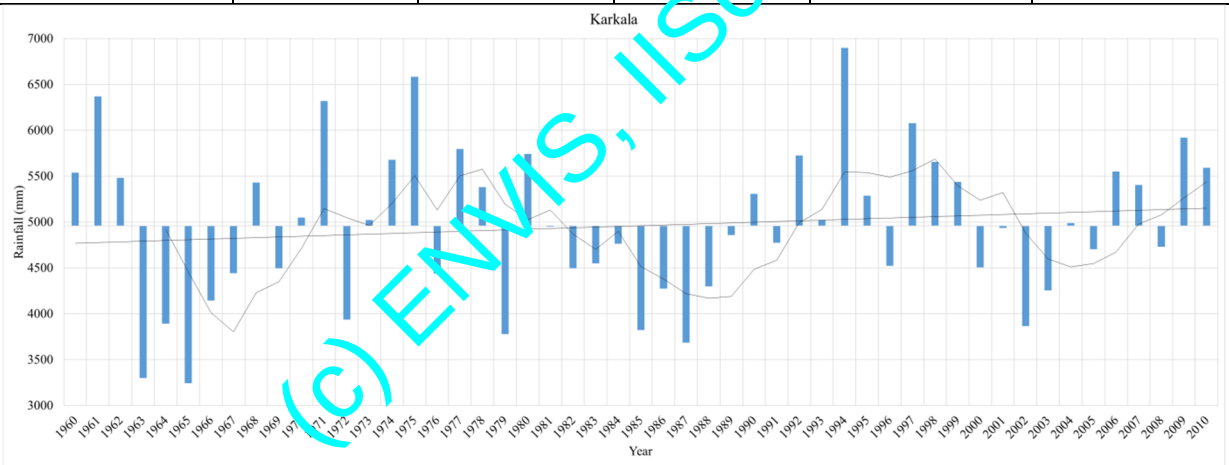

Figure 3: Rainfall Dynamics in Karkala.

2) **Mangalore**: Mangalore taluk is a part of Dakshina Kannada District. Average Annual rainfall measured between 1901 – 2013 in the taluk is about 3445 ± 781 mm (COV 0.23). Highest and lowest rainfall recorded in the taluk were 6791 mm and 1496 mm respectively. Variability of rainfall across last 50 years is as depicted in Table 2 and Figure 4. Trend line shows decreasing rainfall in the catchment. Normal rainfall has a dependability of 94% with return period of 1.3 years. No cases of severe Meteorological

drought have been recorded in Mangalore Taluk, whereas moderate droughts can be expected once in 25.5 years, and excess rain once in 5.1 years.

Table 2: Temporal Variations in Mangalore

IMD Classification	Rainfall	Frequency	Probability	Dependability	Return Period (Years)
Severe Drought	< 2067	0	0		
Moderate Drought	2067 to 2756	2	0.039	100%	25.5
Normal Rainfall	2756 to 4134	39	0.765	94%	1.3
Excess Rainfall	> 4134	10	0.196	20%	5.1

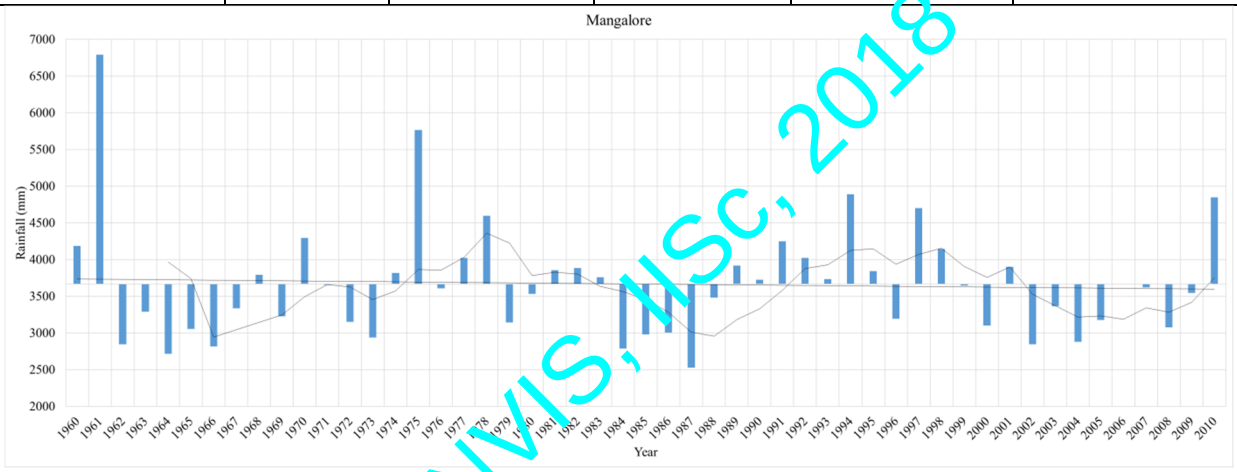

Figure 4: Rainfall Dynamics in Mangalore

3) **Bantwala**: Bantwala taluk is a part of Dakshina Kannada District. Average Annual rainfall measured between 1901 – 2013 in the taluk is about 3762 ± 747 mm (COV 0.20). Highest and lowest rainfall recorded in the taluk were 6057 mm and 1900 mm respectively. Variability of rainfall across last 50 years is as depicted in Table 3 and Figure 5. Trend line shows decreasing rainfall in the catchment. Normal rainfall has a dependability of 92% with return period of 1.3 years. No cases of severe Meteorological drought have been recorded in Bantwala Taluk, whereas moderate droughts can be expected once in 12.8 years, and excess rain once in 6.4 years.

Table 3: Temporal Variations in Bantwala

IMD Classification	Rainfall	Frequency	Probability	Dependability	Return Period (Years)
Severe Drought	< 2257	0	0		
Moderate Drought	2257 to 3009	4	0.078	100%	12.8
Normal Rainfall	3009 to 4514	39	0.765	92%	1.3
Excess Rainfall	> 4514	8	0.157	16%	6.4

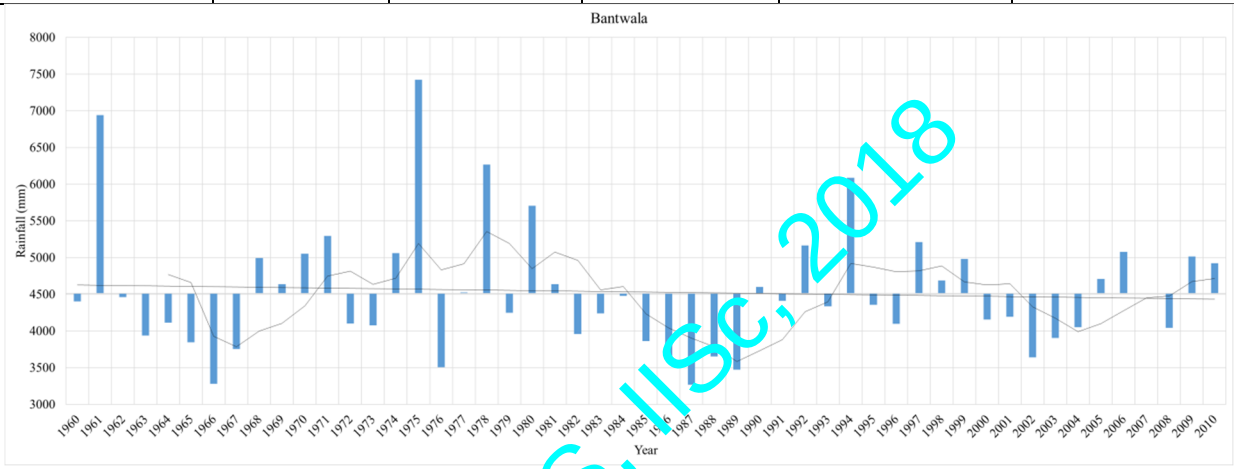

Figure 5: Rainfall Dynamics in Bantwala

4) **Beltangadi**: Beltangadi taluk is a part of Dakshina Kannada District. Average Annual rainfall measured between 1901 – 2013 in the taluk is about 4528 ± 850 mm (COV 0.19). Highest and lowest rainfall recorded in the taluk were 7424 mm and 2520 mm respectively. Variability of rainfall across last 50 years is as depicted in Table 4 and Figure 6. Trend line shows decreasing rainfall in the catchment. Normal rainfall has a dependability of 92% with return period of 1.2 years. No cases of severe Meteorological drought have been recorded in Beltangadi Taluk, whereas moderate droughts can be expected once in 12.8 years, and excess rain once in 10.2 years.

Table 4: Temporal Variations in Beltangadi

IMD Classification	Rainfall	Frequency	Probability	Dependability	Return Period (Years)
Severe Drought	< 2716	0	0		
Moderate Drought	2716 to 3622	4	0.078	100%	12.8
Normal Rainfall	3622 to 5433	42	0.824	92%	1.2
Excess Rainfall	> 5433	5	0.098	10%	10.2

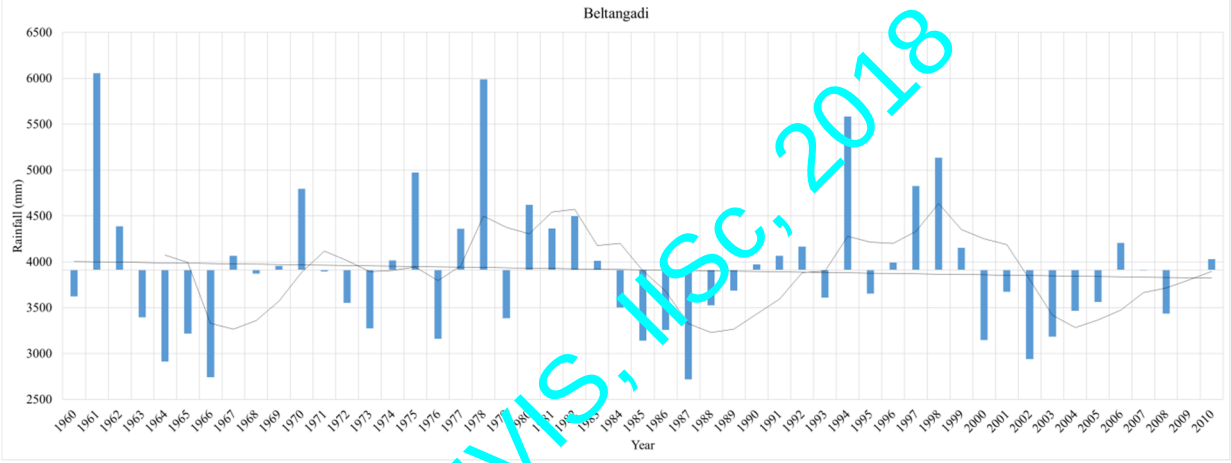

Figure 6: Rainfall Dynamics in Beltangadi

5) **Puttur**: Puttur taluk is a part of Dakshina Kannada District. Average Annual rainfall measured between 1901 – 2013 in the taluk is about 3995 ± 719 mm (COV 0.18). Highest and lowest rainfall recorded in the taluk were 7205 mm and 1734 mm respectively. Variability of rainfall across last 50 years is as depicted in Table 5 and Figure 7. Trend line shows decreasing rainfall in the catchment. Normal rainfall has a dependability of 98% with return period of 1.2 years. No cases of severe Meteorological drought have been recorded in Puttur Taluk, whereas moderate droughts can be expected once in 51 years, and excess rain once in 5.7 years.

Table 5: Temporal Variations in Puttur

IMD Classification	Rainfall	Frequency	Probability	Dependability	Return Period (Years)
Severe Drought	< 2716	0	0		
Moderate Drought	2716 to 3622	1	0.020	100%	51.0
Normal Rainfall	3622 to 5433	41	0.804	98%	1.2
Excess Rainfall	> 5433	9	0.196	18%	5.7

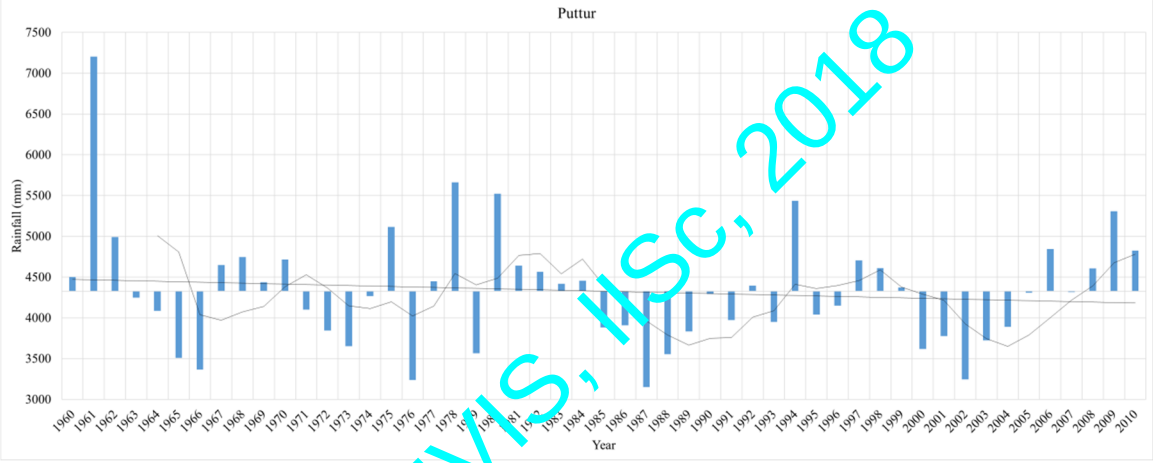

Figure 7 Rainfall Dynamics in Puttur

6) **Sulya**: Sulya taluk is a part of Dakshina Kannada District. Average Annual rainfall measured between 1901 – 2013 in the taluk is about 3947 ± 726 mm (COV 0.18). Highest and lowest rainfall recorded in the taluk were 5863 mm and 1733 mm respectively. Variability of rainfall across last 50 years is as depicted in Table 6 and Figure 8. Trend line shows increasing rainfall in the catchment. Normal rainfall has a dependability of 88% with return period of 1.2 years. Severe Meteorological drought were recorded in Sulya Taluk with return period of 51 years, whereas moderate droughts can be expected once in 10.2 years, and excess rain once in 10.2 years.

Table 6: Temporal Variations in Sulya

IMD Classification	Rainfall	Frequency	Probability	Dependability	Return Period (Years)
Severe Drought	< 2367	1	0.020	100%	51.0
Moderate Drought	2367 to 3157	5	0.098	98%	10.2
Normal Rainfall	3157 to 4736	40	0.784	88%	1.2
Excess Rainfall	> 4739	5	0.098	10%	10.2

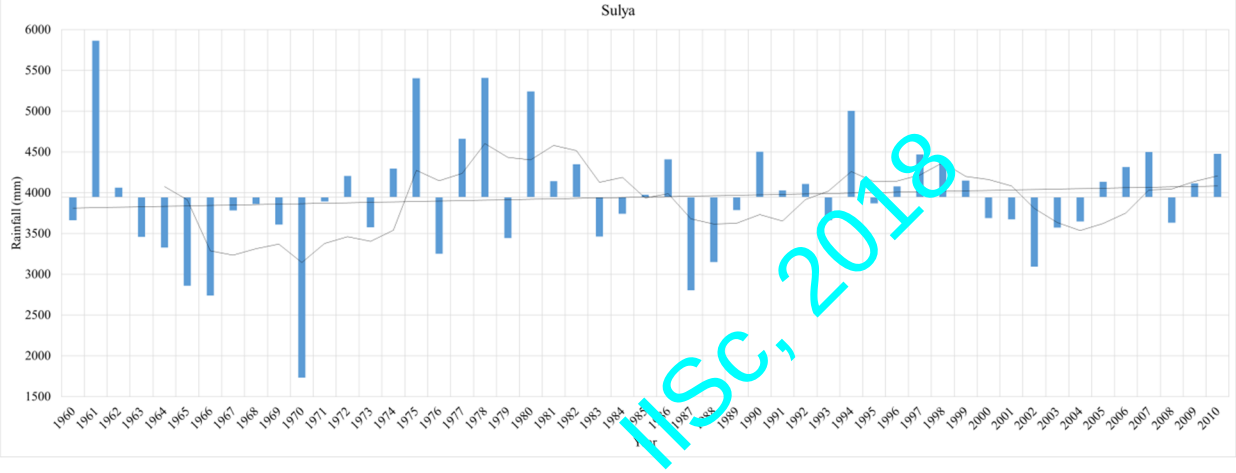

Figure 8: Rainfall Dynamics in Sulya

7) **Mudigere**: Mudigere taluk is a part of Chikmagalur District. Average Annual rainfall measured between 1901 – 2013 in the taluk is about 3123 ± 847 mm (COV 0.27). Highest and lowest rainfall recorded in the taluk were 5869 mm and 1606 mm respectively. Variability of rainfall across last 50 years is as depicted in Table 7 and Figure 9. Trend line shows decreasing rainfall in the catchment. Normal rainfall has a dependability of 82% with return period of 1.7 years. Severe Meteorological drought were recorded in Mudigere Taluk with return period of 51 years, whereas moderate droughts can be expected once in 6.4 years, and excess rain once in 4.3 years.

Table 7: Temporal Variations in Mudigere

IMD Classification	Rainfall	Frequency	Probability	Dependability	Return Period (Years)
Severe Drought	< 1873	1	0.020	100%	51.0
Moderate Drought	1873 to 2498	8	0.157	98%	6.4
Normal Rainfall	2498 to 3747	30	0.588	82%	1.7
Excess Rainfall	> 3747	12	0.235	24%	4.3

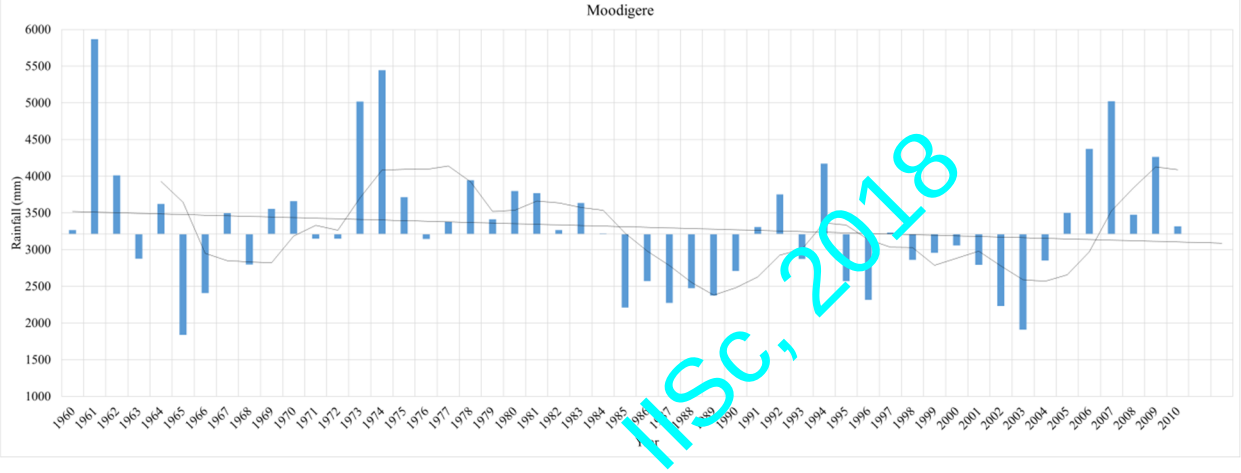

Figure 9: Rainfall Dynamics in Mudigere

8) **Sakleshpura**: Sakaleshpura taluk is a part of Hassan District. Average Annual rainfall measured between 1901 – 2013 in the taluk is about 3909 ± 757 mm (COV 0.26). Highest and lowest rainfall recorded in the taluk were 5059 mm and 1585 mm respectively. Variability of rainfall across last 50 years is as depicted in Table 8 and Figure 10. Trend line shows decreasing rainfall in the catchment. Normal rainfall has a dependability of 71% with return period of 1.7 years. Severe Meteorological drought were recorded in Sakaleshpura Taluk with return period of 51 years, whereas moderate droughts can be expected once in 3.6 years, and excess rain once in 6.4 years.

Table 8: Temporal Variations in Sakaleshpura

IMD Classification	Rainfall	Frequency	Probability	Dependability	Return Period (Years)
Severe Drought	< 1745	1	0.020	100%	51.0
Moderate Drought	1745 to 2327	14	0.275	98%	3.6
Normal Rainfall	2327 to 3491	28	0.549	71%	1.7
Excess Rainfall	> 3491	8	0.157	16%	6.4

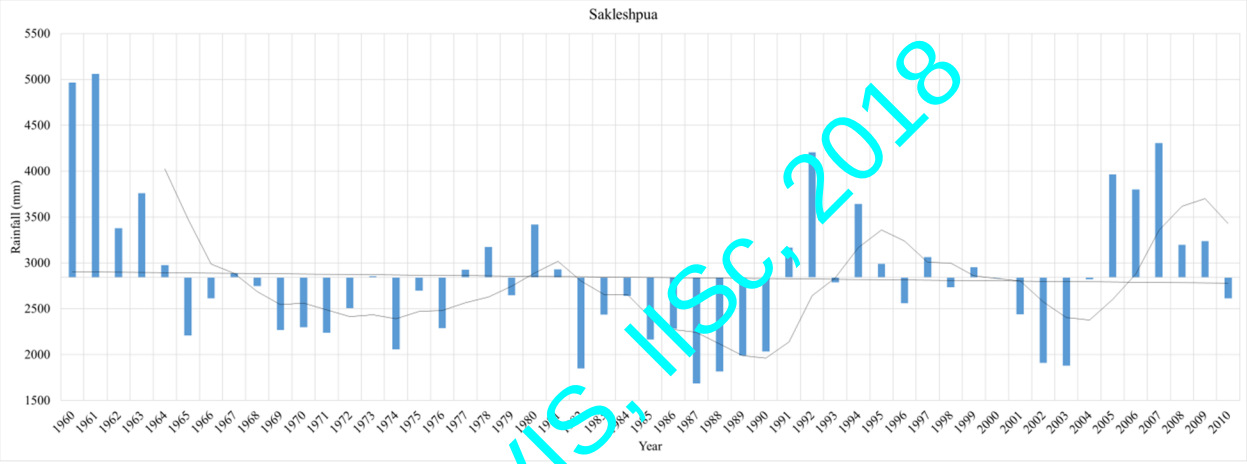

Figure 10: Rainfall Dynamics in Sakaleshpura

9) **Somvarpet**: Somvarpet taluk is a part of Kodagu District. Average Annual rainfall measured between 1901 – 2013 in the taluk is about 2537 ± 696 mm (COV 0.27). Highest and lowest rainfall recorded in the taluk were 4246 mm and 1522 mm respectively. Variability of rainfall across last 50 years is as depicted in Table 9 and Figure 11. Trend line shows increasing rainfall in the catchment. Normal rainfall has a dependability of 73% with return period of 2.2 years. Severe Meteorological drought were recorded in Somvarpet Taluk with return period of 12.8 years, whereas moderate droughts can be expected once in 5.1 years, and excess rain once in 3.6 years.

Table 9: Temporal Variations in Somvarpet

IMD Classification	Rainfall	Frequency	Probability	Dependability	Return Period (Years)
Severe Drought	< 1522	4	0.078	100%	12.8
Moderate Drought	1522 to 2029	10	0.196	92%	5.1
Normal Rainfall	2029 to 3044	23	0.451	73%	2.2
Excess Rainfall	> 3044	14	0.275	27%	3.6

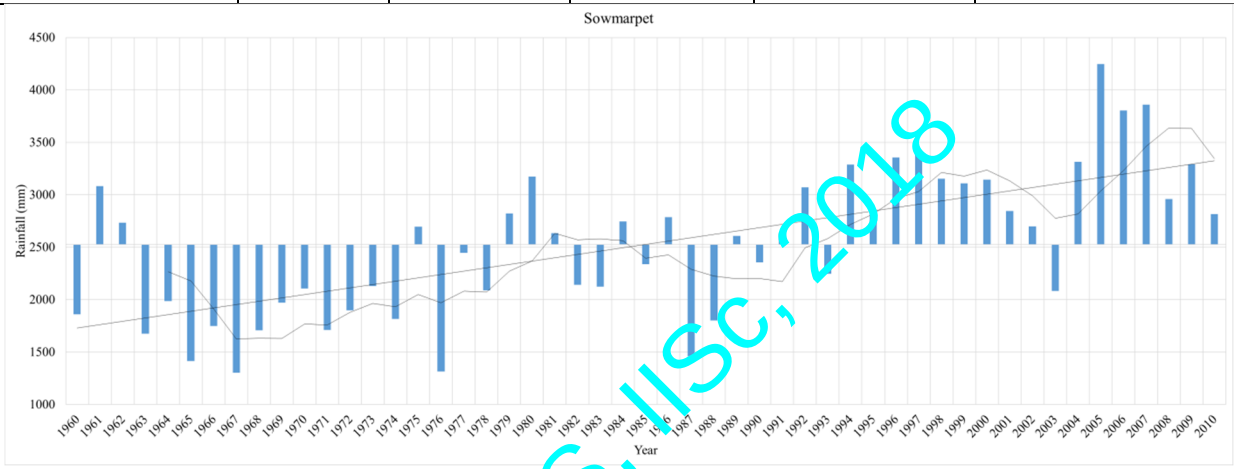

Figure 11: Rainfall Dynamics in Somvarpet

10) **Marcera/Madikeri**: Marcera/taluk is a part of Kodagu District. Average Annual rainfall measured between 1901 – 2013 in the taluk is about 3966 ± 932 mm (COV 0.24). Highest and lowest rainfall recorded in the taluk were 6213 mm and 2089 mm respectively. Variability of rainfall across last 50 years is as depicted in Table 10 and Figure 12. Trend line shows decreasing rainfall in the catchment. Normal rainfall has a dependability of 73% with return period of 1.7 years. Severe Meteorological drought were recorded in Marcera Taluk with return period of 51 years, whereas moderate droughts can be expected once in 5.7 years, and excess rain once in 4.6 years.

Table 10: Temporal Variations in Madikeri

IMD Classification	Rainfall	Frequency	Probability	Dependability	Return Period (Years)
Severe Drought	< 2379	1	0.020	100%	12.8
Moderate Drought	2379 to 3172	9	0.176	92%	5.1
Normal Rainfall	3172 to 4758	30	0.588	73%	2.2
Excess Rainfall	> 4758	11	0.216	27%	3.6

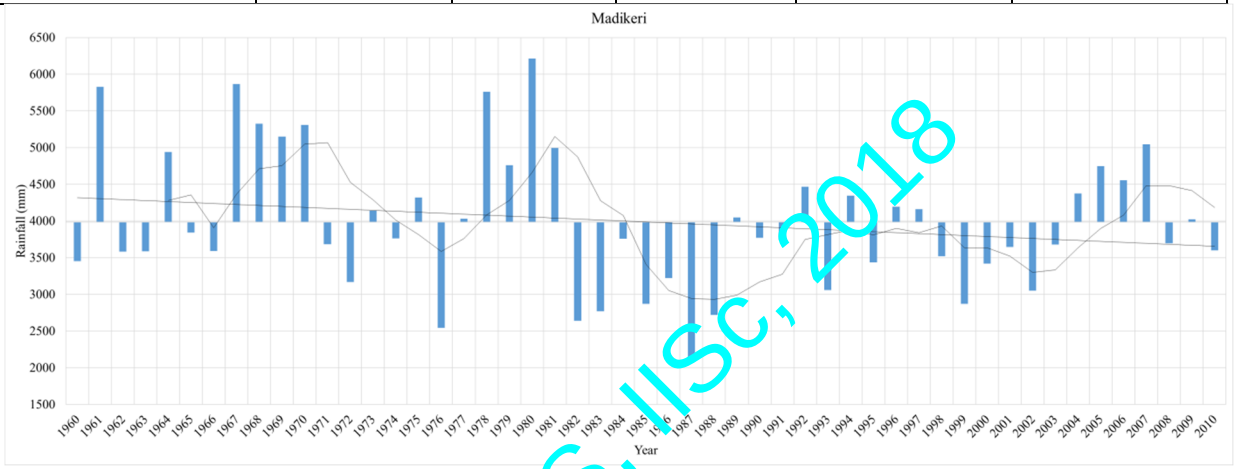

Figure 12: Rainfall Dynamics in Madikeri

Stream Density: Stream density is defined as the ratio of stream length the catchment area. Higher the stream density. Stream density has a direct impact on lag time and hydrograph peak. For a rainfall event, basins with high drainage densities will have relatively rapid response time (shorter lag time) and steeper limbs as against low density drainages, i.e., precipitation gets into streams quicker in high dense drainages, in contrary for catchments with low dense drainages, precipitation has to travel as surface runoff, base flow, pipe flow (sub surface flow), through fall enhancing lag time. Figure 13 depicts that Ghats have higher drainage density as against the coast and plains. Netravathi and Gurupura catchment together have Stream density of 2.5km per sq.km. Figure 14 depicts stream density of each sub catchment. Ghats indicates higher stream density as against the coastal plains.

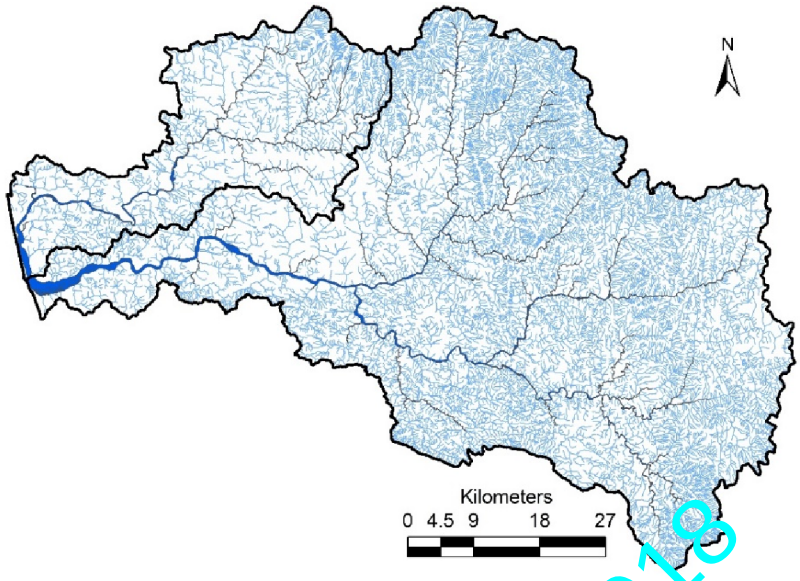

Figure 13: Stream Network

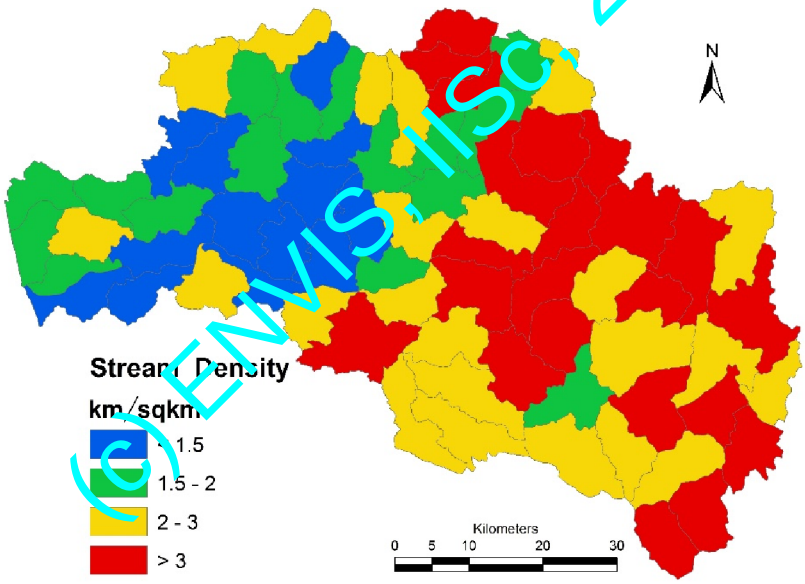

Figure 14: Stream Density – Sub catchment wise

Runoff: Estimate runoff was based on the Natural Resource Conservation Series (NRCS) (*United States Department of Agriculture*; NRCS, 1986; Walker, Prestwich and Spofford, 2006; Williams *et al.*, 2012) earlier known as Soil Conservation Series (SCS) (USDA - Soil Conservation Service, 1972; Mishra *et al.*, 2006) runoff curve number method. NRCS method

(Figure 15) involves quantification of runoff considering precipitation data, land use, soil characteristics.

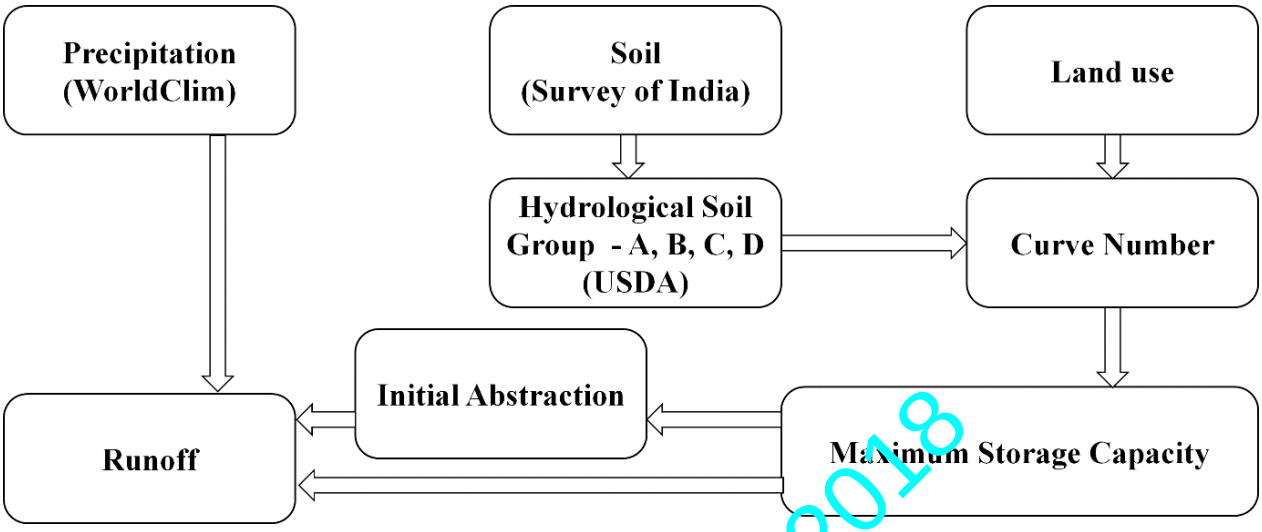

Figure 15: Steps involved in NRCS method of Runoff quantification

Mathematically Yield using NRCS is given as

$$Q = \frac{(P - I_a)^2}{(P - I_a) + S}$$

Where

Q - Discharge/Yield as mm,

P - Precipitation in mm,

I_a - Initial Abstraction in mm,

S – Maximum Storage/Retention Potential in mm

Initial Abstraction (I_a) consists mainly interception, portion of infiltration and surface depression storage. In general, I_a is estimated based on landscape and surface conditions. I_a is estimated as function of maximum potential retentions (S). I_a is generalized as 20% of maximum storage capacity (NRCS, 1986), whereas for Indian conditions, I_a can be taken as 30% of maximum potential storage (Gupta and Panigrahy, 2008). Maximum retention potential is estimated as a function of curve number (USDA-NRCS, 2004a)and is given by

$$S = 25.4 * \left(\left(\frac{1000}{CN}\right) - 10\right)$$

CN represents curve number and is dependent on Soil Hydrological characteristics (Hydrological Soil Group) and Land use characteristics.

Hydrologic Soil group is defined by various soil properties such as density, texture, particle size, *etc.* which defines infiltration rates, storage capabilities of soil. Table 11 provides the details of HSG according national and international definitions and Table 12 provides the details of curve numbers associated with land use and soil group. The estimated runoff was validated with the field data.

Table 11: Hydrologic Soil Groups and their characteristics.

HSG	National (Dhruvananarayan, 1993; Gupta and Panigrahy, 2008)	International (USDA-NRCS, 2009)
A	Sandy and Loamy Soils	• Low runoff potential when thoroughly wet • Less than 10 % clay and more than 90 % sand or gravel and have gravel or sand textures
B	Sandy Loamy and Loam	• Moderately low runoff potential when thoroughly wet • Water transmission through the soil is unimpeded • 10 % and 20 % clay and 50 % to 90 % sand and have loamy sand or sandy loam textures
C	Clay loam	• Moderately high runoff potential when thoroughly wet • Water transmission through the soil is somewhat restricted. • 20 % and 40 % clay and less than 50 percent sand and have loam, silt loam, sandy clay loam, clay loam, and silty clay loam textures
D	Clay	• High runoff potential when thoroughly wet • Water movement through the soil is restricted or very restricted • Greater than 40 percent clay, less than 50 percent sand, and have clayey textures. • High shrink-swell potential

Table 12: Curve numbers based on Land use and Hydrological Soil Group(Mutreja, 1995; USDA-NRCS, 2004b)

Sl.no.	Land use	Hydrological condition	A	B	C	D
1	**Pasture, Grassland or range-continuous forage for grazing**	Poor	68	79	86	89
		Fair	49	69	79	84
		Good	36	61	74	80
2	**Meadow - continuous grass, protected from grazing and generally moved for hay**	Good	30	58	74	78
3	**Brush-weed -grass mixture with Brush as major element**	Poor	48	67	77	83
		Fair	35	56	70	77
		Good	30	48	65	73
4	**Woods- Grass combination (orchard or tree farm)**	Poor	57	73	82	86
		Fair	43	65	76	82
		Good	32	58	72	79
5	**Woods**	Poor	45	66	77	83
		Fair	36	60	73	79
		Good	30	55	70	77
6	**Farmstead - Buildings, lanes, drive ways and surrounds**	-	59	74	82	86
7	**Open space**	Poor	68	79	86	89
		Fair	49	69	79	84
		Good	39	61	74	80
8	**Impervious areas**					
	Paved parking lots, roofs and drive ways, etc.		98	98	98	98
	Streets and Roads					
	Paved; curbs and storm sewers		83	89	92	93
	Paved; open ditches		76	85	89	91
	Gravel		76	85	89	91
	Dirt		72	82	87	89
9	**Urban Area**					
	Commercial	85 % impervious	89	92	94	95
	Industrial	72% impervious	81	88	91	93

	Residential	65% impervious	77	85	92	92
		38% impervious	61	75	83	87
		30% impervious	57	72	81	86
		25% impervious	54	70	81	85
		20% impervious	51	68	79	84
		12% impervious	46	65	77	82
10	**Herbaceous : mixture of grass weed an low growing brush**	Poor		80	87	93
		Fair		71	81	89
		Good		62	84	85
11	**Oak-aspen : Mountain bush mixture of oak brush, aspen, mahogany, maple and other**	Poor		66	74	79
		Fair		48	57	63
		Good		30	41	48
12	**Pinyon-juniper: Pinyon, Juniper or both; grass understory**	Poor		75	85	89
		Fair		58	73	80
		Good		41	61	71
13	**Sage with grass understory**	Poor		67	80	85
		Fair		51	63	70
		Good		35	47	55
14	**Desert Shrub: saltbush, greasewood, cactus, mesquite, etc.**	Poor	63	77	85	88
		Fair	55	72	81	86
		Good	49	68	79	84
Agriculture						
15	**Fallow Land**					
	Bare Soil		77	86	91	94
	Crop Residue	Poor	76	85	90	93
		Good	74	83	88	90
16	**Row Crops**					
	Straight Row	Poor	72	81	88	91
		Good	67	78	85	89
	Crop Residue + Straight Row	Poor	71	80	87	90
		Good	64	75	82	85
	Contoured	Poor	70	79	84	88

		Good	65	75	82	86
	Contoured + Crop Residue	Poor	69	78	83	87
		Good	64	74	81	85
	Contoured + Terraced	Poor	66	74	80	82
		Good	62	71	78	81
	Contoured + Terraced + Crop residue	Poor	65	73	79	81
		Good	61	70	77	80
17	**Small Grains**					
	Straight Row	Poor	65	76	84	88
		Good	63	75	83	87
	Crop Residue + Straight Row	Poor	64	75	83	86
		Good	60	72	80	84
	Contoured	Poor	63	74	82	85
		Good	61	73	81	84
	Contoured + Crop Residue	Poor	62	73	81	84
		Good	60	72	80	83
	Contoured + Terraced	Poor	61	72	79	82
		Good	59	70	78	81
	Contoured + Terraced + Crop residue	Poor	60	71	78	81
		Good	58	69	77	80
18	**Close Seeded or Broadcast Legumes or Rotation Meadows**					
	Straight Row	Poor	66	77	85	89
		Good	58	72	81	85
	Contoured	Poor	64	75	83	85
		Good	55	69	78	83
	Contoured + Terraced	Poor	63	73	80	83
		Good	51	67	76	80

Natural Resource Conservation method was used to quantify the Runoff at Sub basin level in the catchment. Gauging station at Bantwala (Yettinaholé DPR) indicates average of 395 TMC yield between 1971 to 2012. In the last decade, yield in the catchment is about 350 TMC, maximum yield was observed in the year 1980- 81 with yield of 576 TMC and minimum in 226 TMC in 1987-88. Annual water yield is represented in Figure 16. The catchment has an annual average yield about 400 TMC (2603 mm). Runoff Rainfall ratio across sub catchments area as depicted in Figure 18, indicating that the Ghats with good forest cover have lower runoff capabilities i.e., high retention capacities, compared to the coastal and plain lands.

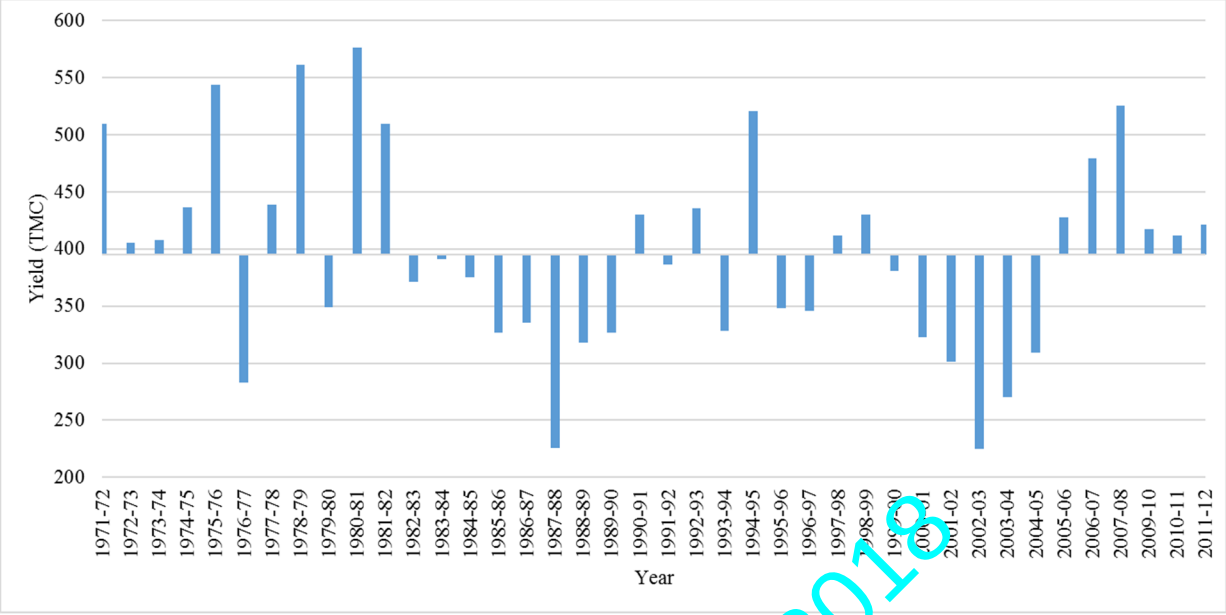

Figure 16: Yield at Bantwala between 1971 – 2012 (June to November Month)

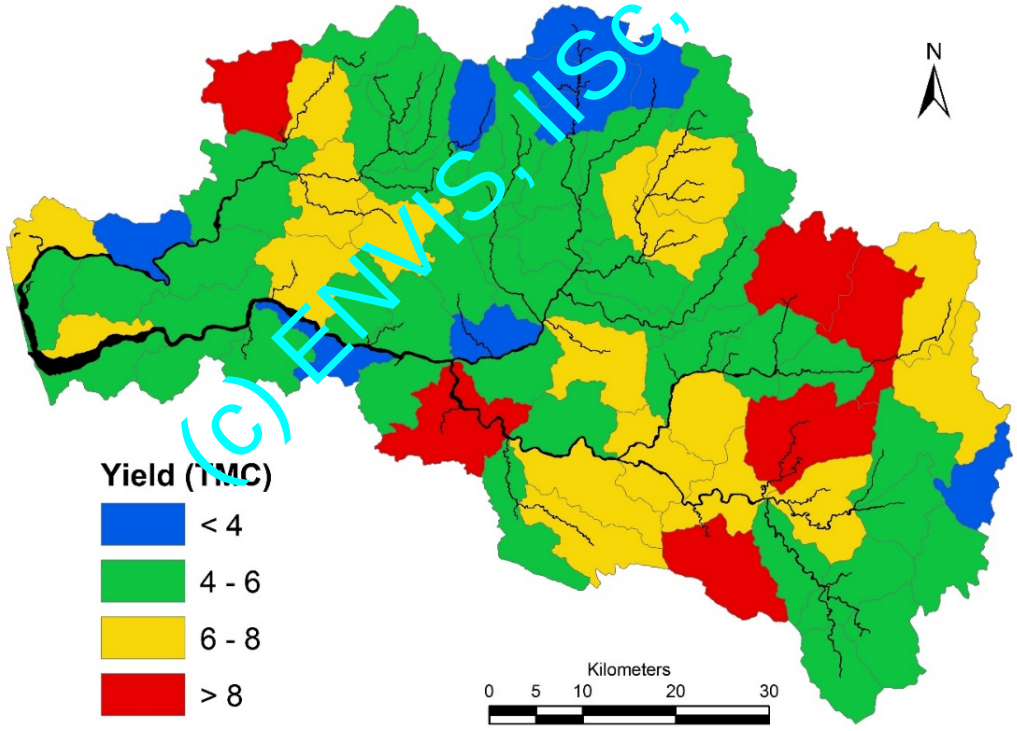

Figure 17: Yield in the catchment

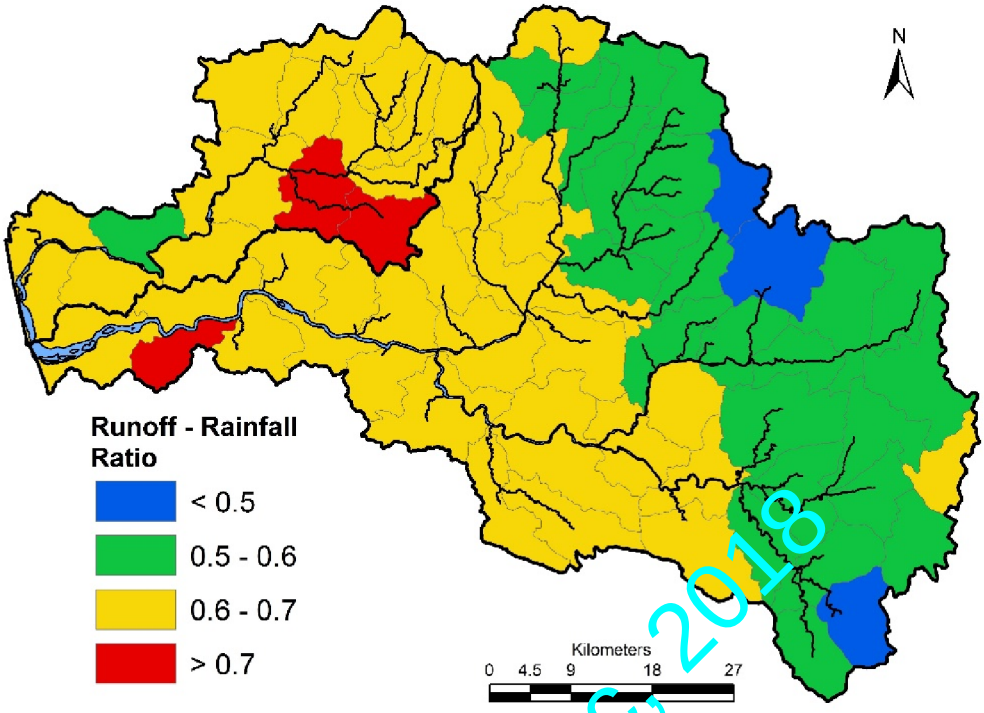

Figure 18: Runoff Rainfall ratio in Netravathi catchment.

Infiltration: Infiltration is amount of water that enters soil surface replenishing soil moisture and building up ground water table (Mutreja, 1995). Infiltration is estimated as function of Rainfall, Runoff, Interception and Evapotranspiration (Figure 19). Interception is quantified across different vegetative landscape based on interception equations as shown in Table 13.

Infiltration = Precipitation – (Runoff + Interception + Evapotranspiration)

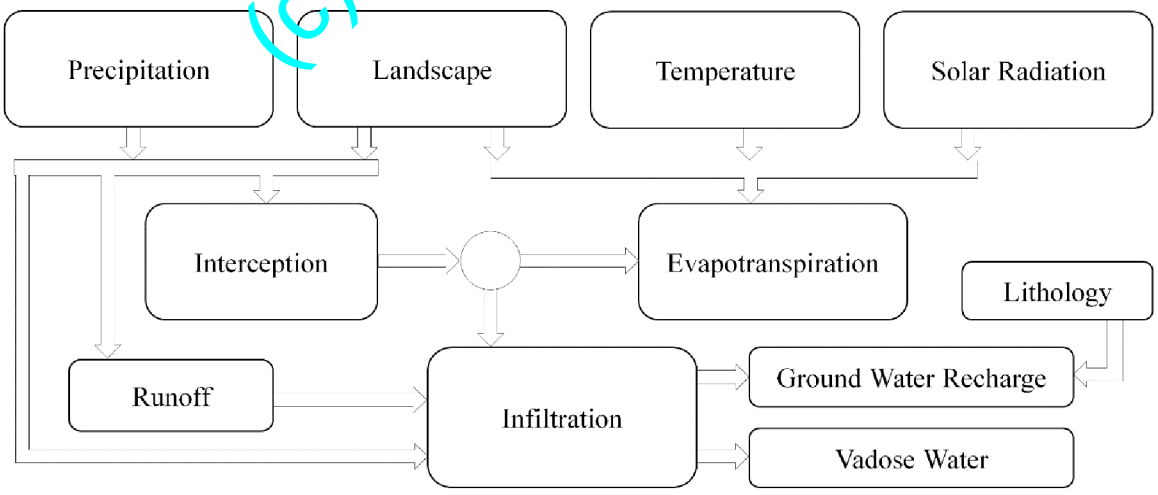

Figure 19. Method involve in estimating Infiltration

Table 13: Interception equations (Ramachandra *et al.*, 2014)

Vegetation types	Interception
Evergreen/semi-evergreen forests	I = 5.5 + 0.3 (P)
Moist deciduous forests	I = 5 + 0.3 (P)
Plantations	I = 5 + 0.2 (P)
Grasslands and scrubs	I = 3.5 +0.18 (P)

Interception during monsoon in the catchment is about 465 mm (86 TMC) and is as depicted in Figure 20, Infiltration about 137 TMC and is as depicted in Figure 21. The Ghats and transitions zones of Netravathi indicates higher interception and infiltration capabilities, whereas the coastal and uplands plains had lower interception and infiltration. Presence of forest across the Ghats play a prominent role in both Intercepting and Infiltrating large quantity of rain water. Larger infiltration capabilities in the catchment upstream are the ones which keep the river perennial.

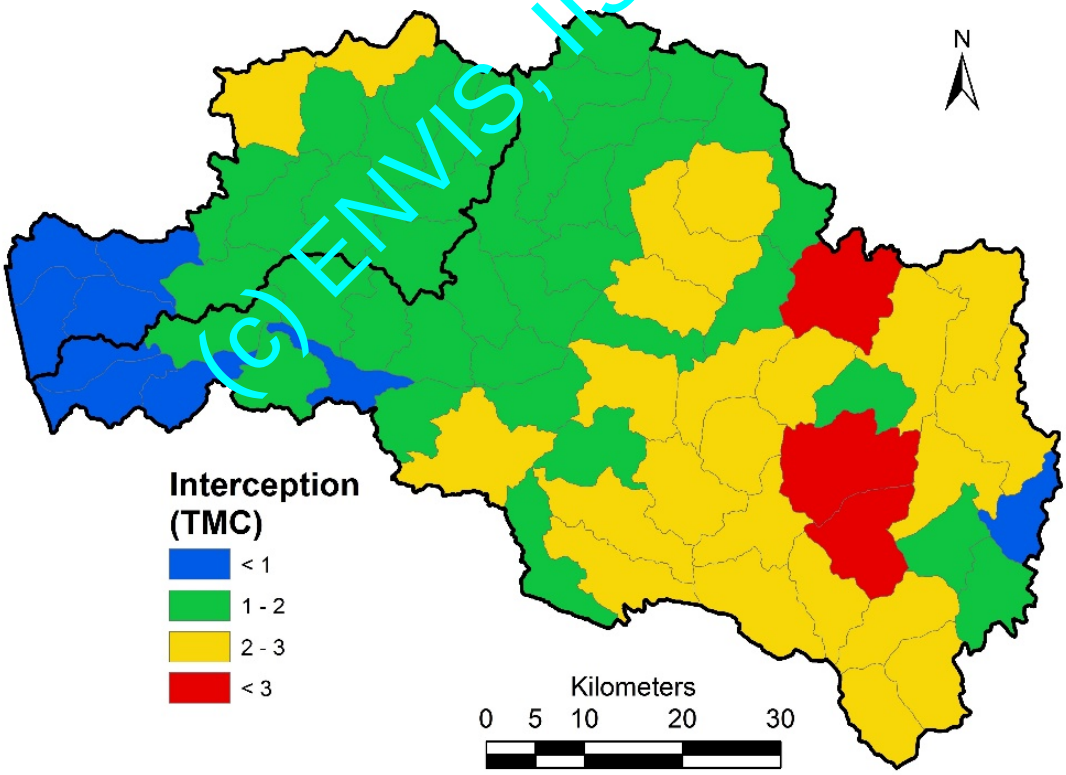

Figure 20: Interception in Netravathi

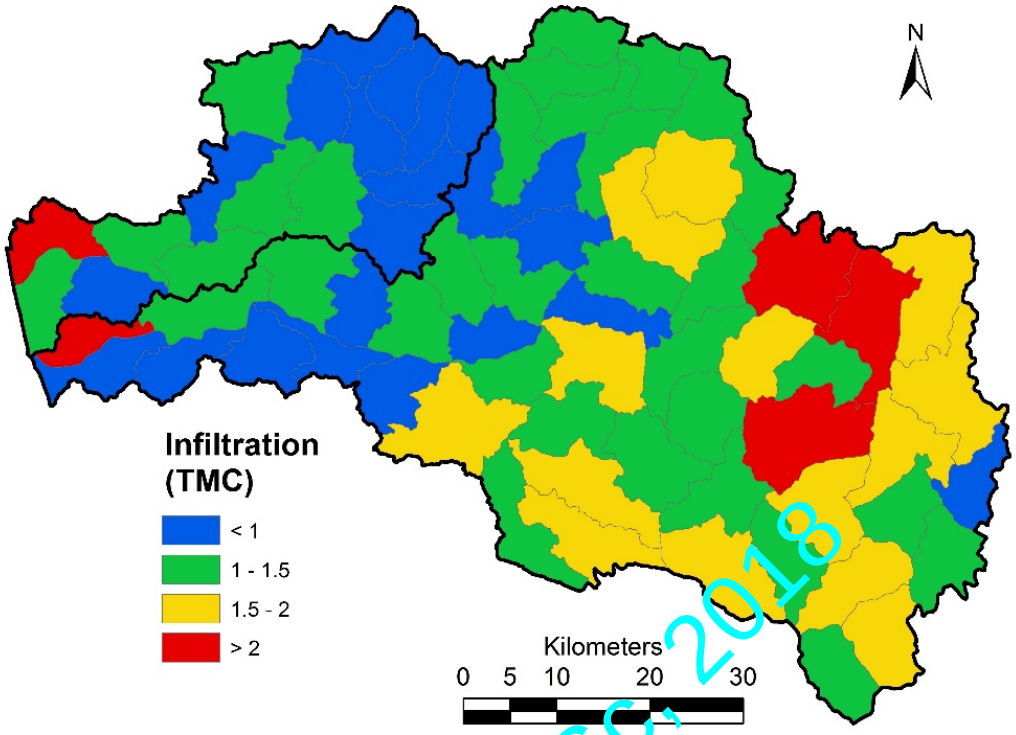

Figure 21: Infiltration in Netravathi

Ground Water Recharge: Ground Water recharge was estimated as function of Porosity of sub strata and Annual Average Rainfall. Porosity of various rock types (Manger, 1963; Morris and Johnson, 1967; Mutreja, 1995; Ramachandra et al., 2013) are as presented in Table 14.

Table 14 Porosity of Rocks

Rock Type	Porosity
Alluvial area Sandy	20 - 25%
Alluvial area Clayey	10 - 20%
Limestone Sandstone, Phyllite, Shale	10 - 20%
Conglomarate	8-12%
Charnokites	8 - 12%
Schist	15-20%
Basaltic - Vesicular	10 - 15%
Basaltic- Weathered	4 - 10%
Granite Weathered	10 -15%
Granite Unweather	5 - 10%

Ground water recharge was estimated as function of porosity of Bed rocks and Rainfall. Ground water recharge in the entire catchment is 62 TMC (405 mm). Figure 22 depicts sub basin wise

Ground water recharge in the catchment. Ghats towards Kumara parvatha have higher volume of Ground water recharge potential in the catchment.

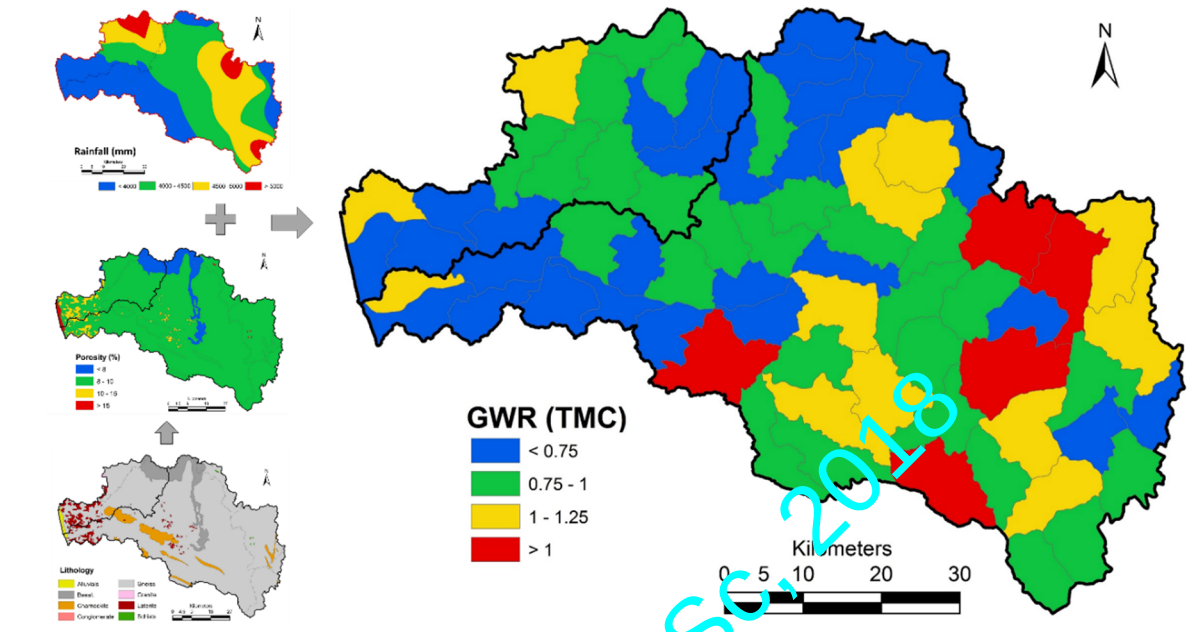

Figure 22: Ground Water Recharge

Evapotranspiration: Potential evapotranspiration (PET) is determined using Hargreaves method (Xu and Singh, 2000, 2001; Alexandris et al., 2008; Rao et al., 2012) which is a radiation based equation (Figure 17). PET is estimated as mm using the Hargreaves equation is given as

$$PET = 0.0023 * \left(\frac{R_A}{\lambda}\right) * \sqrt{T_{max} - T_{min}} * \left(\frac{T_{max} + T_{min}}{2} + 17.8\right)$$

Where R_A is Extra-terrestrial radiation (MJ/m2/day) which depends on the latitudinal gradients(*Food and Agriculture Organisation*), T_{max} is Maximum temperature in degree Celsius (Hijmans et al., 2007), T_{min} Minimum Temperature in degree Celsius (Hijmans et al., 2007) and λ is latent heat of vaporization of water (2.501 MJ/kg) (*Food and Agriculture Organisation*). Actual evapotranspiration is estimated as a product of Potential evapotranspiration (PET) and Evapotranspiration coefficient (K_C) *(Food and Agriculture Organisation*).

Evapotranspiration using Modified Hargreaves method was estimated for non-agriculture/horticulture landscapes only since the crop water demand takes care of the Evaporative fraction in the same. Net Evapotranspiration was quantified as the difference between Gross Evapotranspiration in each sub catchment and Interception, since, during Monsoons, Evaporation water was a part of Intercepted quantity of water. Figure 23 depicts Net

Annual Evapotranspiration in the catchment. Annually about 97.8 TMC of water is transferred from surface to atmosphere as Evapotranspiration from Netravathi Basin. Since the Ghats are dominated by forests, Net Evapotranspiration is higher in those regions.

Table 15: Evapotranspiration coefficients

Land use	***Kc***
Built-up	0.15
Water	1.05
Open space	0.3
Semi-evergreen moist deciduous forest	0.95
Evergreen forest	0.95
Scrub and grassland	0.8
Acacia	0.85
Teak and bamboo	0.85
Dry-deciduous	0.85

Note: Evapotranspiration was quantified only for nonagricultural landscape only. transpiration from agriculture and horticulture were quantified as part of crop water demand

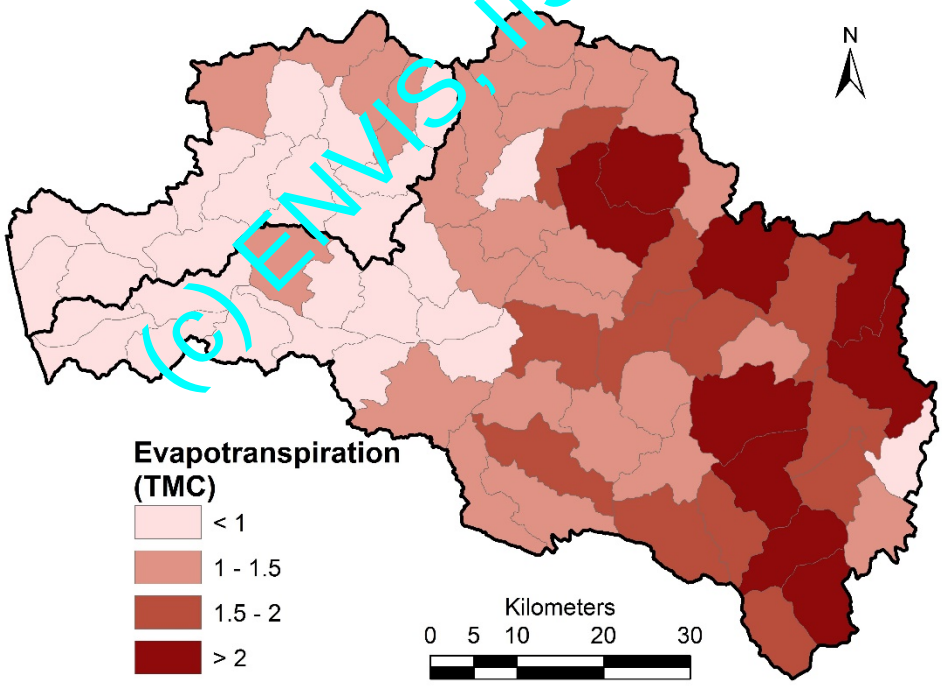

Figure 23: Evapotranspiration

Domestic, Livestock and Irrigation Water Requirements

Domestic Water Demand: Domestic water demand is the amount of water required for the population in the catchment. Figure 24 depict the method involved in estimating domestic water requirement across sub basin level in the catchment.

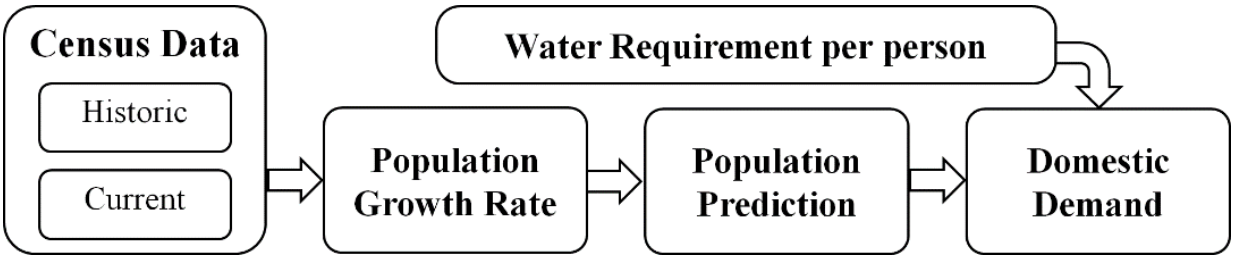

Figure 24: Method involved in estimating Domestic Demand.

Population data for each district in the basin was collected from census of India (Office of the Registrar General & Census Commissioner, 2011), based on the growth rate between 2001 and 2011, population for the year 2021 was predicted across the basin using simple interest method. Demand of 150 lpcd was considered to estimate domestic water demand in the basin. Proportional population was considered for districts which extends beyond the basin boundary.

$$\text{Population 2021} = \text{Population 2011}\ (1 + n.r)$$

Where r is the growth rate between 2011 and 2001, n is number of decades (= 1).

$$r = \frac{Population\ 2011}{Population\ 2001} - 1$$

Domestic Demand was estimated considering population dynamics across the catchment. 135 litres per capita per day was assumed to quantify the water demand. Population for the year 2018 and 2021 was estimated based on the growth rate in each village between 2001 and 2011. Figure 25 depicts the Population dynamics and Figure 26 depicts Annual Domestic water demand in the catchment. Annually 3.71 TMC of water is required to cater the domestic water demand in the catchment. Major cities and towns such as Mangalore, Bantwala, Puttur, Dharmastala, Bajpe, Beltangadi, Padu, Konje have population over 10000 people indicating higher water demand. The coastal catchments have higher water demand compare to the sub catchments in the Ghats.

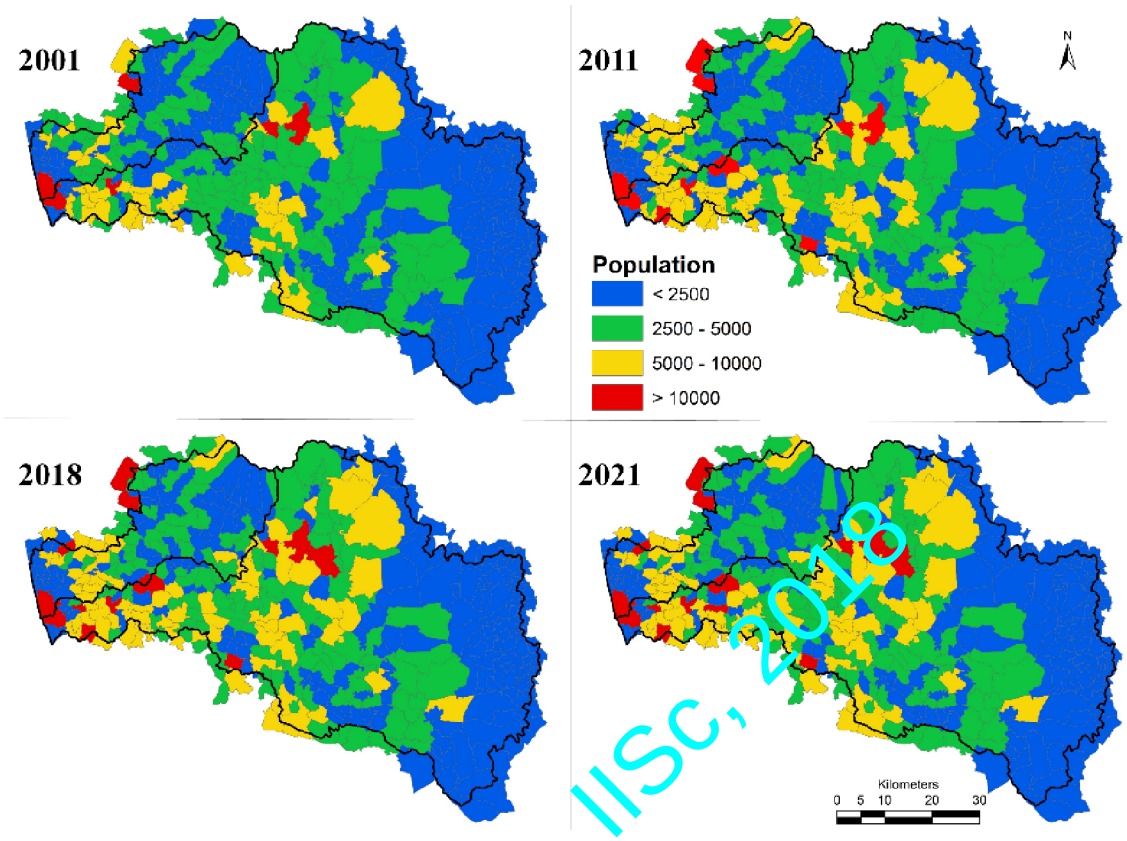

Figure 25: Population Dynamics in the Basin.

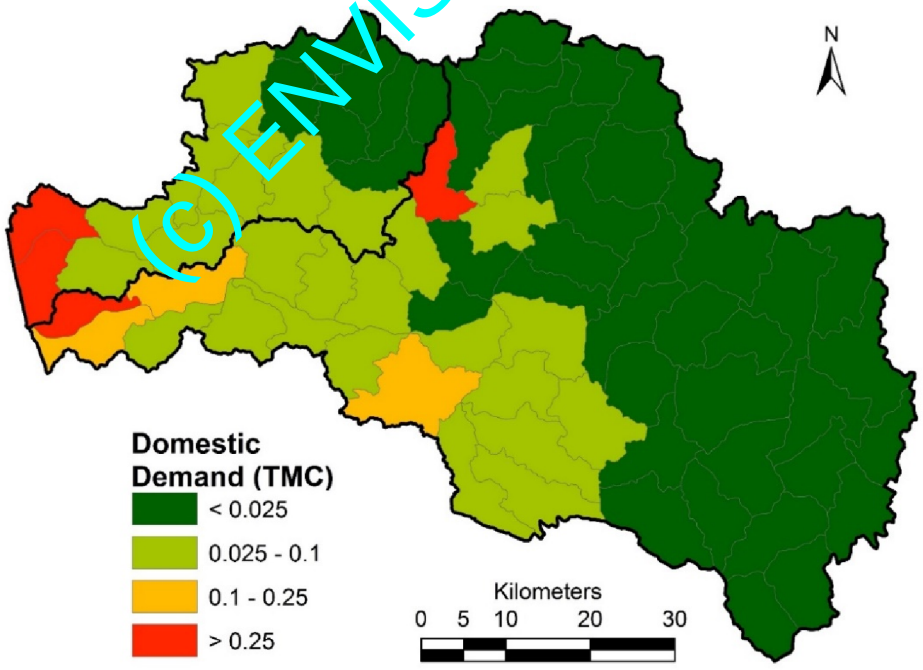

Figure 26: Domestic Water requirement.

Livestock Demand: Similar to domestic demand, livestock demand was estimated considering livestock census across each districts (Department of Animal Husbandry and Veterinary Services, 2012; Department of Statistics, 2012; Department of Animal Hubandry Dairy and Fisheries, 2015). Water demand for livestock was established through telephonic interviews and through literature(Markwick, 2007; Ramachandra *et al.*, 2014; Meehan A, Stokka and Mostrom, 2015). Table 16 provides insights to water demand for various livestock.

Table 16: Livestock Water demand

Livestock	Cattle	Buffalo	Sheep	Goat	Pig	Rabbit	Dog	Poultry
Water ltr/animal	70 - 120	75 - 130	15 - 20	15 - 22	20 - 30	1 - 2	6 – 10	0.25 – 0.35

Livestock Demand in the catchment is about 0.37 TMC in the catchment. Figure 25 depicts the livestock water demand in each sub catchment. The plane lands show higher water demand for livestock compared to the Ghats and the transition zones.

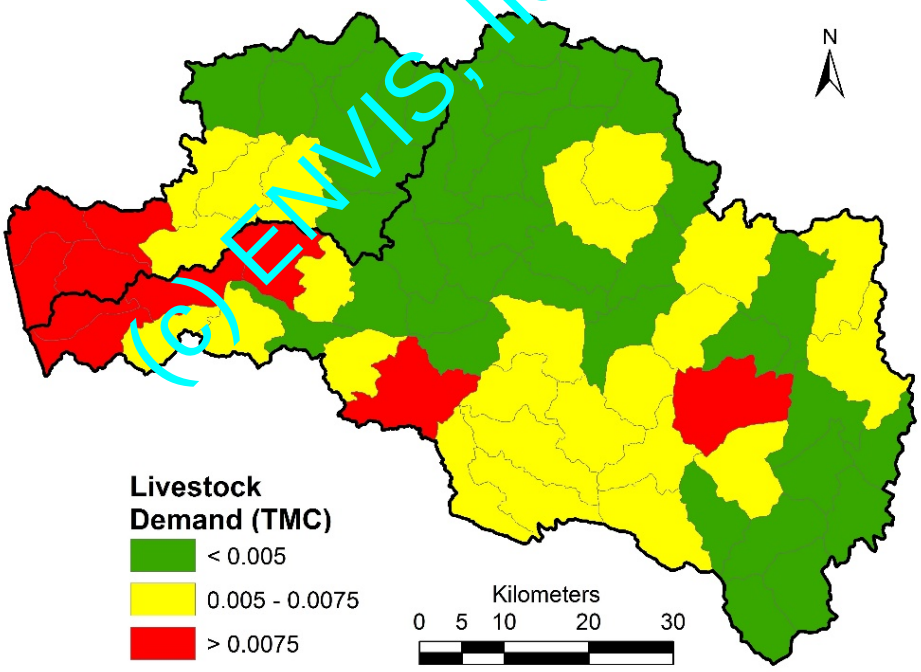

Figure 27: Livestock demand.

Agricultural Demand: Agriculture demands depends on such as type of plant, growth phase of plant. In order to estimate crop water requirements, area under different at district level was established based on the statistical data published by the Government agencies and NGO's (Karnataka State Department of Agriculture, no date; Department of Economics and Statistics, 2011, 2016; Department of Economics & Statistics, 2015). Water requirement for each crop based on their growth phases (*Food and Agriculture Organisation*; *ICAR-Indian Agricutlre Research Institute*; *Karnataka State Department of Agriculture; National Food Security Mission*) were accounted to quantify agriculture demand. Agriculture Demand is the major component in the catchment. The catchment is dominated by Paddy (mono crop and double crop), Horticulture (Rubber, Arecanut, Banana, Coconut) followed Fruits and Vegetable. Across time Large scale landscape changes have occurred in the region converting forest into monoculture(horticulture). Based on the data available at district at a glance, cropping area under each crop for sub catchments were quantified. Based on the crop water requirement for each crop according to the growing season, Crop water demand was estimated. The Basin has crop water demand of 120 TMC. Figure 28 Depicts the crop water requirement for each sub basin. Horticulture dominated Transition zones, Paddy dominated plane lands shows higher water demand as against the Ghats or the Coasts.

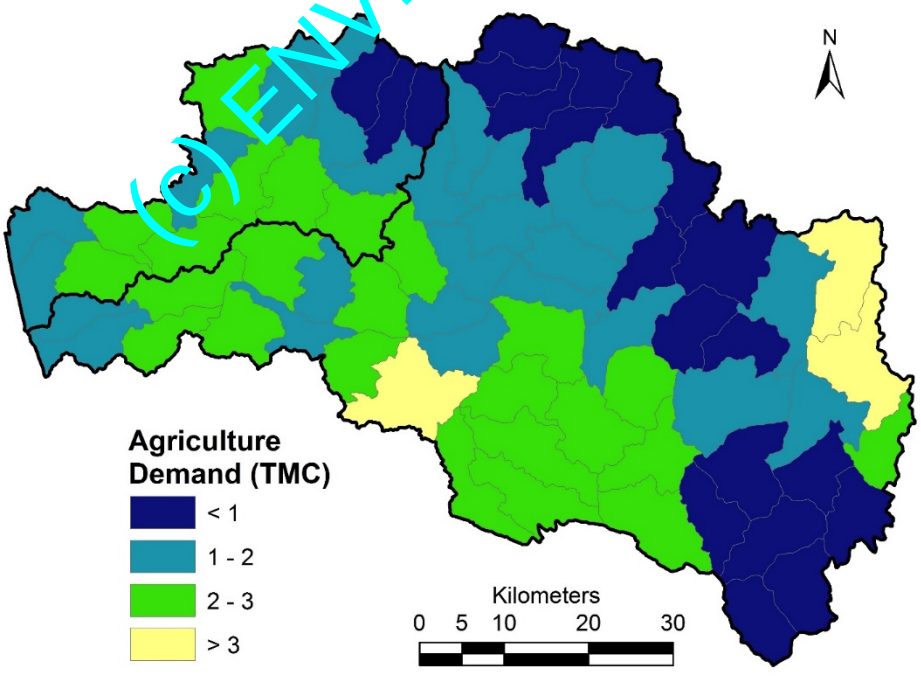

Figure 28: Agriculture Water Demand

Hydrological Status: Hydrological status is estimated as a function of Demand and Available functions. It is a non-dimensional value indicating deficit or excess water availability in the region. Values greater than 1 indicate excess water, values equal to 1 indicate water availability and demands are equal, values less than 1 indicate deficiency.

$$Hydrological\ Status = \frac{f(Water\ Supply)}{f(Water\ Demand)} = \frac{f(Rainfall, Runoff, Infiltration)}{f(Agriculture\ , Domestic\ and\ Livestock\ Demand)}$$

Total Water demand was quantified as function of Agriculture Demand, Domestic and Livestock water demands. Figure 4.23 depicts the total water demand in the catchment. Total water demand other than Terrestrial Environmental demand (Evapotranspiration from forest) and Aquatic Environmental Demand (Stream flow maintenance), is about 124 TMC. Adding Evaporation about 98 TMC, Total water demand would increase to 222 TMC, considering Environmental flow as 30% Mean Annual Runoff, about 128 TMC Total water Demand would increase to 350 TMC

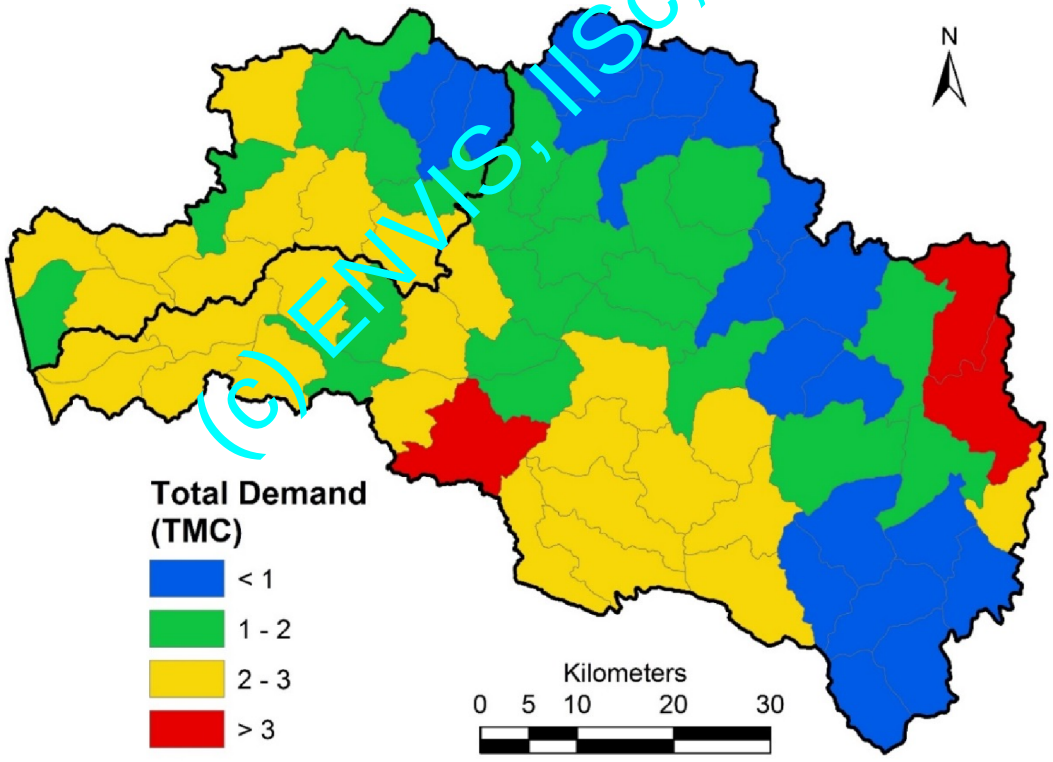

Figure 29: Total Water Demand

Hydrological status, i.e., ratio of Supply to Demand (ratio of 1.14) indicates that the water available in the catchment is just over the demand.

References

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Annexure D

Table a: Village wise ESR across five districts of Netravathi river basin.

District: DAKSHINA KANNADA			
ESR - 1 (62 villages)			
SNO	TAUK NAME	VILLAGE NAME	AREA (Ha)
1	Belthangadi	Charmadi	5645.68
2	Belthangadi	Chibidre	2168.46
3	Belthangadi	Kadirudyavara	1673.85
4	Belthangadi	Kalanja	5039.68
5	Belthangadi	Kokrady	633.62
6	Belthangadi	Kokrady	395.43
7	Belthangadi	Kuthlur	2645.25
8	Belthangadi	Malavanthige	6483.25
9	Belthangadi	Mi[illegible]bagilu	968.64
10	Belthangadi	N[illegible]a	317.78
11	Belthangadi	Na	58.69
12	Belthangadi	Na	179.45
13	Belthangadi	Nadabettu	882.1
14	Belthangadi	Naravi	2774.13
15	Belthangadi	Navara	550.05
16	Belthangadi	Navur	6134.26
17	Belthangadi	Neriya	10758.34
18	Belthangadi	Nidle	2411.35
19	Belthangadi	Pilya	359.11
20	Belthangadi	Puduvettu	3626.91
21	Belthangadi	Savanalu	2320.63
22	Belthangadi	Savya	779.12
23	Belthangadi	Shibaje	3660.65
24	Belthangadi	Shirlal	2494.24
25	Belthangadi	Shishila	4892.95
26	Belthangadi	Sulkeri	526.46
27	Belthangadi	Sulkerimogru	1773.03
28	Belthangadi	Tottatadi	1105.31
29	Puttur	Aithoor	3394.64
30	Puttur	Bantra	527.35
31	Puttur	Bilinele	6925.38
32	Puttur	Kenaje	1949.26

33	Puttur	Kodimbaia	1768.08
34	Puttur	Kombar	4046.73
35	Puttur	Nekkilady	702.23
36	Puttur	Renjiliady	884.01
37	Puttur	Shirady	7085.5
38	Puttur	Shirivagilu	3363.88
39	Sulya	Ainakidu	1583.52
40	Sulya	Aivathoklu	913.48
41	Sulya	Arampadi	876.57
42	Sulya	Balgodu	3911.62
43	Sulya	Balila	631
44	Sulya	Balpa	2243.66
45	Sulya	Guthigar	2686
46	Sulya	Hariharapalathadka	1281.38
47	Sulya	Kalanja	760.05
48	Sulya	Kallamogru	1367.04
49	Sulya	Kalmadka	1263.11
50	Sulya	Kalmakar	1837.94
51	Sulya	Kenya	818.32
52	Sulya	Kuthkunja	1024.16
53	Sulya	Madapady	5631.87
54	Sulya	Muppirya	501.33
55	Sulya	Murulya	1436.69
56	Sulya	Na	757.11
57	Sulya	Nalkur	2363.38
58	Sulya	Pambethady	676.23
59	Sulya	Subramanya	3475.74
60	Sulya	Yedamangala	1673.79
61	Sulya	Yenekul	1162.53
62	Sulya	Yenmur	630.57
ESR - 2 (31 villages)			
SNO	**TAUK NAME**	**VILLAGE NAME**	**AREA (Ha)**
1	Belthangadi	Belthangady	898.98
2	Belthangadi	Hathyadka	1381.81
3	Belthangadi	Kalmanja	1211.23
4	Belthangadi	Kanyady	940.62
5	Belthangadi	Karambar	766.92
6	Belthangadi	Kashipatna	972.25

7	Belthangadi	Kokkada	2370.89
8	Belthangadi	Kuvettu	998.71
9	Belthangadi	Layla	1882.14
10	Belthangadi	Marody	1255.42
11	Belthangadi	Melanthabettu	982.19
12	Belthangadi	Mundaje	1528.01
13	Belthangadi	Nada	1886.87
14	Belthangadi	Perady	609.41
15	Belthangadi	Rekya	2474.78
16	Belthangadi	Tenkakarandur	745.11
17	Belthangadi	Ujre	2702.64
18	Puttur	Alanthaya	625.05
19	Puttur	Bajathur	1936.44
20	Puttur	Baliya	2793.58
21	Puttur	Doipady	1760.68
22	Puttur	Golithattu	1597.04
23	Puttur	Ichalampady	820.53
24	Puttur	Kadaba	888.72
25	Puttur	Konalu	798.96
26	Puttur	Kowkradi	2391.89
27	Puttur	Kunthur	1451.91
28	Puttur	Kutrupadi	954.16
29	Puttur	Nellyadi	1837.9
30	Puttur	Noojibalthil	1497.97
31	Sulya	Devachalla	3531.19
ESR - 3 (95 villages)			
SNO	**TAUK NAME**	**VILLAGE NAME**	**AREA (Ha)**
1	Belthangadi	Andinje	1409.63
2	Belthangadi	Arambody	1995.11
3	Belthangadi	Badagakarandur	506.31
4	Belthangadi	Badekody	601.95
5	Belthangadi	Bajre	989
6	Belthangadi	Balanja	664.43
7	Belthangadi	Bandaru	2026.61
8	Belthangadi	Belala	2866.04
9	Belthangadi	Dharmastala	3025.97
10	Belthangadi	Gardadi	1074.89
11	Belthangadi	Gunduri	463.08

12	Belthangadi	Hosangady	2045.87
13	Belthangadi	Ilanthila	1527.98
14	Belthangadi	Kaliya	1007.41
15	Belthangadi	Kaniyoor	1846.76
16	Belthangadi	Karaya	961.76
17	Belthangadi	Koyyuru	2416.04
18	Belthangadi	Kukkala	682.76
19	Belthangadi	Kukkedi	874.17
20	Belthangadi	Machina	2232.27
21	Belthangadi	Maladi	1013.46
22	Belthangadi	Mogru	1037.48
23	Belthangadi	Mudukody	903.77
24	Belthangadi	Nalkur	978.49
25	Belthangadi	Nittade	627.77
26	Belthangadi	Nyayata Rf	516.86
27	Belthangadi	Padangadi	1148.02
28	Belthangadi	Parenki	913.38
29	Belthangadi	Patrame	1814.82
30	Belthangadi	Sonanduru	539.9
31	Belthangadi	Thannirpantha	1325.49
32	Belthangadi	Uruval	1257.24
33	Belthangadi	Vadilnala	974.1
34	Belthangadi	Venur	286.94
35	Buntwal	Ajjibettu	962.16
36	Buntwal	Badagakajekde	695.97
37	Buntwal	Budoli	315.05
38	Buntwal	Chennaithodi	604.87
39	Buntwal	Devashyapadur	436.98
40	Buntwal	Devasyamuduru	260.24
41	Buntwal	Eliyanadugodu	507.23
42	Buntwal	Irvathur	458.69
43	Buntwal	Kadabettu	467.03
44	Buntwal	Kavalmudur	1566.16
45	Buntwal	Kavalpadur	1095.09
46	Buntwal	Kudambettu	455.38
47	Buntwal	Mudanadugodu	623.3
48	Buntwal	Mudapadukodi	619.63
49	Buntwal	Navur	956.74

50	Buntwal	Pilathabettu	917.59
51	Buntwal	Pilimogru	488.69
52	Buntwal	Tenka Kajekar	646.34
53	Mangalore	Adyapady	491.55
54	Mangalore	Baikampadi	631.62
55	Mangalore	Bangrakulur	238.98
56	Mangalore	Boluru	141
57	Mangalore	Derebailu	476.92
58	Mangalore	Kavooru	458.12
59	Mangalore	Kenjar	185.8
60	Mangalore	Kenjar	513.96
61	Mangalore	Kunjathbailu	375.4
62	Mangalore	Malavoor	626.54
63	Mangalore	Marakada	150.76
64	Mangalore	Mudushedde	606.46
65	Mangalore	Neermarga	442.96
66	Mangalore	Pachanadi	416.06
67	Mangalore	Padavu	909.93
68	Mangalore	Padukody	125.85
69	Mangalore	Padukody	109.99
70	Mangalore	Padushedde	376.67
71	Mangalore	Panjimogar	176.28
72	Mangalor	Thokur	557.68
73	Puttur	Alankar	1424.97
74	Puttur	Belandur	560.32
75	Puttur	Charwaka	1240.48
76	Puttur	Haleneranki	777.19
77	Puttur	Hirebandady	1632.23
78	Puttur	Kaimana	530.67
79	Puttur	Kaniyur	924.37
80	Puttur	Koila	2002.33
81	Puttur	Kolthige	3130.51
82	Puttur	Kudmar	594.26
83	Puttur	Mundur	884.45
84	Puttur	Narimogru	1310.71
85	Puttur	Palthady	1033.98
86	Puttur	Perabe	1200.31
87	Puttur	Punchappady	841.2

88	Puttur	Ramakunja	1166.01
89	Puttur	Sarve	963.94
90	Puttur	Savanur	1062.48
91	Puttur	Shanthigod	1709.12
92	Puttur	Uppinangady	920.29
93	Sulya	Bellare	1044.13
94	Sulya	Kodiyala	1030.33
95	Sulya	Peruvaje	1130.55
ESR - 4 (62 villages)			
SNO	**TAUK NAME**	**VILLAGE NAME**	**AREA (Ha)**
1	Belthangadi	Barya	991.73
2	Belthangadi	Puthila	866.8
3	Belthangadi	Thekkar	724.91
4	Buntwal	Ammunje	641.33
5	Buntwal	Anitoor	543.64
6	Buntwal	Ananthady	924.39
7	Buntwal	Arla	701.72
8	Buntwal	Badagabellur	886.89
9	Buntwal	Balthila	1260.16
10	Buntwal	Bantwal	2044.96
11	Buntwal	Barimar	796.66
12	Buntwal	Biliyur	678.51
13	Buntwal	Bolanthur	720.07
14	Buntwal	Chelur	351.92
15	Buntwal	Gol Thamajal	628.49
16	Buntwal	Idkidu	765.27
17	Buntwal	Ira	1334.59
18	Buntwal	Kadeshvallya	1193.2
19	Buntwal	Kallige	649.13
20	Buntwal	Kariangala	594.6
21	Buntwal	Kariangala	638.36
22	Buntwal	Karpe	553.49
23	Buntwal	Kedila	941.59
24	Buntwal	Kodmannu	337.46
25	Buntwal	Koila	557.41
26	Buntwal	Kukkipady	918.8
27	Buntwal	Kuriyala	865.29
28	Buntwal	Kurnad	630.94

29	Buntwal	Manchi	1464.23
30	Buntwal	Mani	538.73
31	Buntwal	Maninalkur	1367.82
32	Buntwal	Mermajal	518.53
33	Buntwal	Muda	1074.74
34	Buntwal	Munnur	713.83
35	Buntwal	Narikombu	1183.53
36	Buntwal	Netlamudnur	555.43
37	Buntwal	Paanimangalore	603.44
38	Buntwal	Padu	682.98
39	Buntwal	Panjikal	977.9
40	Buntwal	Peraje	539.15
41	Buntwal	Perne	574.64
42	Buntwal	Phajee	1353.13
43	Buntwal	Rayee	702.96
44	Buntwal	Sajipamuda	970.58
45	Buntwal	Sajipanadu	405.86
46	Buntwal	Sajipapadu	304.12
47	Buntwal	Sangabettu	1069.52
48	Buntwal	Sarapady	1091.81
49	Buntwal	Shambur	628.05
50	Buntwal	Tenkabellur	322.23
51	Buntwal	Thumbe	564.35
52	Buntwal	Uli	1282.37
53	Buntwal	Veerakamba	1163.24
54	Mangalore	Addur	481.03
55	Mangalore	Adyar	494.43
56	Mangalore	Alape	314.06
57	Mangalore	Amblamogaru	558.88
58	Mangalore	Arkula	386.41
59	Mangalore	Badagaulipadu	837.71
60	Mangalore	Badagayedapadavu	1028.8
61	Mangalore	Bajal	303.4
62	Mangalore	Bajpe	760.46
63	Mangalore	Bala	565.97
64	Mangalore	Belma	367.69
65	Mangalore	Boliyar	621.06
66	Mangalore	Bondanthila	808.59

67	Mangalore	Harekala	616.93
68	Mangalore	Hosabettu	225.52
69	Mangalore	Idya	641.25
70	Mangalore	Kadri	340.42
71	Mangalore	Kalavar	320.7
72	Mangalore	Kandavara	564.38
73	Mangalore	Kankanadi	307.76
74	Mangalore	Kankanadi	133.58
75	Mangalore	Kannur H S	32.95
76	Mangalore	Kannuru	332.65
77	Mangalore	Kilanjara	477.43
78	Mangalore	Kolambe	1793.82
79	Mangalore	Kolavoor	418.89
80	Mangalore	Konaje	1017.15
81	Mangalore	Kuduka	704.92
82	Mangalore	Kuthethur	795.13
83	Mangalore	Mallur	251.66
84	Mangalore	Mangalore	3193.57
85	Mangalore	Maroli	192.22
86	Mangalore	Mogar	477.26
87	Mangalore	Muduperar	912.77
88	Mangalore	Mulur	390.57
89	Mangalore	Munnuru	440.29
90	Mangalore	Muthur	332.43
91	Mangalore	Na	162.41
92	Mangalore	Neermarga	826.41
93	Mangalore	Panambur	917.12
94	Mangalore	Pavoor	924.49
95	Mangalore	Peramannuru	346.89
96	Mangalore	Permude	775.12
97	Mangalore	Tannirbhavi	373.35
98	Mangalore	Tenkaulipady	583.47
99	Mangalore	Tenkayedapadavu	1210.93
100	Mangalore	Thiruvail	521.41
101	Mangalore	Ulaibettu	556.27
102	Puttur	Aryappu	2072.21
103	Puttur	Balnad	1904.98
104	Puttur	Bannur	593

105	Puttur	Bellipadi	643.5
106	Puttur	Chickamudnur	875.56
107	Puttur	Kabaka	813.45
108	Puttur	Kedambady	954.52
109	Puttur	Kemminje	749.87
110	Puttur	Keyyur	2022.48
111	Puttur	Kodimbady	547.3
112	Puttur	Kudipadi	645.9
113	Puttur	Madnur	1635.55
114	Puttur	Nekkiladi	657.26
115	Puttur	Padnur	737.03
116	Puttur	Puttur	1022.12
117	Sulya	Aivarnad	2323.28
118	Sulya	Amaramudnur	2277.48
119	Sulya	Amarapadnur	1165.04
District: CHIKMAGALURU			
ESR - 1 (9 villages)			
SNO	**TAUK NAME**	**VILLAGE NAME**	**AREA (Ha)**
1	Mudigere	Attigere	1406.55
2	Mudigere	Byarapura	4000.7
3	Mudigere	Byarapura Coffee Estate	987.96
4	Mudigere	Gotti	2637.38
5	Mudigere	Halagadaka State Forest	98.4
6	Mudigere	Kogile	1457.93
7	Mudigere	Kogile Boremale Coffee Estate	387.01
8	Mudigere	Mudgundi	2421.28
9	Mudigere	Taruve	796.01
ESR - 2 (7 villages)			
SNO	**TAUK NAME**	**VILLAGE NAME**	**AREA (Ha)**
1	Mudigere	Alakha Coffee Estate	1755.74
2	Mudigere	Balgi	833.34
3	Mudigere	Baluru	1648.26
4	Mudigere	Durgadahalli	920.69
5	Mudigere	Malemane Coffee Estate	186.13
6	Mudigere	Na	33.38
7	Mudigere	Urubage	3017.11
District: UDUPI			
ESR - 1 (1 villages)			

SNO	TAUK NAME	VILLAGE NAME	AREA (Ha)
1	Karkal	IDU	3065.78
District: UDUPI			
ESR - 2 (6 villages)			
SNO	**TAUK NAME**	**VILLAGE NAME**	**AREA (Ha)**
1	Karkal	Mantradi	897.29
2	Karkal	Marur	1628.04
3	Karkal	Nellikara	1139.06
4	Karkal	Nuralbettu	2169.37
5	Karkal	Panapila	704.12
6	Karkal	Valpadi	1051.03
District: UDUPI			
ESR - 4 (15 villages)			
SNO	**TAUK NAME**	**VILLAGE NAME**	**AREA (Ha)**
1	Karkal	Beluvai	2434.34
2	Karkal	Daregudde	728.57
3	Karkal	Hosabettu	1004.21
4	Karkal	Iruvail	949.67
5	Karkal	Kallabettu	518.52
6	Karkal	Karinje	919.07
7	Karkal	Kellaputtige	468.57
8	Karkal	Mudbidri	1318.81
9	Karkal	Mudukonaje	929.35
10	Karkal	Mudumarnad	922.40
11	Karkal	Padukonaje	1179.38
12	Karkal	Padumarnadu	1166.62
13	Karkal	Punchamogru	976.44
14	Karkal	Renjala	1797.52
15	Karkal	Todar	977.73
District: HASSAN			
ESR - 1 (30 villages)			
SNO	**TAUK NAME**	**VILLAGE NAME**	**AREA (Ha)**
1	Sakaleshpur	Arini Coffee Estate	604.41
2	Sakaleshpur	Arni	1189.55
3	Sakaleshpur	Attihalli	610.22
4	Sakaleshpur	Belehalla	712.62
5	Sakaleshpur	Bettekumari	1275.50
6	Sakaleshpur	Bisle State Forest	2481.54

7	Sakaleshpur	Boranamane	352.05
8	Sakaleshpur	Heggadde	5209.26
9	Sakaleshpur	Hodchhalli	575.28
10	Sakaleshpur	Hongadahalla	748.31
11	Sakaleshpur	Hosahalli	485.42
12	Sakaleshpur	Jambardi	1002.28
13	Sakaleshpur	Jedigadde	547.36
14	Sakaleshpur	Kadagaravalli	1090.66
15	Sakaleshpur	Kadagaravalli Coffee Estate	68.60
16	Sakaleshpur	Kadumane	744.48
17	Sakaleshpur	Kadumane Coffee Estate	2526.50
18	Sakaleshpur	Kagenari State Forest	3078.51
19	Sakaleshpur	Kumaradi	618.37
20	Sakaleshpur	Kumarihalli	7423.97
21	Sakaleshpur	Kyamanahalli	969.71
22	Sakaleshpur	Manibigati Coffee Estate	336.15
23	Sakaleshpur	Manjanahalla Coffee Estate	830.66
24	Sakaleshpur	Mankanahalli	730.50
25	Sakaleshpur	Na	362.64
26	Sakaleshpur	Na	306.93
27	Sakaleshpur	Nadahalli	1131.43
28	Sakaleshpur	Raxdi Coffee Estate	386.37
29	Sakaleshpur	Yadekumari	501.53
30	Sakaleshpur	Yathahalla	1310.17
ESR - 2 (21 villages)			
SNO	**TAUK NAME**	**VILLAGE NAME**	**AREA (Ha)**
1	Sakaleshpur	Bachalli	315.38
2	Sakaleshpur	Banagere	642.03
3	Sakaleshpur	Begadhalli	240.81
4	Sakaleshpur	Goddu	512.57
5	Sakaleshpur	Hadalhalli	986.23
6	Sakaleshpur	Hadalkerehalli	186.49
7	Sakaleshpur	Hadya	728.33
8	Sakaleshpur	Halliyur	222.13
9	Sakaleshpur	Hethur	753.24
10	Sakaleshpur	Kangahalli	488.91
11	Sakaleshpur	Karagur	379.67
12	Sakaleshpur	Magere	780.40

13	Sakaleshpur	Maragathur	262.34
14	Sakaleshpur	Maragunda	406.85
15	Sakaleshpur	Marakalli	857.39
16	Sakaleshpur	Na	120.59
17	Sakaleshpur	Palahalli	221.86
18	Sakaleshpur	Tambalagere	433.04
19	Sakaleshpur	Vanagur	957.55
20	Sakaleshpur	Vanagur Coffee Estate	92.03
21	Sakaleshpur	Yaragalli	792.58
ESR - 3 (24 villages)			
SNO	**TAUK NAME**	**VILLAGE NAME**	**AREA (Ha)**
1	Sakaleshpur	Agalahalli	517.55
2	Sakaleshpur	Anemahal	207.68
3	Sakaleshpur	Arekere	560.80
4	Sakaleshpur	Bobbanahalli	369.16
5	Sakaleshpur	Bommanakere	346.38
6	Sakaleshpur	Bugadahalli	475.67
7	Sakaleshpur	Bykaravalli	494.63
8	Sakaleshpur	Chinnahalli	515.63
9	Sakaleshpur	Dabbegadde	151.06
10	Sakaleshpur	Devihalli	207.28
11	Sakaleshpur	Donigalu	188.36
12	Sakaleshpur	Ganadahole	222.15
13	Sakaleshpur	Haragarahalli	347.97
14	Sakaleshpur	Hebbasale	951.07
15	Sakaleshpur	Hennalli	378.65
16	Sakaleshpur	Hullahalli Coffee Estate	41.02
17	Sakaleshpur	Kalgane	166.25
18	Sakaleshpur	Karadigala	479.30
19	Sakaleshpur	Kelagina Manchahalli	422.26
20	Sakaleshpur	Kesaganahalli	598.99
21	Sakaleshpur	Kumbardicoffeeestate	139.10
22	Sakaleshpur	Kyanahalli	338.37
23	Sakaleshpur	Mavinakolu	103.76
24	Sakaleshpur	Volalahalli	266.46
District: KODAGU			
ESR - 1 (6 villages)			
SNO	**TAUK NAME**	**VILLAGE NAME**	**AREA (Ha)**

1	Mercara	Galibeedu Forest	3800.64
2	Mercara	Hammiyala	4409.81
3	Mercara	Kaloor	6084.68
4	Somvarpet	Kothanalli	1501.98
5	Somvarpet	Kumaralli Forest	4789.28
6	Somvarpet	Surlabi	6626.69
ESR - 2 (4 villages)			
SNO	**TAUK NAME**	**VILLAGE NAME**	**AREA (Ha)**
1	Somvarpet	Bettadalli	790.24
2	Somvarpet	Haraga	836.12
3	Somvarpet	Kundahalli	890.54
4	Somvarpet	Santhalli	967.63

Table b: ESR - Netravthi basin at district wise.

District Name		Dakshina Kannada		Chikmagaluru		Udupi		Hassan		Kodagu	
SNO	ESR Type	Area (Ha)	Number of Villages	Area (Ha)	Number of Villages	Area (Ha)	Number of Villages	Area (Ha)	Number of Villages	Area (Ha)	Number of Villages
1	ESR 1	141412.57	62	14193.22	9	3065.78	1	42191.98	33	27213.08	6
2	ESR 2	46494	31	8394.65	7	7588.91	6	10380.42	21	3484.53	4
3	ESR 3	89760.26	95	0	0	0	0	8489.55	24	0	0
4	ESR 4	94676.62	119	0	0	16291.2	15	0	0	16291.2	0
TOTAL		**372343.45**	**307**	**22587.87**	**16**	**26945.89**	**22**	**61061.95**	**78**	**46988.81**	**10**

Annexure E

The union government (MoEFCC, GoI) constituted Gadgil Committee, known as WGEEP or Western Ghats Ecology Expert Panel to identify ecological sensitive areas. Objectives of this research panel were to study the present-day condition of the Western Ghats regarding of ecology of Western Ghats region, to distinguish Ecologically Sensitive Areas (ESA) within the Western Ghats, to make recommendations for Western Ghats conservation, protection, and rejuvenation (Gadgil et al., 2011). WGEEP has submitted a report to the government of India on 31 August 2011. This panel assigned an entire hilly range of Western Ghats as an ecologically sensitive area by considering different parameters such as biological features like habitat, cultural and historical significance. According to this report, 142 taluks in the Western Ghats consider into the ecologically sensitive zones 1, 2, 3 and restricted the all developmental activities like mining, thermal power plants etc. Figure 55 shows ESA map as per Gadgil report. The report highlights, taluks such as Belthangadi, Sulya, Karkala, Madikeri, Somwarpet, Mudigeri, Sakleshpur as ESA 1 and Puttur as ESA 3. The taluks such as Mangalore, Bantwal are not assigned any status.

Dr. K. Kasthurirangan with researchers of 10 members of the high-level working group (HLWG) has been formed by MoEFCC to prepare a report on Western Ghats to retard the agitations raised for Gadgil committee report. The Objectives of this research committee were a present-day condition of the Western Ghats regarding vegetation, endemism, rainfall, deforestation, Ecological sensitive regions, population density, the area under the natural and cultural landscapes, the number of villages and taluks under Western Ghats region in the different states (Kasturirangan, 2013). They followed geospatial analysis for the identification of Ecologically Sensitive Zones (ESZ). According to Kasthurirangan committee only 60,000 sq.km (37%) of the natural landscape the total area the Western Ghats, be brought under ESZ. That ESZ area having a high biological richness and low fragmentation and low population density, Protected areas (PAs), World Heritage Sites (WHSs), Tiger and elephant corridors. They recommended a non-tolerance policy with respect to the banning of complete mining, quarrying and polluting industries in the ESZ region. This report was prepared to satisfy pro developers, industrialists, natural resource exploiters than conservation of biodiversity and habitat. Figure 56 depicts the villages considered for ESZ notification as per HLWG. The WGEEP had adopted holistic way of

assigning ESAs than HLWG, which can be perceived from Figure I, II. Annexure E highlights the village wise ecological sensitive regions status as per WGEEP, HLWG and IISc_ENVIS (current approach) reports (Table a).

Figure I: ESA as per WGEEP report

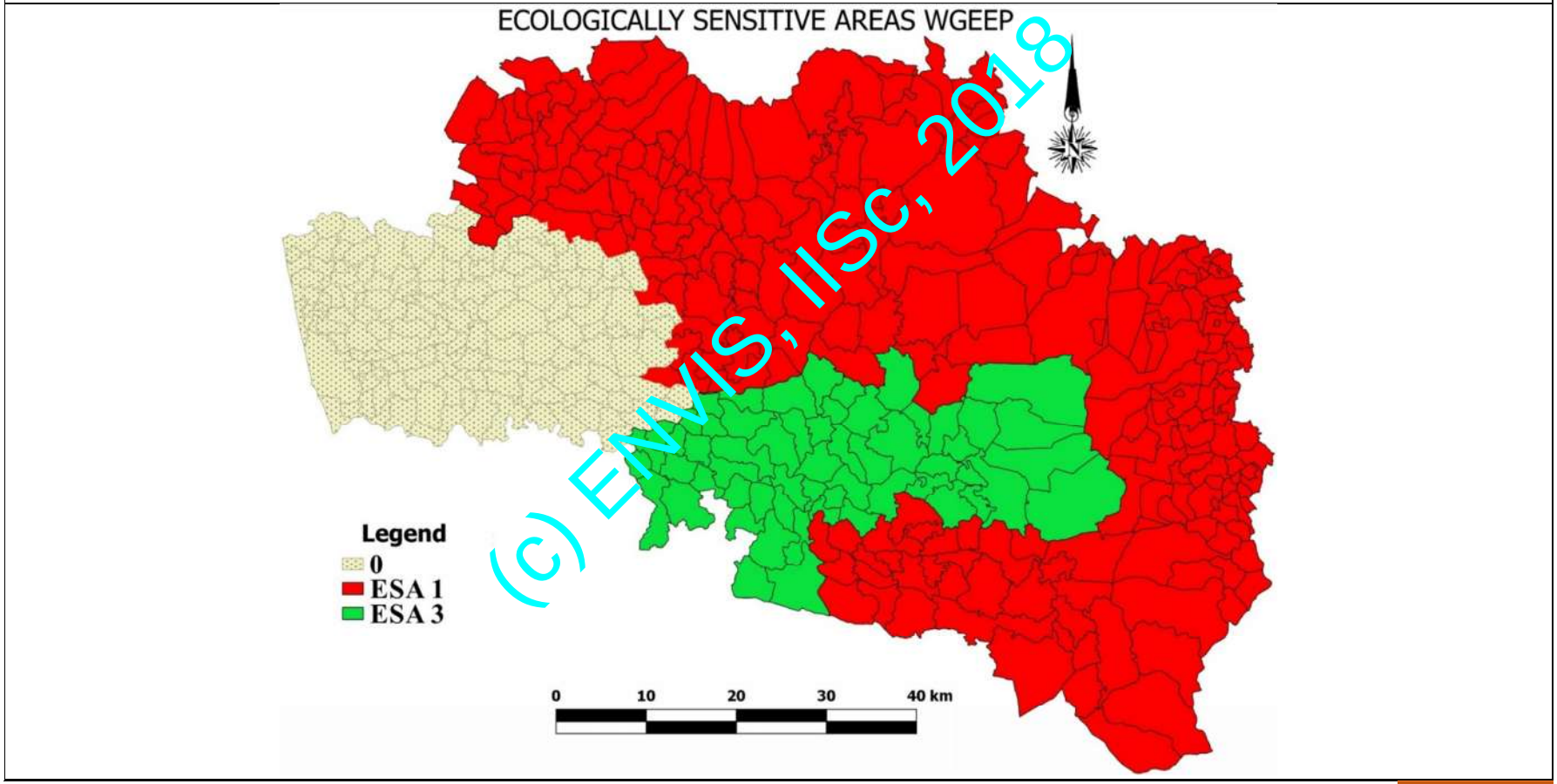

Figure II: ESZ assigned as per HLWG report

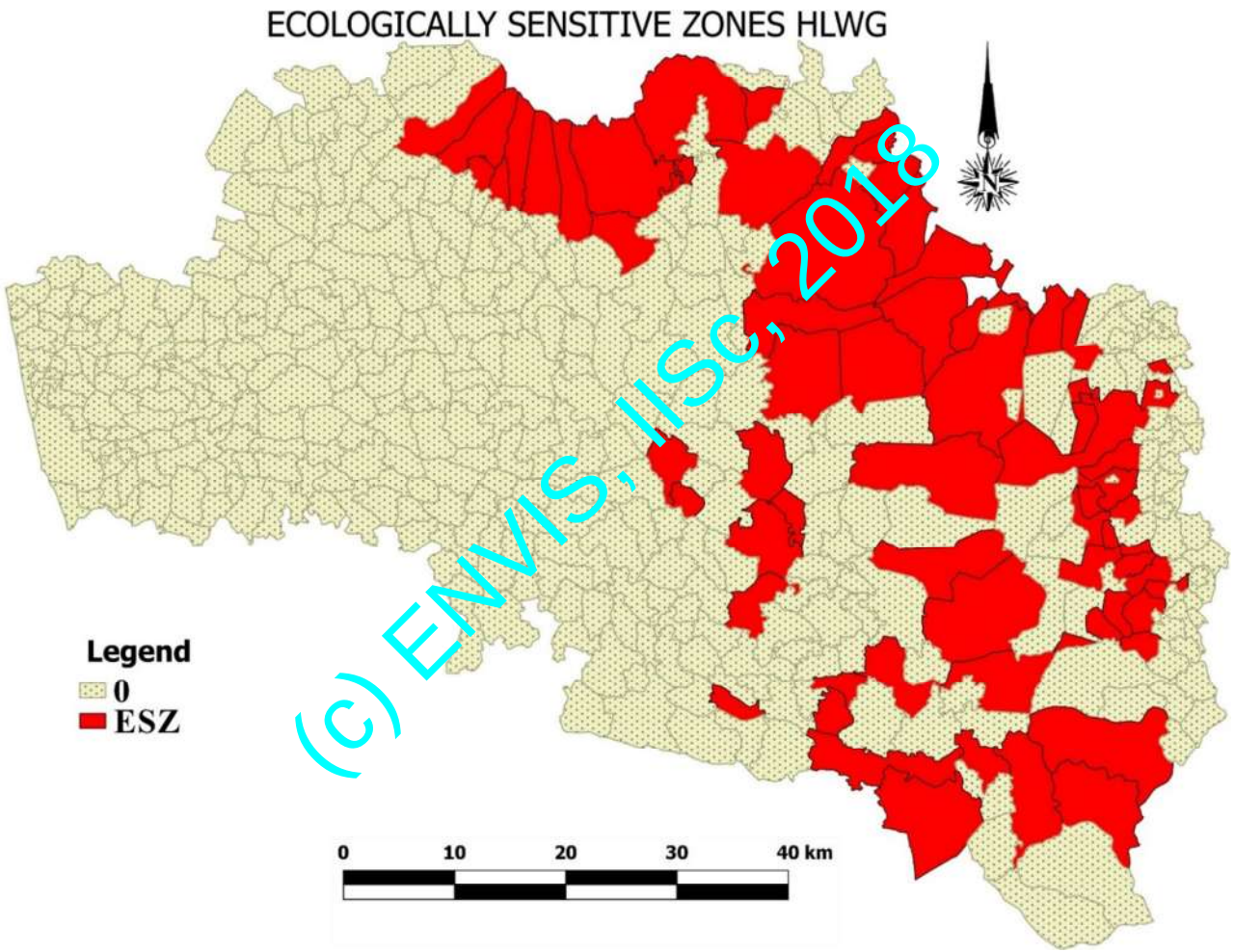

Figure II: ES villages as per the current work (IISc-ENVIS)

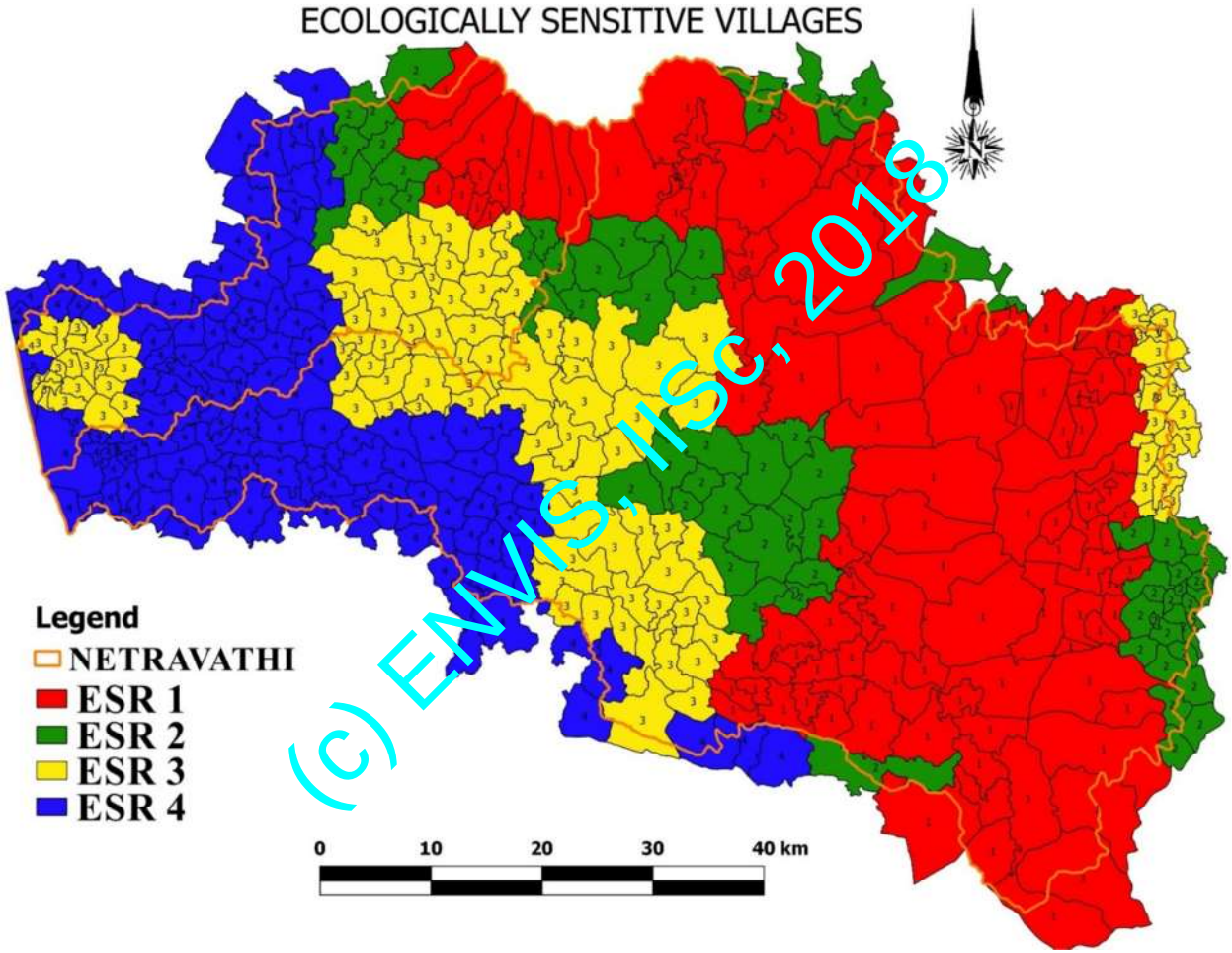

Table a: Village wise ESR based on the various reports

SNO	DISTRICT	TALUK	LOCATION	AREA	ESA_WGEEP	ESZ_HLWG	ESR_ IISc_ENVIS
1	**Dakshina Kannada**	Belthangadi	Malavanthige	6483.25	1	1	1
2	**Dakshina Kannada**	Belthangadi	Naravi	2774.13	1	1	1
3	**Dakshina Kannada**	Belthangadi	Kuthlur	2645.25	1	1	1
4	**Dakshina Kannada**	Belthangadi	Sulkerimogru	1773.03	1	1	1
5	**Dakshina Kannada**	Belthangadi	Mithabagilu	968.64	1	0	1
6	**Dakshina Kannada**	Belthangadi	Shirlal	2494.24	1	1	1
7	**Dakshina Kannada**	Belthangadi	Navur	6134.26	1	1	1
8	**Dakshina Kannada**	Belthangadi	Savanalu	2320.63	1	1	1
9	**Dakshina Kannada**	Belthangadi	Charmadi	5645.68	1	1	1
10	**Dakshina Kannada**	Belthangadi	Marody	1255.42	1	0	2
11	**Dakshina Kannada**	Belthangadi	Kadirudyavara	1673.85	1	0	1
12	**Dakshina Kannada**	Belthangadi	Na	317.78	1	1	1
13	**Dakshina Kannada**	Belthangadi	Sulkeri	526.46	1	1	1
14	**Dakshina Kannada**	Belthangadi	Navara	550.05	1	1	1
15	**Dakshina Kannada**	Belthangadi	Savya	779.12	1	0	1
16	**Dakshina Kannada**	Belthangadi	Na	58.69	1	1	1
17	**Dakshina Kannada**	Belthangadi	Neriya	10758.3	1	1	1
18	**Dakshina Kannada**	Belthangadi	Kokrady	633.62	1	0	1
19	**Dakshina Kannada**	Belthangadi	Kashipatna	972.25	1	0	2
20	**Dakshina Kannada**	Belthangadi	Na	179.45	1	1	1
21	**Dakshina Kannada**	Belthangadi	Perady	609.41	1	0	2
22	**Dakshina Kannada**	Belthangadi	Nadabettu	882.10	1	0	1
23	**Dakshina Kannada**	Belthangadi	Kokrady	395.43	1	0	1

24	**Dakshina Kannada**	Belthangadi	Andinje	1409.63	1	0	3
25	**Dakshina Kannada**	Belthangadi	Pilya	359.11	1	0	1
26	**Dakshina Kannada**	Belthangadi	Badekody	601.95	1	0	3
27	**Dakshina Kannada**	Belthangadi	Badagakarandur	506.31	1	0	3
28	**Dakshina Kannada**	Belthangadi	Hosangady	2045.87	1	0	3
29	**Dakshina Kannada**	Belthangadi	Mudukody	903.77	1	0	3
30	**Dakshina Kannada**	Belthangadi	Nada	1886.87	1	1	2
31	**Dakshina Kannada**	Belthangadi	Karambar	766.92	1	0	2
32	**Dakshina Kannada**	Belthangadi	Kanyady	940.62	1	0	2
33	**Dakshina Kannada**	Belthangadi	Chibidre	2168.46	1	0	1
34	**Dakshina Kannada**	Belthangadi	Nalkur	978.49	1	0	3
35	**Dakshina Kannada**	Belthangadi	Mundaje	1528.01	1	0	2
36	**Dakshina Kannada**	Belthangadi	Tenkakarandur	745.11	1	0	2
37	**Dakshina Kannada**	Belthangadi	Tottatadi	1105.31	1	0	1
38	**Dakshina Kannada**	Belthangadi	Balanja	664.43	1	0	3
39	**Dakshina Kannada**	Belthangadi	Melantabettu	982.19	1	0	2
40	**Dakshina Kannada**	Belthangadi	Laya	1882.14	1	0	2
41	**Dakshina Kannada**	Belthangadi	Nittade	627.77	1	0	3
42	**Dakshina Kannada**	Belthangadi	Arambody	1995.11	1	0	3
43	**Dakshina Kannada**	Belthangadi	Ujre	2702.64	1	0	2
44	**Dakshina Kannada**	Belthangadi	Gunduri	463.08	1	0	3
45	**Dakshina Kannada**	Belthangadi	Venur	286.94	1	0	3
46	**Dakshina Kannada**	Belthangadi	Padangadi	1148.02	1	0	3
47	**Dakshina Kannada**	Belthangadi	Kalmanja	1211.23	1	0	2
48	**Dakshina Kannada**	Belthangadi	Bajre	989.00	1	0	3
49	**Dakshina Kannada**	Belthangadi	Gardadi	1074.89	1	0	3
50	**Dakshina Kannada**	Belthangadi	Kukkedi	874.17	1	0	3

51	**Dakshina Kannada**	Belthangadi	Kuvettu	998.71	1	0	2
52	**Dakshina Kannada**	Belthangadi	Belthangady	898.98	1	0	2
53	**Dakshina Kannada**	Belthangadi	Puduvettu	3626.91	1	1	1
54	**Dakshina Kannada**	Belthangadi	Koyyuru	2416.04	1	0	3
55	**Dakshina Kannada**	Belthangadi	Sonanduru	539.90	1	0	3
56	**Dakshina Kannada**	Belthangadi	Dharmastala	3025.97	1	0	3
57	**Dakshina Kannada**	Belthangadi	Vadilnala	974.10	1	0	3
58	**Dakshina Kannada**	Belthangadi	Maladi	1013.46	1	0	3
59	**Dakshina Kannada**	Belthangadi	Kaliya	1007.41	1	0	3
60	**Dakshina Kannada**	Belthangadi	Shishila	4892.95	1	1	1
61	**Dakshina Kannada**	Belthangadi	Belala	2866.04	1	0	3
62	**Dakshina Kannada**	Belthangadi	Kalanja	5039.68	1	1	1
63	**Dakshina Kannada**	Belthangadi	Machina	2232.27	1	0	3
64	**Dakshina Kannada**	Belthangadi	Parenki	913.38	1	0	3
65	**Dakshina Kannada**	Belthangadi	Kukkala	682.76	1	0	3
66	**Dakshina Kannada**	Belthangadi	Nyayana PF	516.86	1	0	3
67	**Dakshina Kannada**	Belthangadi	Nidle	2411.35	1	0	1
68	**Dakshina Kannada**	Belthangadi	Kaniyoor	1846.76	1	0	3
69	**Dakshina Kannada**	Belthangadi	Patrame	1814.82	1	0	3
70	**Dakshina Kannada**	Belthangadi	Bandaru	2026.61	1	0	3
71	**Dakshina Kannada**	Belthangadi	Thannirpantha	1325.49	1	0	3
72	**Dakshina Kannada**	Belthangadi	Uruval	1257.24	1	0	3
73	**Dakshina Kannada**	Belthangadi	Shibaje	3660.65	1	0	1
74	**Dakshina Kannada**	Belthangadi	Puthila	866.80	1	0	4
75	**Dakshina Kannada**	Belthangadi	Kokkada	2370.89	1	0	2
76	**Dakshina Kannada**	Belthangadi	Hathyadka	1381.81	1	0	2
77	**Dakshina Kannada**	Belthangadi	Karaya	961.76	1	0	3

78	**Dakshina Kannada**	Belthangadi	Barya	991.73	1	0	4
79	**Dakshina Kannada**	Belthangadi	Mogru	1037.48	1	0	3
80	**Dakshina Kannada**	Belthangadi	Ilanthila	1527.98	1	0	3
81	**Dakshina Kannada**	Belthangadi	Rekya	2474.78	1	0	2
82	**Dakshina Kannada**	Belthangadi	Thekkar	724.91	1	0	4
83	**Dakshina Kannada**	Mangalore	Badagayedapadavu	1028.80	0	0	4
84	**Dakshina Kannada**	Mangalore	Kuthethur	795.13	0	0	4
85	**Dakshina Kannada**	Mangalore	Permude	775.12	0	0	4
86	**Dakshina Kannada**	Mangalore	Kolambe	1793.82	0	0	4
87	**Dakshina Kannada**	Mangalore	Tenkayedapadavu	1210.93	0	0	4
88	**Dakshina Kannada**	Mangalore	Idya	641.25	0	0	4
89	**Dakshina Kannada**	Mangalore	Muduperar	912.77	0	0	4
90	**Dakshina Kannada**	Mangalore	Bajpe	760.46	0	0	4
91	**Dakshina Kannada**	Mangalore	Bala	565.97	0	0	4
92	**Dakshina Kannada**	Mangalore	Kalaval	320.70	0	0	4
93	**Dakshina Kannada**	Mangalore	Badagalipadu	837.71	0	0	4
94	**Dakshina Kannada**	Mangalore	Kilanjara	477.43	0	0	4
95	**Dakshina Kannada**	Mangalore	Hosabettu	225.52	0	0	4
96	**Dakshina Kannada**	Mangalore	Panambur	917.12	0	0	4
97	**Dakshina Kannada**	Mangalore	Muthur	332.43	0	0	4
98	**Dakshina Kannada**	Mangalore	Malavoor	626.54	0	0	3
99	**Dakshina Kannada**	Mangalore	Thokur	557.68	0	0	3
100	**Dakshina Kannada**	Mangalore	Mogar	477.26	0	0	4
101	**Dakshina Kannada**	Mangalore	Kolavoor	418.89	0	0	4
102	**Dakshina Kannada**	Mangalore	Kenjar	185.80	0	0	3
103	**Dakshina Kannada**	Mangalore	Kenjar	513.96	0	0	3
104	**Dakshina Kannada**	Mangalore	Kandavara	564.38	0	0	4

105	**Dakshina Kannada**	Mangalore	Baikampadi	631.62	0	0	3
106	**Dakshina Kannada**	Mangalore	Adyapady	491.55	0	0	3
107	**Dakshina Kannada**	Mangalore	Mulur	390.57	0	0	4
108	**Dakshina Kannada**	Mangalore	Tenkaulipady	583.47	0	0	4
109	**Dakshina Kannada**	Mangalore	Padushedde	376.67	0	0	3
110	**Dakshina Kannada**	Mangalore	Kunjathbailu	375.40	0	0	3
111	**Dakshina Kannada**	Mangalore	Mudushedde	606.46	0	0	3
112	**Dakshina Kannada**	Mangalore	Panjimogar	176.28	0	0	3
113	**Dakshina Kannada**	Mangalore	Marakada	150.76	0	0	3
114	**Dakshina Kannada**	Mangalore	Addur	481.03	0	0	4
115	**Dakshina Kannada**	Mangalore	Tannirbhavi	573.35	0	0	4
116	**Dakshina Kannada**	Mangalore	Thiruvail	521.41	0	0	4
117	**Dakshina Kannada**	Mangalore	Padukody	125.85	0	0	3
118	**Dakshina Kannada**	Mangalore	Padukody	109.99	0	0	3
119	**Dakshina Kannada**	Mangalore	Ulaibettu	556.27	0	0	4
120	**Dakshina Kannada**	Mangalore	Pachanadi	416.06	0	0	3
121	**Dakshina Kannada**	Mangalore	Kaveru	458.12	0	0	3
122	**Dakshina Kannada**	Mangalore	Bangrakulur	238.98	0	0	3
123	**Dakshina Kannada**	Mangalore	Derebailu	476.92	0	0	3
124	**Dakshina Kannada**	Mangalore	Boluru	141.00	0	0	3
125	**Dakshina Kannada**	Mangalore	Mallur	251.66	0	0	4
126	**Dakshina Kannada**	Mangalore	Bondanthila	808.59	0	0	4
127	**Dakshina Kannada**	Mangalore	Neermarga	442.96	0	0	3
128	**Dakshina Kannada**	Mangalore	Padavu	909.93	0	0	3
129	**Dakshina Kannada**	Mangalore	Mangalore	3193.57	0	0	4
130	**Dakshina Kannada**	Mangalore	Kadri	340.42	0	0	4
131	**Dakshina Kannada**	Mangalore	Neermarga	826.41	0	0	4

132	**Dakshina Kannada**	Mangalore	Arkula	386.41	0	0	4
133	**Dakshina Kannada**	Mangalore	Maroli	192.22	0	0	4
134	**Dakshina Kannada**	Mangalore	Alape	314.06	0	0	4
135	**Dakshina Kannada**	Mangalore	Adyar	494.43	0	0	4
136	**Dakshina Kannada**	Mangalore	Kannuru	332.65	0	0	4
137	**Dakshina Kannada**	Mangalore	Kankanadi	307.76	0	0	4
138	**Dakshina Kannada**	Mangalore	Kannur H S	32.95	0	0	4
139	**Dakshina Kannada**	Mangalore	Kankanadi	133.58	0	0	4
140	**Dakshina Kannada**	Mangalore	Pavoor	924.49	0	0	4
141	**Dakshina Kannada**	Mangalore	Na	162.41	0	0	4
142	**Dakshina Kannada**	Mangalore	Bajal	503.40	0	0	4
143	**Dakshina Kannada**	Mangalore	Harekala	616.93	0	0	4
144	**Dakshina Kannada**	Mangalore	Boliyar	621.06	0	0	4
145	**Dakshina Kannada**	Mangalore	Amblamogaru	558.88	0	0	4
146	**Dakshina Kannada**	Mangalore	Munnuru	440.29	0	0	4
147	**Dakshina Kannada**	Mangalore	Kudugu	704.92	0	0	4
148	**Dakshina Kannada**	Mangalore	Konaje	1017.15	0	0	4
149	**Dakshina Kannada**	Mangalore	Belma	367.69	0	0	4
150	**Dakshina Kannada**	Mangalore	Peramannuru	346.89	0	0	4
151	**Dakshina Kannada**	Buntwal	Sangabettu	1069.52	0	0	4
152	**Dakshina Kannada**	Buntwal	Eliyanadugodu	507.23	0	0	3
153	**Dakshina Kannada**	Buntwal	Karpe	553.49	0	0	4
154	**Dakshina Kannada**	Buntwal	Ajjibettu	962.16	0	0	3
155	**Dakshina Kannada**	Buntwal	Kukkipady	918.80	0	0	4
156	**Dakshina Kannada**	Buntwal	Chennaithodi	604.87	0	0	3
157	**Dakshina Kannada**	Buntwal	Pilathabettu	917.59	0	0	3
158	**Dakshina Kannada**	Buntwal	Rayee	702.96	0	0	4

159	**Dakshina Kannada**	Buntwal	Irvathur	458.69	0	0	3
160	**Dakshina Kannada**	Buntwal	Koila	557.41	0	0	4
161	**Dakshina Kannada**	Buntwal	Pilimogru	488.69	0	0	3
162	**Dakshina Kannada**	Buntwal	Arla	701.72	0	0	4
163	**Dakshina Kannada**	Buntwal	Kudambettu	455.38	0	0	3
164	**Dakshina Kannada**	Buntwal	Budoli	315.05	0	0	3
165	**Dakshina Kannada**	Buntwal	Mudapadukodi	619.63	0	0	3
166	**Dakshina Kannada**	Buntwal	Panjikal	977.90	0	0	4
167	**Dakshina Kannada**	Buntwal	Badagabellur	886.89	0	0	4
168	**Dakshina Kannada**	Buntwal	Kariangala	594.60	0	0	4
169	**Dakshina Kannada**	Buntwal	Mudanadugodu	623.30	0	0	3
170	**Dakshina Kannada**	Buntwal	Kadabettu	467.03	0	0	3
171	**Dakshina Kannada**	Buntwal	Kavalpadur	1095.09	0	0	3
172	**Dakshina Kannada**	Buntwal	Kavalmudur	1566.16	0	0	3
173	**Dakshina Kannada**	Buntwal	Kuriyala	865.29	0	0	4
174	**Dakshina Kannada**	Buntwal	Tenkabettur	322.23	0	0	4
175	**Dakshina Kannada**	Buntwal	Bantwal	2044.96	0	0	4
176	**Dakshina Kannada**	Buntwal	Ammunje	641.33	0	0	4
177	**Dakshina Kannada**	Buntwal	Badagakajekde	695.97	0	0	3
178	**Dakshina Kannada**	Buntwal	Navur	956.74	0	0	3
179	**Dakshina Kannada**	Buntwal	Tenka Kajekar	646.34	0	0	3
180	**Dakshina Kannada**	Buntwal	Kallige	649.13	0	0	4
181	**Dakshina Kannada**	Buntwal	Devashyapadur	436.98	0	0	3
182	**Dakshina Kannada**	Buntwal	Devasyamuduru	260.24	0	0	3
183	**Dakshina Kannada**	Buntwal	Mermajal	518.53	0	0	4
184	**Dakshina Kannada**	Buntwal	Uli	1282.37	0	0	4
185	**Dakshina Kannada**	Buntwal	Muda	1074.74	0	0	4

186	**Dakshina Kannada**	Buntwal	Kodmannu	337.46	0	0	4
187	**Dakshina Kannada**	Buntwal	Narikombu	1183.53	0	0	4
188	**Dakshina Kannada**	Buntwal	Sarapady	1091.81	0	0	4
189	**Dakshina Kannada**	Buntwal	Maninalkur	1367.82	0	0	4
190	**Dakshina Kannada**	Buntwal	Padu	682.98	0	0	4
191	**Dakshina Kannada**	Buntwal	Shambur	628.05	0	0	4
192	**Dakshina Kannada**	Buntwal	Thumbe	564.35	0	0	4
193	**Dakshina Kannada**	Buntwal	Balthila	1260.16	0	0	4
194	**Dakshina Kannada**	Buntwal	Munnur	713.83	0	0	4
195	**Dakshina Kannada**	Buntwal	Paanimangalore	603.44	0	0	4
196	**Dakshina Kannada**	Buntwal	Barimar	796.66	0	0	4
197	**Dakshina Kannada**	Buntwal	Sajipamuda	970.58	0	0	4
198	**Dakshina Kannada**	Buntwal	Sajipapadu	304.12	0	0	4
199	**Dakshina Kannada**	Buntwal	Sajipanadu	405.86	0	0	4
200	**Dakshina Kannada**	Buntwal	Kadeshvalya	1193.20	0	0	4
201	**Dakshina Kannada**	Buntwal	Amtoor	543.64	0	0	4
202	**Dakshina Kannada**	Buntwal	Gol Thanajal	628.49	0	0	4
203	**Dakshina Kannada**	Buntwal	Pinjeer	1353.13	0	0	4
204	**Dakshina Kannada**	Buntwal	Biliyur	678.51	0	0	4
205	**Dakshina Kannada**	Buntwal	Mani	538.73	0	0	4
206	**Dakshina Kannada**	Buntwal	Chelur	351.92	0	0	4
207	**Dakshina Kannada**	Buntwal	Ira	1334.59	0	0	4
208	**Dakshina Kannada**	Buntwal	Manchi	1464.23	0	0	4
209	**Dakshina Kannada**	Buntwal	Peraje	539.15	0	0	4
210	**Dakshina Kannada**	Buntwal	Veerakamba	1163.24	0	0	4
211	**Dakshina Kannada**	Buntwal	Perne	574.64	0	0	4
212	**Dakshina Kannada**	Buntwal	Kedila	941.59	0	0	4

213	**Dakshina Kannada**	Buntwal	Ananthady	924.39	0	0	4
214	**Dakshina Kannada**	Buntwal	Bolanthur	720.07	0	0	4
215	**Dakshina Kannada**	Buntwal	Kurnad	630.94	0	0	4
216	**Dakshina Kannada**	Buntwal	Netlamudnur	555.43	0	0	4
217	**Dakshina Kannada**	Buntwal	Kariangala	638.36	0	0	4
218	**Dakshina Kannada**	Buntwal	Idkidu	765.27	0	0	4
219	**Dakshina Kannada**	Puttur	Kowkradi	2391.89	3	1	2
220	**Dakshina Kannada**	Puttur	Golithattu	1597.04	3	1	2
221	**Dakshina Kannada**	Puttur	Shirady	7085.50	3	1	1
222	**Dakshina Kannada**	Puttur	Bajathur	1936.44	3	0	2
223	**Dakshina Kannada**	Puttur	Konalu	798.96	3	0	2
224	**Dakshina Kannada**	Puttur	Nellyadi	1337.90	3	0	2
225	**Dakshina Kannada**	Puttur	Uppinangady	920.29	3	0	3
226	**Dakshina Kannada**	Puttur	Nekkiladi	657.26	3	0	4
227	**Dakshina Kannada**	Puttur	Alanthaya	625.05	3	1	2
228	**Dakshina Kannada**	Puttur	Noojibalthil	1497.97	3	0	2
229	**Dakshina Kannada**	Puttur	Kenaje	1949.26	3	0	1
230	**Dakshina Kannada**	Puttur	Hirebandady	1632.23	3	0	3
231	**Dakshina Kannada**	Puttur	Shirivagilu	3363.88	3	0	1
232	**Dakshina Kannada**	Puttur	Ichalampady	820.53	3	1	2
233	**Dakshina Kannada**	Puttur	Ramakunja	1166.01	3	0	3
234	**Dakshina Kannada**	Puttur	Kodimbady	547.30	3	0	4
235	**Dakshina Kannada**	Puttur	Ballya	2793.58	3	1	2
236	**Dakshina Kannada**	Puttur	Bellipadi	643.50	3	0	4
237	**Dakshina Kannada**	Puttur	Koila	2002.33	3	0	3
238	**Dakshina Kannada**	Puttur	Haleneranki	777.19	3	0	3
239	**Dakshina Kannada**	Puttur	Padnur	737.03	3	0	4

240	**Dakshina Kannada**	Puttur	Bannur	593.00	3	0	4
241	**Dakshina Kannada**	Puttur	Perabe	1200.31	3	0	3
242	**Dakshina Kannada**	Puttur	Renjiliady	884.01	3	0	1
243	**Dakshina Kannada**	Puttur	Kabaka	813.45	3	0	4
244	**Dakshina Kannada**	Puttur	Chickamudnur	875.56	3	0	4
245	**Dakshina Kannada**	Puttur	Kunthur	1451.91	3	0	2
246	**Dakshina Kannada**	Puttur	Shanthigod	1709.12	3	0	3
247	**Dakshina Kannada**	Puttur	Kombar	4046.73	3	1	1
248	**Dakshina Kannada**	Puttur	Alankar	1424.97	3	0	3
249	**Dakshina Kannada**	Puttur	Kudipadi	645.90	3	0	4
250	**Dakshina Kannada**	Puttur	Aithoor	3394.64	3	0	1
251	**Dakshina Kannada**	Puttur	Puttur	1022.12	3	0	4
252	**Dakshina Kannada**	Puttur	Narimogru	1310.71	3	0	3
253	**Dakshina Kannada**	Puttur	Kutrupadi	954.16	3	0	2
254	**Dakshina Kannada**	Puttur	Bilinele	6925.38	3	1	1
255	**Dakshina Kannada**	Puttur	Bantra	527.35	3	0	1
256	**Dakshina Kannada**	Puttur	Kemminje	749.87	3	0	4
257	**Dakshina Kannada**	Puttur	Savanur	1062.48	3	0	3
258	**Dakshina Kannada**	Puttur	Charwaka	1240.48	3	0	3
259	**Dakshina Kannada**	Puttur	Dolpady	1760.68	3	1	2
260	**Dakshina Kannada**	Puttur	Balnad	1904.98	3	0	4
261	**Dakshina Kannada**	Puttur	Kadaba	888.72	3	0	2
262	**Dakshina Kannada**	Puttur	Mundur	884.45	3	0	3
263	**Dakshina Kannada**	Puttur	Aryappu	2072.21	3	0	4
264	**Dakshina Kannada**	Puttur	Kudmar	594.26	3	0	3
265	**Dakshina Kannada**	Puttur	Kodimbaia	1768.08	3	0	1
266	**Dakshina Kannada**	Puttur	Sarve	963.94	3	0	3

267	**Dakshina Kannada**	Puttur	Punchappady	841.20	3	0	3
268	**Dakshina Kannada**	Puttur	Kaimana	530.67	3	0	3
269	**Dakshina Kannada**	Puttur	Nekkilady	702.23	3	0	1
270	**Dakshina Kannada**	Puttur	Belandur	560.32	3	0	3
271	**Dakshina Kannada**	Puttur	Kaniyur	924.37	3	0	3
272	**Dakshina Kannada**	Puttur	Kedambady	954.52	3	0	4
273	**Dakshina Kannada**	Puttur	Palthady	1033.98	3	0	3
274	**Dakshina Kannada**	Puttur	Keyyur	2022.48	3	0	4
275	**Dakshina Kannada**	Puttur	Kolthige	3130.51	3	0	3
276	**Dakshina Kannada**	Puttur	Madnur	1635.55	3	0	4
277	**Dakshina Kannada**	Sulya	Yedamangala	1573.79	1	0	1
278	**Dakshina Kannada**	Sulya	Peruvaje	1130.55	1	0	3
279	**Dakshina Kannada**	Sulya	Murulya	1436.69	1	0	1
280	**Dakshina Kannada**	Sulya	Kenya	818.32	1	0	1
281	**Dakshina Kannada**	Sulya	Kodiyala	1030.33	1	0	3
282	**Dakshina Kannada**	Sulya	Bappa	2243.66	1	1	1
283	**Dakshina Kannada**	Sulya	Yenekur	630.57	1	0	1
284	**Dakshina Kannada**	Sulya	Yenekul	1162.53	1	0	1
285	**Dakshina Kannada**	Sulya	Aivathoklu	913.48	1	0	1
286	**Dakshina Kannada**	Sulya	Subramanya	3475.74	1	1	1
287	**Dakshina Kannada**	Sulya	Balila	631.00	1	0	1
288	**Dakshina Kannada**	Sulya	Na	757.11	1	1	1
289	**Dakshina Kannada**	Sulya	Bellare	1044.13	1	0	3
290	**Dakshina Kannada**	Sulya	Muppirya	501.33	1	0	1
291	**Dakshina Kannada**	Sulya	Kalmadka	1263.11	1	0	1
292	**Dakshina Kannada**	Sulya	Arampadi	876.57	1	0	1
293	**Dakshina Kannada**	Sulya	Guthigar	2686.00	1	0	1

294	**Dakshina Kannada**	Sulya	Pambethady	676.23	1	0	1
295	**Dakshina Kannada**	Sulya	Nalkur	2363.38	1	0	1
296	**Dakshina Kannada**	Sulya	Kalanja	760.05	1	1	1
297	**Dakshina Kannada**	Sulya	Kuthkunja	1024.16	1	1	1
298	**Dakshina Kannada**	Sulya	Ainakidu	1583.52	1	0	1
299	**Dakshina Kannada**	Sulya	Aivarnad	2323.28	1	0	4
300	**Dakshina Kannada**	Sulya	Amarapadnur	1165.04	1	0	4
301	**Dakshina Kannada**	Sulya	Amaramudnur	2277.48	1	0	4
302	**Dakshina Kannada**	Sulya	Devachalla	3531.19	1	1	2
303	**Dakshina Kannada**	Sulya	Hariharapallathadka	1281.38	1	1	1
304	**Dakshina Kannada**	Sulya	Balgodu	3911.62	1	1	1
305	**Dakshina Kannada**	Sulya	Kallamogru	1367.04	1	0	1
306	**Dakshina Kannada**	Sulya	Madapady	5631.87	1	1	1
307	**Dakshina Kannada**	Sulya	Kalmakar	1837.94	1	0	1
308	**Chikmagaluru**	Mudigere	Alakha Coffee Estate	1755.74	1	0	2
309	**Chikmagaluru**	Mudigere	Baluru	1648.26	1	0	2
310	**Chikmagaluru**	Mudigere	Bargi	833.34	1	0	2
311	**Chikmagaluru**	Mudigere	Na	33.38	1	0	2
312	**Chikmagaluru**	Mudigere	Durgadahalli	920.69	1	1	2
313	**Chikmagaluru**	Mudigere	Mudgundi	2421.28	1	0	1
314	**Chikmagaluru**	Mudigere	Malemane Coffee Estate	186.13	1	0	2
315	**Chikmagaluru**	Mudigere	Halagadaka State Forest	98.40	1	0	1
316	**Chikmagaluru**	Mudigere	Attigere	1406.55	1	1	1
317	**Chikmagaluru**	Mudigere	Taruve	796.01	1	1	1
318	**Chikmagaluru**	Mudigere	Kogile	1457.93	1	1	1
319	**Chikmagaluru**	Mudigere	Kogile Boremale Coffee Estate	387.01	1	0	1

320	**Chikmagaluru**	Mudigere	Gotti	2637.38	1	1	1
321	**Chikmagaluru**	Mudigere	Urubage	3017.11	1	1	2
322	**Chikmagaluru**	Mudigere	Byarapura	4000.70	1	1	1
323	**Chikmagaluru**	Mudigere	Byarapura Coffee Estate	987.96	1	1	1
324	**Hassan**	Sakaleshpur	Achanahalli	1618.42	1	1	1
325	**Hassan**	Sakaleshpur	Jambardi	1002.28	1	0	1
326	**Hassan**	Sakaleshpur	Agani	1368.41	1	1	1
327	**Hassan**	Sakaleshpur	Maragunda	406.85	1	1	2
328	**Hassan**	Sakaleshpur	Agalahalli	517.55	1	0	3
329	**Hassan**	Sakaleshpur	Kumarihalli	7423.97	1	1	1
330	**Hassan**	Sakaleshpur	Dabbegadde	51.06	1	0	3
331	**Hassan**	Sakaleshpur	Kyamanahalli	969.71	1	0	1
332	**Hassan**	Sakaleshpur	Hodchhalli	575.28	1	0	1
333	**Hassan**	Sakaleshpur	Hennalli	378.65	1	0	3
334	**Hassan**	Sakaleshpur	Ganadahalli	222.15	1	0	3
335	**Hassan**	Sakaleshpur	Mavinakodu	103.76	1	0	3
336	**Hassan**	Sakaleshpur	Raxdi Coffee Estate	386.37	1	0	1
337	**Hassan**	Sakaleshpur	Heebasale	951.07	1	0	3
338	**Hassan**	Sakaleshpur	Kumaradi	618.37	1	0	1
339	**Hassan**	Sakaleshpur	Kadumane Coffee Estate	2526.50	1	0	1
340	**Hassan**	Sakaleshpur	Nadahalli	1131.43	1	0	1
341	**Hassan**	Sakaleshpur	Anemahal	207.68	1	0	3
342	**Hassan**	Sakaleshpur	Devihalli	207.28	1	1	3
343	**Hassan**	Sakaleshpur	Donigalu	188.36	1	0	3
344	**Hassan**	Sakaleshpur	Kalgane	166.25	1	0	3
345	**Hassan**	Sakaleshpur	Kumbardicoffeeestate	139.10	1	0	3
346	**Hassan**	Sakaleshpur	Na	362.64	1	1	1

347	**Hassan**	Sakaleshpur	Kesaganahalli	598.99	1	1	3
348	**Hassan**	Sakaleshpur	Manjanahalla Coffee Estate	830.66	1	0	1
349	**Hassan**	Sakaleshpur	Manibigati Coffee Estate	336.15	1	0	1
350	**Hassan**	Sakaleshpur	Heggadde	5209.26	1	1	1
351	**Hassan**	Sakaleshpur	Hullahalli Coffee Estate	41.02	1	0	3
352	**Hassan**	Sakaleshpur	Arekere	560.80	1	0	3
353	**Hassan**	Sakaleshpur	Kadumane	744.48	1	1	1
354	**Hassan**	Sakaleshpur	Kyanahalli	338.37	1	0	3
355	**Hassan**	Sakaleshpur	Bykaravalli	494.63	1	0	3
356	**Hassan**	Sakaleshpur	Bugadahalli	475.67	1	0	3
357	**Hassan**	Sakaleshpur	Haragarahalli	347.97	1	0	3
358	**Hassan**	Sakaleshpur	Aluvalli	994.17	1	1	1
359	**Hassan**	Sakaleshpur	Kelagina Manchahalli	422.26	1	0	3
360	**Hassan**	Sakaleshpur	Bommanakere	346.38	1	0	3
361	**Hassan**	Sakaleshpur	Chinnahalli	515.63	1	0	3
362	**Hassan**	Sakaleshpur	Kadagaravalli	1090.66	1	1	1
363	**Hassan**	Sakaleshpur	Kagenari State Forest	3078.51	1	0	1
364	**Hassan**	Sakaleshpur	Karadigala	479.30	1	0	3
365	**Hassan**	Sakaleshpur	Kadagaravalli Coffee Estate	68.60	1	0	1
366	**Hassan**	Sakaleshpur	Volalahalli	266.46	1	0	3
367	**Hassan**	Sakaleshpur	Yadekumari	501.53	1	1	1
368	**Hassan**	Sakaleshpur	Hongadahalla	748.31	1	1	1
369	**Hassan**	Sakaleshpur	Belehalla	712.62	1	0	1
370	**Hassan**	Sakaleshpur	Hosahalli	485.42	1	1	1
371	**Hassan**	Sakaleshpur	Bobbanahalli	369.16	1	0	3
372	**Hassan**	Sakaleshpur	Hadalhalli	986.23	1	0	2
373	**Hassan**	Sakaleshpur	Marakalli	857.39	1	0	2

374	**Hassan**	Sakaleshpur	Hethur	753.24	1	0	2
375	**Hassan**	Sakaleshpur	Jedigadde	547.36	1	1	1
376	**Hassan**	Sakaleshpur	Bettekumari	1275.50	1	0	1
377	**Hassan**	Sakaleshpur	Hadya	728.33	1	0	2
378	**Hassan**	Sakaleshpur	Yathahalla	1310.17	1	1	1
379	**Hassan**	Sakaleshpur	Attihalli	610.22	1	1	1
380	**Hassan**	Sakaleshpur	Yaragalli	792.58	1	1	2
381	**Hassan**	Sakaleshpur	Bisle State Forest	2481.54	1	0	1
382	**Hassan**	Sakaleshpur	Bachalli	315.38	1	0	2
383	**Hassan**	Sakaleshpur	Boranamane	352.05	1	0	1
384	**Hassan**	Sakaleshpur	Halliyur	222.13	1	0	2
385	**Hassan**	Sakaleshpur	Karagur	279.67	1	0	2
386	**Hassan**	Sakaleshpur	Na	120.59	1	1	2
387	**Hassan**	Sakaleshpur	Maragathur	262.34	1	1	2
388	**Hassan**	Sakaleshpur	Begadhalli	240.81	1	0	2
389	**Hassan**	Sakaleshpur	Arni	1189.55	1	0	1
390	**Hassan**	Sakaleshpur	Vanagur	957.55	1	1	2
391	**Hassan**	Sakaleshpur	Palahalli	221.86	1	0	2
392	**Hassan**	Sakaleshpur	Mankanahalli	730.50	1	1	1
393	**Hassan**	Sakaleshpur	Goddu	512.57	1	0	2
394	**Hassan**	Sakaleshpur	Arini Coffee Estate	604.41	1	1	1
395	**Hassan**	Sakaleshpur	Vanagur Coffee Estate	92.03	1	0	2
396	**Hassan**	Sakaleshpur	Hadalkerehalli	186.49	1	0	2
397	**Hassan**	Sakaleshpur	Kangahalli	488.91	1	0	2
398	**Hassan**	Sakaleshpur	Banagere	642.03	1	1	2
399	**Hassan**	Sakaleshpur	Na	306.93	1	1	1
400	**Hassan**	Sakaleshpur	Tambalagere	433.04	1	0	2

401	**Hassan**	Sakaleshpur	Magere	780.40	1	0	2
402	**Udupi**	Karkal	Idu	3065.78	1	0	1
403	**Udupi**	Karkal	Nuralbettu	2169.37	1	0	2
404	**Udupi**	Karkal	Renjala	1797.52	1	0	4
405	**Udupi**	Karkal	Nellikara	1139.06	1	0	2
406	**Udupi**	Karkal	Beluvai	2434.34	1	0	4
407	**Udupi**	Karkal	Panapila	704.12	1	0	2
408	**Udupi**	Karkal	Kellaputtige	468.57	1	0	4
409	**Udupi**	Karkal	Daregudde	728.57	1	0	4
410	**Udupi**	Karkal	Mudumarnad	922.40	1	0	4
411	**Udupi**	Karkal	Padumarnadu	1166.62	1	0	4
412	**Udupi**	Karkal	Mantradi	897.29	1	0	2
413	**Udupi**	Karkal	Valpadi	1051.03	1	0	2
414	**Udupi**	Karkal	Mudukonaje	929.35	1	0	4
415	**Udupi**	Karkal	Marur	1628.04	1	0	2
416	**Udupi**	Karkal	Padukonaje	1179.38	1	0	4
417	**Udupi**	Karkal	Mudukudri	1318.81	1	0	4
418	**Udupi**	Karkal	Kanabettu	518.52	1	0	4
419	**Udupi**	Karkal	Karinje	919.07	1	0	4
420	**Udupi**	Karkal	Hosabettu	1004.21	1	0	4
421	**Udupi**	Karkal	Todar	977.73	1	0	4
422	**Udupi**	Karkal	Punchamogru	976.44	1	0	4
423	**Udupi**	Karkal	Iruvail	949.67	1	0	4
424	**Kodagu**	Somvarpet	Kumaralli & Forest	4789.28	1	0	1
425	**Kodagu**	Somvarpet	Kundahalli	890.54	1	0	2
426	**Kodagu**	Somvarpet	Bettadalli	790.24	1	0	2
427	**Kodagu**	Somvarpet	Kothanalli	1501.98	1	0	1

428	**Kodagu**	Somvarpet	Santhalli	967.63	1	0	2
429	**Kodagu**	Somvarpet	Surlabi	6626.69	1	1	1
430	**Kodagu**	Somvarpet	Haraga	836.12	1	0	2
431	**Kodagu**	Mercara	Hammiyala	4409.81	1	1	1
432	**Kodagu**	Mercara	Kaloor	6084.68	1	0	1
433	**Kodagu**	Mercara	Galibeedu & Forest	3800.64	1	0	1

As per three reports (WGEEP, HLWG, IISc-ENVIS) 50 villages are gained status of ESR-1 and shown in Table b. HLWG has not assigned 226 villages of basin (which are part of Western Ghats) under any status signifies the lacunas compared to WGEEP, IISc ENVIS reports. WGEEP has assigned Puttur taluk as ESR-3 status because of least forest cover as compared to other taluks. WGEEP has not considered Bantwal and Mangalore taluks since they fall outside Western Ghats with least forest cover.

Table b: Villages of ESR 1 based on three reports.

SNO	DISTRICT	TALUK_NAME	LOCATION	AREA	ESR_WGEEP	ESR_HLWG	ESR_IIScENVIS
1	DAKSHINA KANNADA	Belthangadi	Malavanthige	6483.25	1	1	1
2	DAKSHINA KANNADA	Belthangadi	Naravi	2774.13	1	1	1
3	DAKSHINA KANNADA	Belthangadi	Kuthlur	2645.25	1	1	1
4	DAKSHINA KANNADA	Belthangadi	Sulkerimogru	1773.03	1	1	1
5	DAKSHINA KANNADA	Belthangadi	Shirlal	2494.24	1	1	1
6	DAKSHINA KANNADA	Belthangadi	Navur	6134.26	1	1	1
7	DAKSHINA KANNADA	Belthangadi	Savanalu	2320.63	1	1	1
8	DAKSHINA KANNADA	Belthangadi	Charmadi	5645.68	1	1	1
9	DAKSHINA KANNADA	Belthangadi	Na	317.78	1	1	1
10	DAKSHINA KANNADA	Belthangadi	Sulkeri	526.46	1	1	1

11	DAKSHINA KANNADA	Belthangadi	Navara	550.05	1	1	1
12	DAKSHINA KANNADA	Belthangadi	Na	58.69	1	1	1
13	DAKSHINA KANNADA	Belthangadi	Neriya	10758.34	1	1	1
14	DAKSHINA KANNADA	Belthangadi	Na	179.45	1	1	1
15	DAKSHINA KANNADA	Belthangadi	Puduvettu	3626.91	1	1	1
16	DAKSHINA KANNADA	Belthangadi	Shishila	4892.95	1	1	1
17	DAKSHINA KANNADA	Belthangadi	Kalanja	5039.68	1	1	1
18	DAKSHINA KANNADA	Sulya	Balpa	2243.66	1	1	1
19	DAKSHINA KANNADA	Sulya	Subramanya	3475.74	1	1	1
20	DAKSHINA KANNADA	Sulya	Na	757.11	1	1	1
21	DAKSHINA KANNADA	Sulya	Kalanja	760.05	1	1	1
22	DAKSHINA KANNADA	Sulya	Kuthkunja	1024.16	1	1	1
23	DAKSHINA KANNADA	Sulya	Hariharapallathadka	1281.38	1	1	1
24	DAKSHINA KANNADA	Sulya	Balgodu	3911.62	1	1	1
25	DAKSHINA KANNADA	Sulya	Madapady	5631.87	1	1	1
26	**CHIKMAGALURU**	Mudigere	Attigere	1406.55	1	1	1
27	**CHIKMAGALURU**	Mudigere	Karuve	796.01	1	1	1
28	**CHIKMAGALURU**	Mudigere	Kogile	1457.93	1	1	1
29	**CHIKMAGALURU**	Mudigere	Gotti	2637.38	1	1	1
30	**CHIKMAGALURU**	Mudigere	Byarapura	4000.7	1	1	1
31	**CHIKMAGALURU**	Mudigere	Byarapura Coffee Estate	987.96	1	1	1
32	**HASSAN**	Sakaleshpur	Achanahalli	1618.42	1	1	1
33	**HASSAN**	Sakaleshpur	Agani	1368.41	1	1	1
34	**HASSAN**	Sakaleshpur	Kumarihalli	7423.97	1	1	1
35	**HASSAN**	Sakaleshpur	Na	362.64	1	1	1
36	**HASSAN**	Sakaleshpur	Heggadde	5209.26	1	1	1
37	**HASSAN**	Sakaleshpur	Kadumane	744.48	1	1	1

38	**HASSAN**	Sakaleshpur	Aluvalli	994.17	1	1	1
39	**HASSAN**	Sakaleshpur	Kadagaravalli	1090.66	1	1	1
40	**HASSAN**	Sakaleshpur	Yadekumari	501.53	1	1	1
41	**HASSAN**	Sakaleshpur	Hongadahalla	748.31	1	1	1
42	**HASSAN**	Sakaleshpur	Hosahalli	485.42	1	1	1
43	**HASSAN**	Sakaleshpur	Jedigadde	547.36	1	1	1
44	**HASSAN**	Sakaleshpur	Yathahalla	1310.17	1	1	1
45	**HASSAN**	Sakaleshpur	Attihalli	610.22	1	1	1
46	**HASSAN**	Sakaleshpur	Mankanahalli	730.5	1	1	1
47	**HASSAN**	Sakaleshpur	Arini Coffee Estate	604.41	1	1	1
48	**HASSAN**	Sakaleshpur	Na	306.93	1	1	1
49	**KODAGU**	Somvarpet	Surlabi	6626.69	1	1	1
50	**KODAGU**	Mercara	Hammiyala	4409.81	1	1	1

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Research Article Open Access

Environmental Flow Assessment in a Lotic Ecosystem of Central Western Ghats, India

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Abstract

Environmental/Ecological flow refers to the minimum flow of water to be maintained in a water body (river, lake, etc.) to sustain ecosystem services. Understanding environmental flow is important to ensure the local ecological and social (people, agriculture and horticulture, etc.) needs in a sustained and balanced way, while designing large scale projects (such as hydro-electric, river diversion, etc.). Western Ghats are the mountain ranges extending from southern tip of India (Tamil Nadu-Kanyakumari) to Gujarat. These mountain ranges are rich in biodiversity with diverse and endemic flora and fauna, and is birth place to numerous perennial rivers namely Netravathi, Sita, Sharavathi, Aghanashini, Krishna, Cauvery, etc. Western Ghats is often referred as water tower of peninsular India, due to the water and food security provided by the ecosystem through array of services. The region is also one among 35 global biodiversity hotspots. However, deforestation due to large scale land cover changes has affected the water sustenance in the region evident from the quantity and duration of water availability during post monsoon period. Forests in the Western Ghats along with the soil characteristics and precipitation plays a major role in storing water in sub-surface (vadoze and groundwater) zones during monsoon, and releases to the streams during post monsoon periods catering to the needs of the dependent biota including humans. Some of these undisturbed/unaltered natural flow conditions in rivers and streams have proved their worth with the presence of rich and diverse species and array of ecosystem services, which also has helped in sustaining the livelihood of dependent populations. The undisturbed flow conditions guarantees the natural flow as well as minimum flow in streams to sustain the ecosystem services, which helps in meeting the social and ecological needs. Growing demand to cater the demands of burgeoning human population coupled with accelerated pace of deforestation due to unplanned and senseless developmental projects in the ecologically fragile regions have led the water scarcity even in regions receiving high amount of rainfall. In the current communication an attempt is made to understand the linkages between the hydrological dynamics across varied landscape with the anthropogenic and ecological water needs. If the available water resource meets the societal and environmental demands across seasons, the catchment is said to achieve the minimum flow requirements. The federal government has plans to divert the water from rivers in Western Ghats region to the dry arid regions in Karnataka. In this regard, environmental flow assessment of Yettinaholé river in Central Western Ghats is carried out to understand the feasibility of river diversion through the assessment of hydrologic regime with the analysis of land use dynamics (using remote sensing data), meteorological data (rainfall, temperature, etc. from IMD, Pune), hydrological data (from gauged streams) apart from field investigations in the catchment. The catchments receive annual rainfall of 3000-5000 mm (Department of Statistics, Government of Karnataka). Land use analyses reveal that Major portion of the catchment is covered with evergreen forest (45.08%) followed by agriculture plantations (29.05%) and grass lands (24.06%). Water yield in the catchment computed for each of sub-catchments based on the current land use and other related hydrological parameters using empirical method. The total runoff yield from the catchments is estimated to be 9.55 TMC. About 5.84 TMC is required for domestic purposes including agriculture, horticulture and livestock rearing. The quantum of water required to sustain fish life in the streams is about 2 TMC, computed based on hydrological discharge monitoring and fish diversity in streams during 18 months (covering all seasons) in select streams in Western Ghats. Considering the available water is sufficient only to meet the anthropogenic and ecological needs in the region, the sustainable option to meet the water requirements in dry arid regions would be through (i) decentralized water harvesting (through tanks, ponds, lakes, etc.), (ii) rejuvenation or restoration of existing lakes/ponds, (iii) reuse of waste water, (iv) recharging groundwater resources, (v) planting native species of grasses and tree species in the catchment (to enhance percolation of water in the catchment), (vi) implementation of soil and water conservation through micro-watershed approaches. Implementation of these location specific approaches in arid regions would cost much less compared to the river diversion projects, which if implemented would help the section of the society involved in decision making, construction and implementation of the project.

Keywords: Ecological flow; Yettinaholé River; Watershed; Land cover; Fresh water ecosystem

Introduction

The Western Ghats is a series of hills located in the western part of peninsular India stretching over a distance of 1,600 km from north to south and covering an area of about 1,60,000 sq.km and one among the

35 global hotspots of biodiversity [1-3]. It harbors very rich and rare flora and fauna and there are records of over 4,500 species of flowering plants with 38% endemics, 330 butterflies with 11% endemics, 156 reptiles with 62% endemics, 508 birds with 4% endemics, 120 mammals with 12% endemics, 289 fishes with 41% endemics and 135 amphibians with 75% endemics [4-7].

Western Ghats has numerous watersheds that feed perennial rivers of peninsular India [2]. It encompasses series of west and east flowing rivers that originates from the Western Ghats, supporting as source of sustenance for existing life forms in the environment. One such source of perennial waters is Yettinaholé originating at an altitude of 950 m in Sakaleshpura taluk of Hassan district, and tributary of river Gundia, which joins Kumaradhara and finally drains to Netravathi River The region with a repository of endemic and rare biodiversity is ecologically sensitive and large scale degradation of catchment landscape have influenced the availability of water and has also affected the sustenance of biodiversity. Changes in landscape structure and the regional climate [8,9] have altered the hydrologic regime [10,11] in many lotic ecosystems in the tropical regions, affecting the potential of the catchment to retain water in the surface and sub surfaces. Various studies carried out in Western Ghats [12-14] and across the globe show the relevance of landscape on surface and subsurface hydrological regime [12-19]. Few studies carried out in Western Ghats also emphasize on the role of hydrological regime on the habitats, ecology, biodiversity, quality of water, soil and ecosystem etc. [20-23]. In the current communication an attempt has been made to understand the linkages between the hydrological dynamics across varied landscape of Yettinaholé catchment with the societal and environmental water needs. In this regard, the study investigates land use dynamics, hydrological yield, fish diversity in select streams and linkages with the flow during lean season and drivers of hydrological regime impairment.

Materials and Methods

Study area

Yettinaholé catchment has a pristine ecosystem with rich biodiversity (Figure 1 and Table 1), extend from 12044'N to 12058'N Latitude and 75037'E to 75047'E longitude encompassing total area of 179.68 km^2. The terrain (Figure 2) is undulating with altitude varying from 666 m above MSL to 1292 m above MSL leading to higher density of stream network (Figure 3). Geologically, rock types consist of Gneiss, the soils are loamy ranging from sandy loamy to clay loamy. Soils (Figure 4) in the region are fertile and highly permeable, hence allowing the precipitated water to percolate easily into the subsurface recharging ground water and storing water in the sub surfaces and hence keeping the water source perennial to the catchment and the downstream users during and post monsoon.

Decadal population in Sakleshpura Taluk (spatial extent 1034 sq. km) of Hassan district is given in Figure 5 and Table 2 shows a declining trend due to migration to cities during post 2001. Population dynamics of the catchments also follows the dynamics of Sakleshpura taluk. Total Population of all the catchments with respect to census data [24,25] was estimated as 17005 in 2001, has declined to 16345 in 2011 at a decadal rate of 3.88%. Population for the year 2014 was calculated as 16156 based on the temporal data. Population density for each of the sub catchments are as depicted in Figure 6 and Table 3.

Sub basin id	Stream Name	Area (Ha)
1	Yettinaholé	4878.7
2	Yettinaholé T2	781.1
3	Yettinaholé T1	991.1
4	Kadumane holé 2	761.4
5	Kadumane holé 1	1362.4
6	Hongada halla	5676.6
7	Keri holé	2198.3
8	Yettinaholé lower reach	1319.1

Table 1: Study Area.

Census Year	1921	1931	1941	1951	1961
Population	44115	44300	43765	53398	77522
Census Year	**1971**	**1981**	**1991**	**2001**	**2011**
Population	91775	114008	124753	133657	128633

Table 2: Population Growth of Sakleshpura Taluk [24,25].

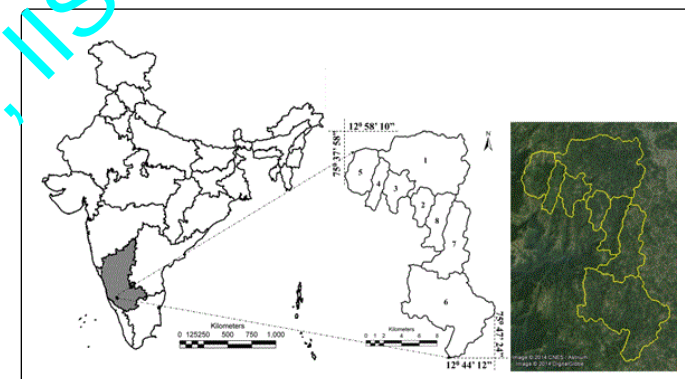

Figure 1: Study Area-Yettinaholé catchment, Karnataka, India.

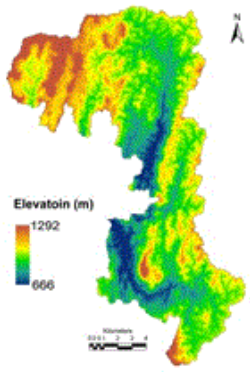

Figure 2: Digital Elevation Model.

Figure 3: Stream Network.

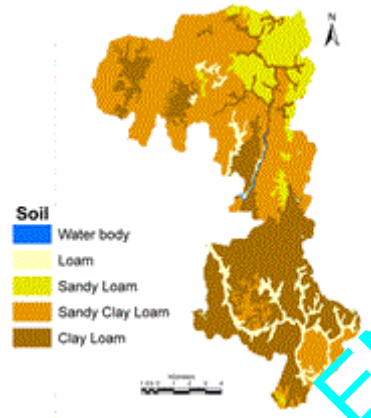

Figure 4: Soil.

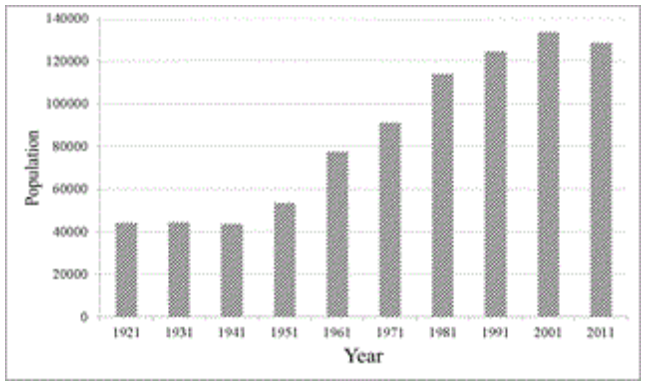

Figure 5: Population Growth of Sakleshpura Taluk.

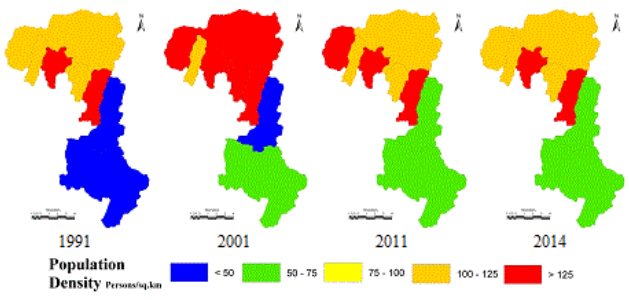

Figure 6: Population Density in Sub Catchments.

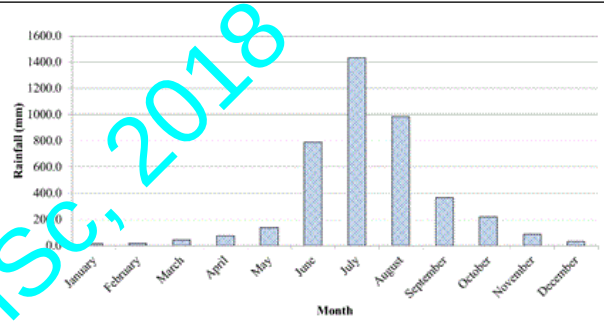

Figure 7: Rainfall in mm.

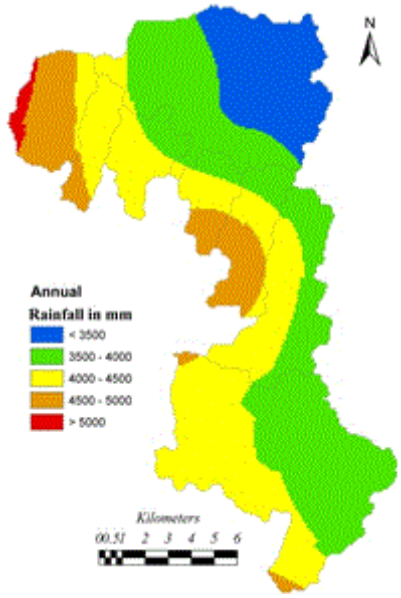

Figure 8: Rainfall distribution.

Sub Basin Id	Sub basin	1991	2001	2011	2014
1	Yettina holé	117.86	126.92	122	120.59
2	Yettina holé T2	116.12	125.08	120.22	118.81
3	Yettina holé T1	126.52	136.31	130.96	129.45
4	Kadumane holé 2	108.36	116.76	112.17	110.98
5	Kadumane holé 1	121.33	130.65	125.58	124.12
6	Hongadahalla	47.26	50.89	48.92	48.36
7	Keri holé	32.71	35.25	33.89	33.48
8	Yettina holé lower reach	151.46	163.14	156.85	155.03

Table 3: Population density (persons per sq. km).

The region receives an annual rainfall of 3500 to 5000 mm across the catchment. Precipitation in the catchment during June to September is due to the southwest monsoons, with July having maximum rainfall over 1300 mm. Monthly variation in rainfall is depicted in Figure 7. Spatial variation of rainfall across the catchments was assessed based on 110 years data [26] (1901 to 2010) from the rain gauge stations in and around the catchment (Figure 8). Figure 9 depicts monthly temperatures [27] variations, which ranges from 14.7°C (January) to 31.6°C (in March).

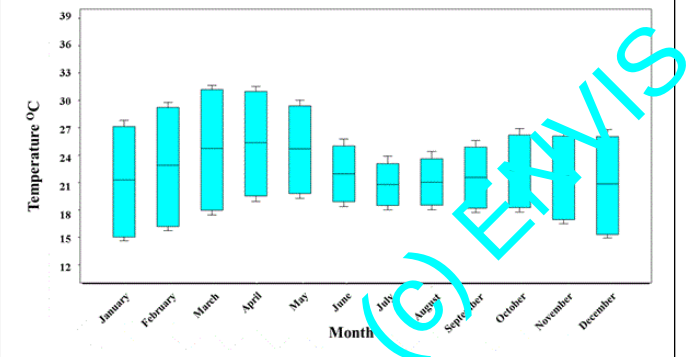

Figure 9: Monthly temperature variations.

Data

Data required for hydrological and land use analyses were (i) social and demographic data from the government agencies, (ii) temporal remote sensing data from public archive and (iii) primary data through field investigations. Latest remote sensing data used is of Landsat 8 series (2014). Rainfall data was acquired from the Directorate of Economics and Statistics, Government of Karnataka [26], Temperature data was sourced from World Clim-Global Climate Data [27] of 1 km resolution. Census data collected from government of India, state and district census departments [24,25]. These data was supplemented with secondary data compiled from various sources as tabulated in Table 4. Primary data is compiled through field investigations and through structured questionnaire (household survey).

Method

The method for the evaluation of the environmental flow and hydrological status is given in Figure 10. Hydrologic assessment in the catchment involved 1) delineation of catchment boundary 2) land use analysis, 3) assessment of the hydro meteorological data, 4) analysis of population census data, 5) compilation of data through public interactions for assessing the water needs for livestock, agriculture/horticulture and cropping pattern, and 6) evaluation of hydrologic regime.

Delineation of catchment boundary: Catchment boundaries (Figure 1) and the stream networks (Figure 3) were delineated considering the topography of the terrain based on CartoSat DEM using the QSWAT module-Quantum GIS 2.10 32 bit. These catchment boundaries were overlaid on the extracted boundaries from the Survey of India topographic maps for validations. Corrected catchment boundaries were further overlaid on Google earth in order to visualize the terrain variations (Figure 2).

Data	Description	Source
Remote sensing data-spatial data	Remote sensing data of 30 m spatial resolution and 16 bit radiometric resolution were used to analyse land uses at catchment levels.	[28]
Rainfall	Daily rainfall data of 110 years (1901-2010), to assess the trends in rainfall distribution and variability across basins.	[26,29]
Crop Calendar	To estimate the crop water requirements based on the growth phases	[30-35]
Crop Coefficient	Evaporative coefficients used to estimate the actual evapotranspiration.	[33,36]
Temperature (max, min, mean), Extraterrestrial solar radiation	Monthly temperature data (1 km spatial resolution) and monthly extra-terrestrial solar radiation (Every 1° North latitude) available	[27,36-38]

	across different hemispheres to estimate the potential evapotranspiration.	
Population data	Population census data available at village level (2001, 2011), used to estimate the population at sub basin level for the year 2014, and estimate the water requirement for domestic use at sub basin levels.	[24,25]
Livestock Census	Taluk level data was used to estimate the livestock population and estimate water requirement at each of the river basins.	[39]
Digital Elevation data	Carto-DEM of 30 m resolution in association with Google earth and the Survey of India-Topographic maps (1:50000) was used to delineate the catchment boundaries, stream networks, contours, etc.	[40]
Secondary Data	Collateral data from government agencies regarding agriculture, horticulture, forests, soil, etc. for land use classification, delineation of streams/rivers/catchment, geometric correction (Remote sensing data).	[40-44]
Field data	Geometric Corrections, training data for land use classification, crop water requirement, livestock water requirement, etc.	GPS based field data, data form public (stratified random sampling of households)
Flow data	Evaluation of minimum flow requirements to sustain ecology (fish, etc.) and downstream dependent population's livelihood	Flow measurements at Hongadahalla, Kadumanehalla, and select streams of Sharavathi river [45,46]
Fish diversity	Understanding fish ecology in relation to water quantity and duration of flow to determine EF	Selected stream catchments and dams Sharavathi river [47]

Table 4: Data used for land use and assessment of hydrologic regime.

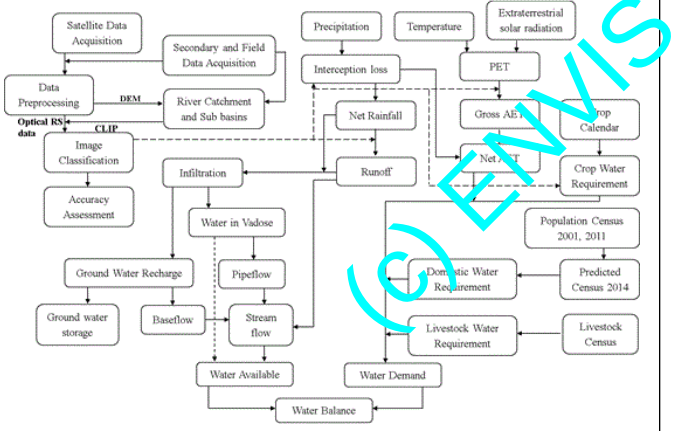

Figure 10: Method for computing environmental flow based on hydrologic variables.

Land use assessment: Large scale land-use land-cover (LULC) changes leading to deforestation is one of the drivers of global climate changes and alteration of biogeochemical cycles. This has given momentum to investigate the causes and consequences of LULC by mapping and modelling landscape patterns and dynamics and evaluating these in the context of human-environment interactions in the riverine landscapes. Human induced environmental changes and consequences are not uniformly distributed over the earth. However their impacts threaten the sustenance of human-environmental relationships. Land cover refers to physical cover and biophysical state of the earth's surface and immediate subsurface and is confined to describe vegetation and manmade features. Thus, land cover reflects the visible evidence of land cover of vegetation and non-vegetation. Land use refers to use of the land surface through modifications by humans and natural phenomena. Heterogeneous terrain in the landscape with the interacting ecosystems is characterized by its dynamics. Human induced land use and land cover (LULC) changes have been the major driver of the landscape dynamics at local levels. Land use assessment was carried using the maximum likelihood classification technique [48,49]. Understanding of landscape dynamics helps in the sustainable management of natural resources.

Land use analysis involved i) generation of FCC-False Colour Composite (Figure 11) of remote sensing data (bands-green, red and NIR). This helped in locating heterogeneous patches in the landscape ii) selection of training polygons (these correspond to heterogeneous patches in FCC) covering 15% of the study area and uniformly distributed over the entire study area, iii) loading these training polygons co-ordinates into pre-calibrated GPS, vi) collection of the corresponding attribute data (land use types) for these polygons from the field. GPS helped in locating respective training polygons in the field, iv) supplementing this information with Google Earth v) 65% of the training data has been used for classification, while the balance is used for validation or accuracy assessment.

Land uses were categorized into 8 classes namely. i) water bodies (lakes/tanks, rivers, streams, ii) built up (buildings, roads or any paved surface, iii) open spaces iv) evergreen forest (evergreen and semi evergreen), v) deciduous forest (Moist deciduous and dry deciduous) vi) scrub land and grass lands, vii) agriculture, (viii) private plantations (coconut, arecanut, rubber) and forest plantations (Acacia, Teak, etc.)

Assessment of the hydro meteorological data: This involved assessment of the spatial and temporal variations in rainfall [26,29,50] in and around the study region. Long term precipitation data helped in understanding the rainfall variability over decades. Along with rainfall,

temperature (minimum, maximum and average), extra-terrestrial solar radiation across the catchment were used to hydrological behaviors of the catchments which enables to understand the hydrological status.

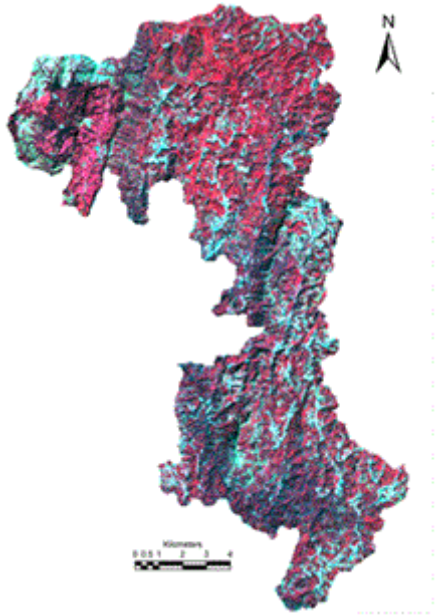

Figure 11: False Colour Composite of Study area.

Rainfall: Point data of daily rainfall from rain gauge stations for the period 1901-2010 [26,29,50] were used for the analysis. Some rain gauge stations had incomplete records with missing data for few months. The average monthly and annual rainfall data were used to derive rainfall map throughout the study area and was used to derive the gross yield (RG) in the basin (equation 1). Net yield (RN) was quantified (equation 2) as the difference between gross rainfall and interception (In).

RG=A × P ……. (1)

RN=RG-In …… (2)

Where, RG: Gross rainfall yield volume; A: Area in Hectares; P: Precipitation in mm, RN: Net rainfall yield volume; and In: Interception volume

*Interception*During monsoons, portion of rainfall does not reach the surface of the earth; it remains on the canopy of trees, roof tops, etc. and gets evaporated. Field studies in Western Ghats show that, losses due to interception is about 15% to 30%, based on the canopy cover. Table 5 shows the interception loss across various rainy months and land uses.

Vegetation types	Period	Interception
Evergreen/semi evergreen forests	June-October	I=5.5+0.30 (P)
Moist deciduous forests	June-October	I=5.0+0.30 (P)
Plantations	June-October	I=5.0+0.20 (P)
Agricultural crops (paddy)	June	0
	July-August	I=1.8+0.10 (P)
	September	I=2.0+0.18 (P)
	October	0
Grasslands and scrubs	June-September	I=3.5+0.18 (P)
	October	I=2.5+0.10 (P)

Table 5: Interception loss.

Runoff: Portion of rainfall that flows in the streams after precipitation [2,8,10,11] are (i) surface runoff or direct runoff and (ii) sub surface runoff.

Surface runoff: Portion of water that directly enters into the streams during rainfall, which is estimated based on the empirical [9,10,11] relationships given in equation 3.

Q=Σ(Ci × PR × Ai)/1000……(3)

Where, Q: Runoff in cubic meters per month; C: Catchment/Runoff coefficient, depends on land uses as given in Table 6 [36]; PR: Net rainfall in mm; i: Land use type; Ai: Area of Landscape i as square meters.

Land Use	Catchment Coefficient
Urban	0.85
Agriculture	0.6
Open lands	0.7
Evergreen forest	0.15
Scrub/Grassland	0.6
Forest Planation	0.65
Agriculture Plantation	0.5
Deciduous Forest	0.15

Table 6: Catchment coefficients.

Infiltration: The portion of water enters the subsurface (vadoze and groundwater zones) during precipitation depending on land cover in the catchment. During field monitoring of streams in the forested catchment, overland flow is noticed in streams only after couple of days rainfall. This means that overland flow in the catchment with vegetation cover happens after the saturation of sub surfaces. The water stored in sub-surfaces will flow laterally towards streams and contributes to stream flow during non-monsoon periods, which are referred as pipe flow (during post monsoon) and base flow (during summer).

Inf=RN-Q……(4)

Ground water recharge: This is the portion of water that is percolated below the soil stratum (vadoze) after soil gets saturated. Recharge is considered the fraction of infiltrated water that recharges the aquifer after satisfying available water capacity and pipe flow. Krishna Rao equation, (equation 5) [19] was used to determine the ground water recharge.

GWR=RC × (PR-C) × A …… (5)

Where, GWR: Ground water recharge; RC: Ground water recharge coefficient (Table 7); C: Rainfall Coefficient (Table 7); A: Area of the catchment. The recharge coefficient and the constant vary depending land uses with the annual rainfall.

Annual Rainfall	R_C	C
400 to 600 mm	0.2	400
600 to 1000 mm	0.25	400
>2000 mm	0.35	600

Table 7: Ground water recharge coefficients.

Sub surface flow (Pipe flow): Part of the infiltrated effective rainfall circulates more or less horizontally (lateral flow) in the superior soil layer and appears at the surface through stream channels is referred as subsurface flow. The presence of a relatively permeable shallow layer favors this flow. Subsurface flows in water bearing formations have a drainage capacity slower than superficial flows, but faster than groundwater flows. Pipe flow is considered to be the fraction of water that remains after infiltrated water satisfies the available water capacities under each soil. Pipe flow is estimated for all the basins as function of infiltration, ground water recharge and pipe flow coefficient, given by equation 6

$$PF=(Inf-GWR) \times KP \ldots\ldots (6)$$

Where, PF: Pipeflow; Inf: Infiltration volume; KP: Pipe flow coefficient [2]

Groundwater discharge: Groundwater discharge or base flow is estimated by multiplying the average specific yield of aquifer under each land use with the recharged water. Specific yield represents the water yielded from water bearing material. In other words, it is the ratio of the volume of water that the material, after being saturated, will yield by gravity to its own volume. Base flow appears after monsoon and receding of pipe-flow. This water generally sustains flow in the rivers during dry seasons. A portion of recharged water flows to the streams as ground water discharge which is dependent on the topography, geology and the land use conditions. Equation 7 defines Ground water discharge as product of specific yield and the portion of ground water recharged.

$$GWD=GWR \times YS \ldots\ldots(7)$$

Where, GWD: Ground water discharge; GWR: Ground water recharge; YS: Specific yield [2].

Estimation of water demand evapotranspiration

Evaporation is a process where in water is transferred as vapour to the atmosphere. Transpiration is the process by which water is released to the atmosphere from plants through leaves and other parts above ground. Evapotranspiration is the total water lost from different land use due to evaporation from soil, water and transpiration by plants. Some of the important factors that affect the rate of evapotranspiration are: (i) temperature, (ii) wind, (iii) light intensity, (iv) Sun light hours, (v) humidity, (vi) plant characteristics, (vii) land use type and (viii) soil moisture. If sufficient moisture is available to completely meet the needs of vegetation in the catchment, the resulting evapotranspiration is termed as potential evapotranspiration (PET). The real evapotranspiration occurring in specific situation is called as actual evapotranspiration (AET). These evapotranspiration rates from forests are more difficult to describe and estimate than for other vegetation types.

Potential evapotranspiration (PET) was determined using Hargreaves method (Hargreaves [2,36]) an empirical based radiation based equation, which is shown to perform well in humid climates. PET is estimated as mm using the Hargreaves equation is given by equation 8.

$$PET=0.0023 \times (RA/\lambda) \times \sqrt{(Tmax-Tmin)} \times ((Tmax+Tmin)/2+17.8) \ldots\ldots(8)$$

Where, RA: Extra-terrestrial radiation ($MJ/m^2/day$) [36]; Tmax: Maximum temperature [42]; Tmin: Minimum temperature [42]; λ: latent heat of vapourisation of water (2.501 MJ/kg)

Actual evapotranspiration is estimated as a product of Potential evapotranspiration (PET) and Evapotranspiration coefficient (KC) (Table 8), given in equation 9. The evapotranspiration coefficient is a function of land use varies with respect to different land use. Table 8 gives the evapotranspiration coefficients for different land use

$$AET=PET \times KC \ldots\ldots(9)$$

Land use	K_C
Built-up	0.15
Water	1.05
Open space	0.3
Evergreen forest	0.95
Scrub and grassland	0.8
Forest Plantation	0.85
Agriculture Plantation	0.8
Deciduous forest	0.85

Table 8: Evapotranspiration coefficient.

Note: the crop water requirement was estimated for different crops and different seasons based on land use, assumption is individual crop water requirement and different growth phases (need different quantum of water for their development inclusive of evaporation).

Domestic water demand: Understanding the population dynamics in a region is necessary to quantify and also to predict the domestic water demand. Population census for villages during 2001 and 2011 [24] were considered in order to compute the population of the basin level. Based on the rate of change of population (equation 10), the population for the year 2014 was predicted as given in equation 11.

$$r=(P2011/P2001-1)/n \ldots\ldots(10)$$

Where, P2001 and P2011 are population for the year 2001 and 2011 respectively; n is the number of decades which is equal to 1; r is the rate of change

$$P2014=P2011 \times (1+n \times r) \ldots\ldots(11)$$

Where, P2014 is the population for the year 2014; n is the number of decades which is equal to 0.3.

Domestic water demand is assessed as the function of water requirement per person per day, population and season. Water required per person includes water required for bathing, washing,

drinking and other basic needs. Water requirements across various seasons are as depicted in Table 9.

Season	Water lpcd
Summer	150
Monsoon	125
Winter	135

Table 9: Seasonal water requirement.

	Water Requirement in lpcd (Liters per animal per day)							
Season\Animal	Cattle	Buffalo	Sheep	Goat	Pigs	Rabbits	Dogs	Poultry
Summer	100	105	20	22	30	2	10	0.35
Monsoon	70	75	15	15	20	1	6	0.25
Winter	85	90	18	20	25	1.5	8	0.3

Table 10: Livestock water requirement.

Crop water requirement: The crop water requirement for various crops was estimated considering their growth phase and details of the cropping pattern in the catchment (based on the data compiled from household surveys and publications such as the district at a glance, department of agriculture). Land use information was used in order to estimate the cropping area under various crops. Figure 12 provides the information of various crop water requirements based on their growth phase as cubic meter per hectare.

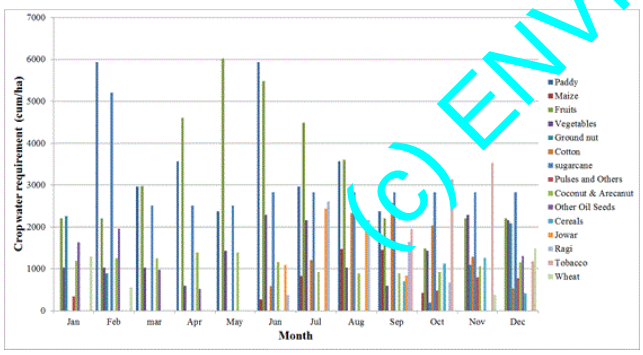

Figure 12: Crop water requirement (as cum per hectare per month).

Evaluating hydrological status: The hydrological status in the catchment is analysed for each month based on the water balance which take into account the water available to that of the demand. The water available in the catchment is function of water in the soil, run off (streams and river) and water available in the water bodies (Lentic water bodies such as lakes, etc.). Water demand in the catchment is estimated as the function of societal demand and terrestrial ecosystem (AET from forested landscape) crop water demand, domestic and livestock demand and the evapotranspiration. The catchment is considered hydrological sufficient, if the water available caters the water demand completely else the deficit catchment, if the water demand is more than the water available in the system.

Livestock water requirement: Household surveys were conducted with the structured questionnaires to understand the agricultural and horticulture cropping pattern and water needed for various crops in the catchment. Livestock population details were obtained from the district statistics office and water requirement for different animals were quantified based on the household interviews. Table 10 gives the water requirement for various animals.

Quantification of the environmental flow: Ecological investigations include the investigations of fish diversity across seasons. Habitat simulation method [51-56] was adopted to assess flows on basis of quantity and suitability of physical habitat available to target species under different flow regimes. In order to evaluate the natural flow regime [53,54], 18-24 months field monitoring of select streams in Sharavathi river basin and at Hongadahalla and Kadumanehalla (of Yettinaholé catchment) was carried out. This field data was compared with the long term flow measurements data at Hongadahalla and Kadumanehalla [45]. The natural flow that sustains native biota during lean season is accounted as the ecological or environmental flow [57-60] for the respective lotic system. In the current study, hydrologic assessment and investigations on the occurrence of native fish species (with diversity) helped in ascertaining the minimum flow required to sustain the native fish biota.

Results

Land use analysis

Land use analysis was carried out using remote sensing data of 2014, for Yettinaholé catchment (a tributary of Gundia River) and results are given in Figure 13 and Table 11. Major portion of the catchment is covered with evergreen forest (45.08%) followed by agriculture plantations (29.05%) and grass lands (24.06%). The valleys along the stream are dominated by agriculture lands and horticulture plantations, the hill tops dominated by grass lands, slopes covered with forest cover. The accuracy of the land use classification is 87% with kappa of 0.82. Temporal land use in the Gundia river catchment during 2000, 2006, 2010 and 2014 are depicted in Figure 14 and details are provided in Table 12. Results reveal that area under forests has reduced from 70.74% (in 2000) to 61.15% (in 2014).

Land use	Area (%)
Built up	0.07
Agriculture Plantation	29.25

Evergreen	45.08
Forest Plantation	0.001
Water	0.002
Open land	0.91
Agriculture	0.62
Grassland	24.06

Table 11: Land use in Yettinaholé catchment.

The region receives annual rainfall ranging from 3000 mm to 4500 mm. Variability of rainfall was assessed based on 11 rain gauge stations in the catchment and is given in Figure 15.

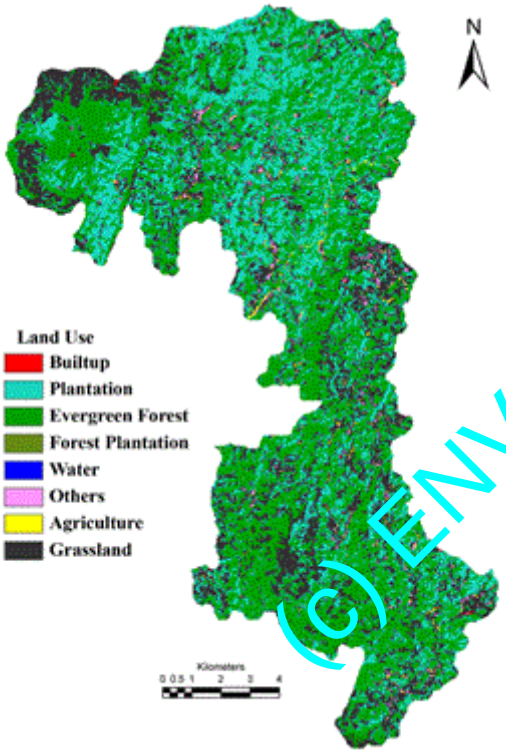

Figure 13: Land use in Yettinaholé catchment (eastern part of Gundya river basin).

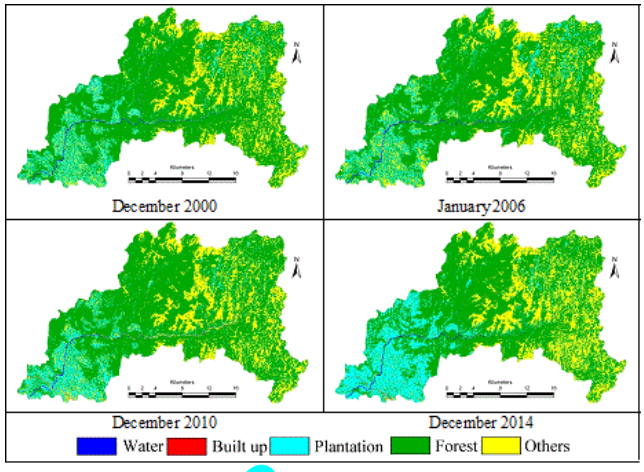

Figure 14: Land use dynamics-Gundia river basin.

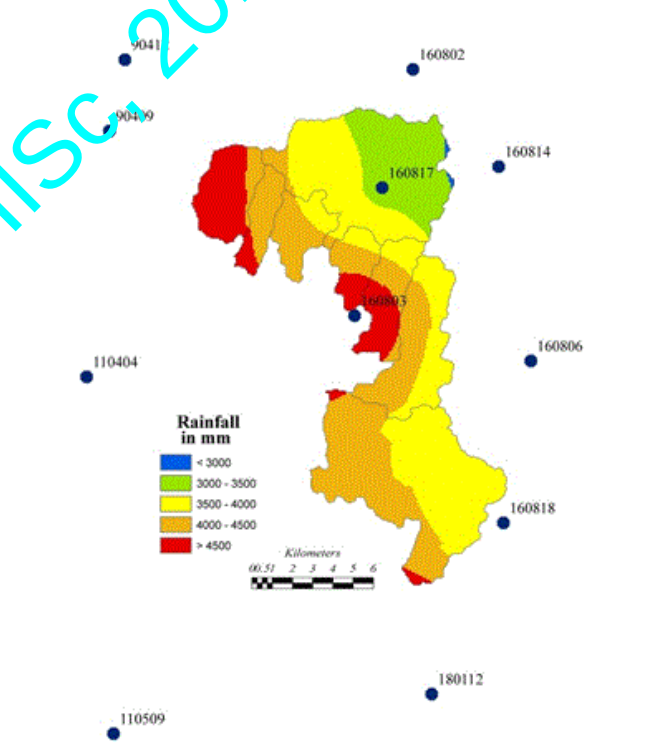

Figure 15: Spatial patterns of rainfall and rain gauge stations.

Land use	2000 December		2006 January		2010 December		2014 December	
	Area (sq.km)	% Area	Area (sq.km)	% Area	Area (sq.km)	% Area	Area (sq.km)	% Area
Water	4.05	0.63	3.61	0.56	2.96	0.46	3.11	0.49
Built up	0.44	0.07	0.17	0.03	2.41	0.38	2.72	0.43
Plantation	74.61	11.66	77.55	12.11	79.29	12.39	121.29	18.95

Forest	452.8	70.74	443.36	69.26	443.27	69.25	391.43	61.15
Others	108.22	16.91	115.44	18.03	112.18	17.53	121.56	18.99

Table 12: Land use dynamics - Gundia River basin.

Figure 16 provides the annual variability of hydrological parameters for understanding the hydrological regime. Gross rainfall, estimated as product of catchment area and rainfall. The gross rainfall varies from 33232 kilo.cum (in Kadumane holé 2 and Yettinaholé 2) and over 2000000 kilo.cum (in Yettinaholé and Hongada halla catchments). Portion of the water doesn't reach the earth surface, but is intercepted by the earth features namely the tree canopy, building tops, pavements etc., which gets evaporated. Runoff in the basin is estimated as a function of catchment characteristics along with rainfall. Yettinholé, catchment is covered predominantly by evergreen forests, has aided in recharging groundwater zone and sub surfaces. Infiltration of significant amount of precipitation to underlying layers, has reduced the overland flow and thus retarded the flash floods. The infiltration of water to sub-surface takes place during monsoon, and overland flow (surface runoff) happens during the monsoon (rainfall>50 mm per month) and quantity depends on the catchment characteristics namely land use/land cover in the catchment, soil porosity, texture, presence of organic matter (leave debris, decayed matter etc.). The portion of water percolates through the sub surfaces and thus recharges ground water resources. Water stored in vadoze zone (sub-surface) and groundwater zone moves laterally to streams with cessation of rain. Forests in the catchment have played a prominent role in maintaining stream flow, water holding capacity of soil, ground water, which also plays a pivotal role in catering the ecological and environmental demand of water. Sub basin wise yields are listed in Table 13; the surface runoff during the monsoon is estimated to be 9.55 TMC.

Sub basin	Average Annual Rainfall mm	Gross Rainfall TMC	Runoff yield as TMC
Yettina hole	3539.73	5.98	2.62
Yettina holé T2	4311.44	1.23	0.58
Yettina holé T1	4109.99	1.33	0.57
Kadumane holé 2	4364.85	1.2	0.53
Kadumane holé 1	4725.54	1.79	0.7
Hongadahalla	4000.77	6.7	2.68
Keri holé	4013.09	2.69	1.17
Yettina holé lower reach	4385.25	1.81	0.69
GROSS Yield (TMC)			9.55

Table 13: Catchment yield.

Evapotranspiration in the catchment depends on the land use, solar radiation, variations in temperature, precipitation, etc. Potential evapotranspiration was estimated using Hargreaves method. PET indicates the maximum possible water that can evaporate, PET varies between 160 mm/month (March) to 85 mm/month (monsoon season). Considering the various land use characteristics in the catchments, actual evapotranspiration was estimated in the catchments show variation of 40 mm/month (monsoon) to 120 mm/month (March).

Crop water demand was calculated in each catchment based on cropping pattern, area under each crop, and water required across the growth phases of the crops, which were compiled from various literatures (local, national and international) and discussion with the public regarding cropping practices and experiences. Table 9 and Figure 12, details season-wise crop water requirements and growth phases. The agricultural water demand of 2.6 TMC in the catchments is for horticultural and paddy cultivation. Livestock water demand given in Table 10 was estimated based on the livestock population (compiled from District at a glance of Hassan 2012-13).

Census data for the year 2001 and 2011 with the decadal rate of change in population was used compute the population for 2014 and water demand. Population for the year 2014 was estimated as 16156 persons. Catchment had a population of 17005 (in 2001), which decreased to 16345 (in 2011) at a decadal decline of 3.88%. The population density in the catchments varies from 33 persons per sq.km (in Keriholé) to about 150 persons per sq.km (Yettinaholé lower reach).

Ecological Flow Assessment: Flow measurements during the study period at two basins namely Hongadahalla and Kadumaneholé of Yettinaholé namely and based on the long term monitoring data [45] is given in Figures 16 and 17 respectively. This illustrates that flow during the lean season is about 10% of the annual flow, which is lower than the minimum flow requirement to sustain the ecosystem services in the water body.

Monthly monitoring of select streams in Sharavathi River basin over 24 months (covering all seasons) revealed the linkages of fish diversity with the duration of water flow in the respective stream. Table 14 lists the fish diversity across monitored streams. The current assessment confirm the requirement of 24 to 30% of annual flow during lean

seasons to sustain the native fish diversity of endemic species [46,47]. Based on this, the ecological flow in Yettinaholé catchment (during the lean seasons) is 2.8 TMC.

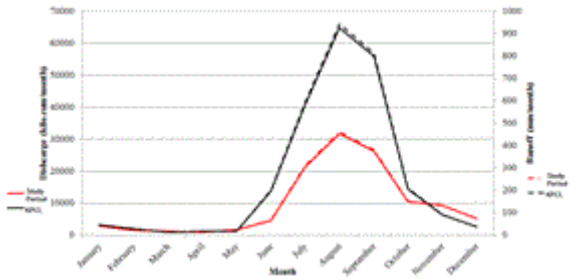

Figure 16: Hongadahalla.

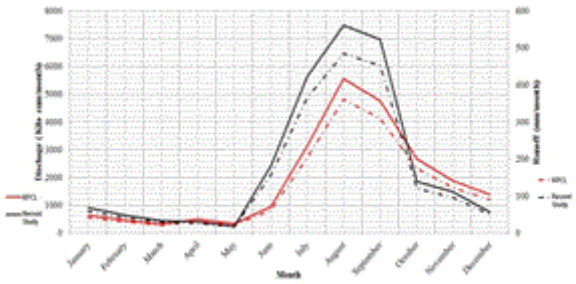

Figure 17: Kadumaneholé.

Fishes (Scientific Name)	Hill streams									
	Huruli River	Nagodi River	Birer River	Yenne River	Kouthi Stream	Sharavathi	Hirekunji	Sharmanavathi	Haridravathi	Nandihole
Amblyphyrngodon mola										
Aplocheilus lineatus	*	*	*	*	*	*	*	*		
Barilius canarensis			*		*					
Catla catla										
Chanda nama	*						*			
Channa marulius						*				
Cirhina fulungee						*		*		
Cirhina mrigala										
Cirrhinus reba								*		
Clarius byatracus										
Cyprinus carpio						*				
Danio aequipinnatus	*	*	*	*	*	*	*	*	*	*
Garra gotyla stenorynchus	*					*		*		*
Glossogobius giurus										
Heteropneustis fossilis										
Labeo fimbriatus										
Labeo rohita						*				
Lepidocephalichthys thermalis			*		*					
Mastacembalus arnatus						*				
Mystus cavesius	*									
Mystus keletius	*									
Mystus malabaricus	*									

Namacheilus rueppelli		*	*							
Ompok bimaculatus						*				
Ompok sp.										
Oreochromis mossambica										
Pseudambasis ranga	*									
Pseudeutropius atherenoides	*									
Puntius arulius					*					
Puntius dorsalis										
Puntius fasciatus	*	*	*	*	*					
Puntius filamentosis				*	*					
Puntius kolus										
Puntius narayani										
Puntius parrah										
Puntius ticto										
Rasbora daniconius	*	*	*	*	*	*	*		*	*
Salmostoma boopis						*	*		*	

Table 14: Fish diversity in select streams of Sharavathi River basin.

	Description	Quantity
1	Gross Area	179.68 sq.km
2	Average Annual Rainfall	3500 - 4500 mm
3	Water Yield in Yettinaholé catchment	2.55 TMC
4	Ground Water Recharge	0.49 TMC
5	Evapotranspiration	3.16 TMC
6	Irrigation Water Requirement	2.64 TMC
7	Domestic Water Requirement	0.03 TMC
8	Livestock Water Requirement	0.01 TMC
9	Total Water Demand (anthropogenic)	5.84 TMC
10	Ecological or environmental flow	2.8 TMC

Table 15: Hydrological assessment in Yettinaholé catchment.

The water demand and availability are listed in Table 15 and Figure 18 depicts the spatial variability of resources. Total water demand (5.84 TMC of water) across the catchments (accounting anthropogenic and evapo-transpiration of terrestrial ecosystems) was obtained as a function of evaporation, livestock, and domestic and agriculture demands. Availability of water in the catchment was assessed as a function of runoff during all seasons. The assessment showed that most streams in the forested catchment are perennial compared to steams in the catchment predominantly covered with monoculture plantations (6-9 months) or the streams in catchment dominated by open area or barren area (4 months). The available water in Yettinaholé catchment is sufficient to cater the existing water demand (social, ecological and environmental) throughout the year.

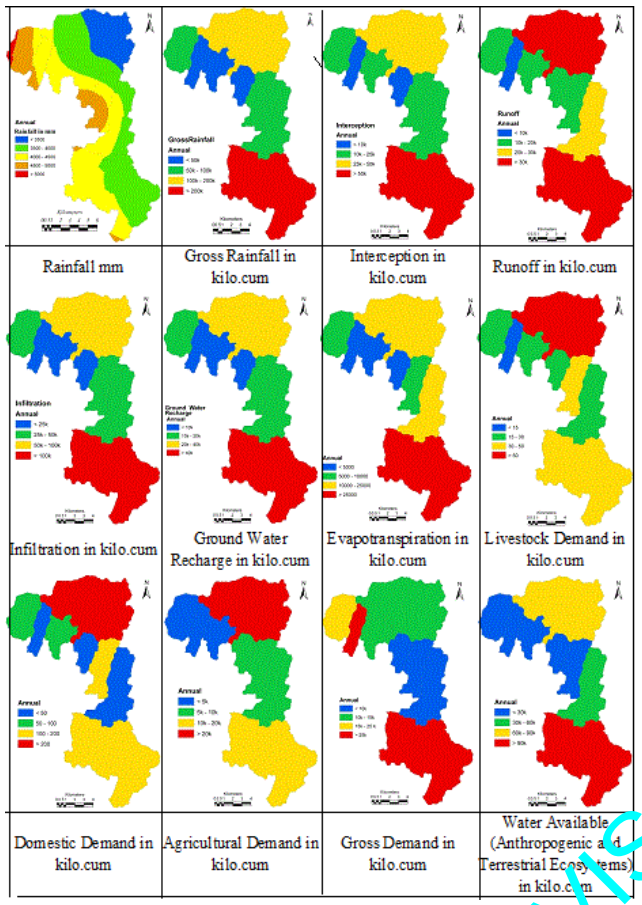

Figure 18: Hydrologic assessment in Yettinaholé catchment.

Conclusion

Yettinaholé River is currently catering to the anthropogenic and ecological water needs in the catchment. Higher discharge of water during monsoon has helped in the transport of nutrients, silt, etc., which has helped in sustaining the riparian's vegetation and aquatic life apart from meeting the anthropogenic demand (for horticulture, agriculture etc.). Many streams of Yettinaholé are perennial, which has helped in sustaining the rich and diverse aquatic life apart from sustaining horticultural, agricultural activities (3 crops per year) and fishery.

Hydrological yield computation shows the water yield in the catchment is about 9.5 TMC, About 5.84 TMC is required for domestic purposes including agriculture, horticulture and livestock rearing and the quantum of water required to sustain fish life in the streams is about 2 TMC. This highlights that water available in the catchment is sufficient to sustain the current ecological and anthropogenic (agricultural, horticultural) demand. Alterations in the catchment integrity (land cover) or water diversions would result in the variation in the natural flow regime affecting the biodiversity of riparian's and aquatic habitats and more importantly people's livelihood who are dependent on fisheries, etc. in the downstream. In this contyext, The federal government's plan to divert Yettinaholé River water to the dry arid regions in Karnataka is neither technically feasible, economically viable nor ecologically sound apart from depriving the anthropogenic demand in the Yettinaholé River catchment. The sustainable option to meet the water requirements in arid regions is through (i) decentralized water harvesting (through tanks, ponds, lakes, etc.), (ii) rejuvenation or restoration of existing lakes/ponds, (iii) reuse of treated waste water, (iv) recharging groundwater resources, (v) planting native species of plants in the catchment, (vi) implementation of soil and water conservation through micro-watershed approaches.

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