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**“Degradation of Forest and Its Impact on Water Potential and Pollution of Uttar Kannada District of Karnataka State – India
: A Geographical approach”**

By

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Abstract

The district Uttara Kannada is a part of one of the **Hot Spots** of the world. It is located in the steep western slope of western ghat across the direction of s-w monsoon. It supports lush green forest and origin of swift flowing rivers, tanks and rich ground water potential. Earlier its forest cover was 79.31 per cent and the environment was in equilibrium. The increased pressure on forest degraded its density and led to permanent loss at many places.

The western ghat acts as a overhead tank with ensured water sources to the low lying region. With the degradation of forest the source of water is disturbed. The barren surface exposed to sun light reduces the surface and sub-surface water potential. The heavy down pour loosens the barren surface soil and causes severe and frequent wide spread land slide hazards which open up fresh surface and increases turbidity of water. Huge vegetative and animal matter collected by streams decay and reduces purity of water and its storage capacity. The loose and barren surface soil is much affected by wind and pollutes air during dry season. The unscientific method of paddy cultivation in the terraced bunds on the hill slope also adds turbid water. Turbidity level increases due to reduction in water during dry season and lowers dissolved oxygen content which affects aquatic and terrestrial life and also human needs. Silting is a major threat which initiates frequent flood hazards and pollutes the domestic water of the estuary plain and human life and economic activities.

Therefore the study aims at analyzing and identifying the actual impact on water potential by man's indirect unscientific activities.

Keywords	Forest degradation, water potential and pollution
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Introduction

The serious and growing concern of the present world is conservation and management of forest and environment which is dynamic with time and space today. The dense evergreen untouched forest rarely exists today. Its mismanagement affected environment thereby life style and economic well-being of the people. The development in science and technology provided increasing wants of life which has direct effect on forest. Hence determining, monitoring and maintenance of forest become mandatory for sustainable development.

Objectives and Methodology

Efforts have been made to collect and discern all available sources of data and information. Non-availability of sufficient data has caused set back in many approaches. The secondary sources of data have collected from concerned department of the district. SOI topographical maps of scale 1:50,000 are used for identification of relief and slope gradient. GIS is used to find out the degraded forest region and other related aspects. Problem oriented photographs are taken from field visit during different seasons.

The study aims at identifying the factors responsible for degradation of forest and its impact on quality of water on fauna, flora and on human life in different parts of the district. A cause of forest degradation is tested with correlation matrix using 14 variables. The physical and chemical quality of water is the obtained from the district pollution control board. The physical properties of water are also identified by visiting the field during different seasons. Field investigation and local survey with the experienced old age people of the locality conveyed much support for ground truth of the changing situation in different fields.

Study area

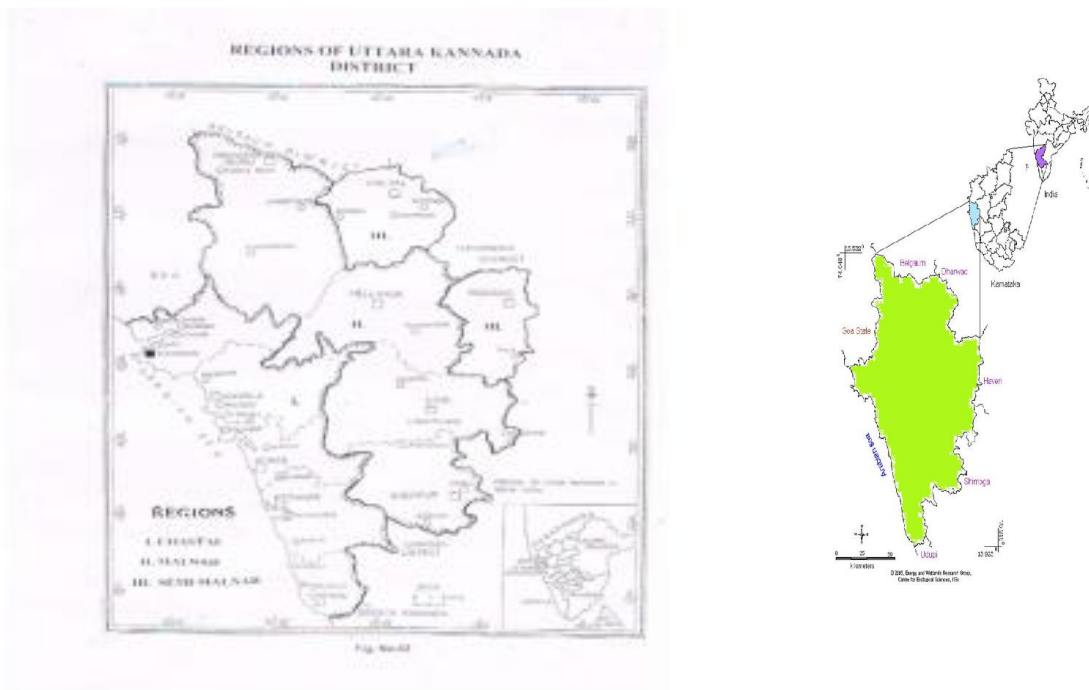
The Uttara kannada district is a “ **Land of Natural Museum**”, which is located to the north-western part of the Karnataka State, possesses 10,258.80 sq.km. of area. The rich biotic gallery of the district declared it as

one of the “Hot spots” of the world. It possesses three distinct reliefs they are the Western Ghat which occupies major part from north to south and an elongated narrow coastal plain lies between foothills of western Ghat and Arabian sea and the eastern border is a rolling relief with low hills. The land mass of the district is situated up to 915 m. above MSL. The south-west monsoon blessed the district with an average of 245.52 cm. of rainfall which supports mighty and perennial rivers. The suitable climate, soil and relief supported luxuriant fauna and flora.

The population of the district is 14, 37,169 with a density of 141 per sq. km. Of the 1,275 settlements 1,246 are small and isolated rural with 10, 18,216 people as per 2011 census. The urban structure is simple with small 11 natural towns. The district depends on outside urban centre for its specialized activities (Fig.No.1)

Location of Uttara Kannada District

Fig. No. 1



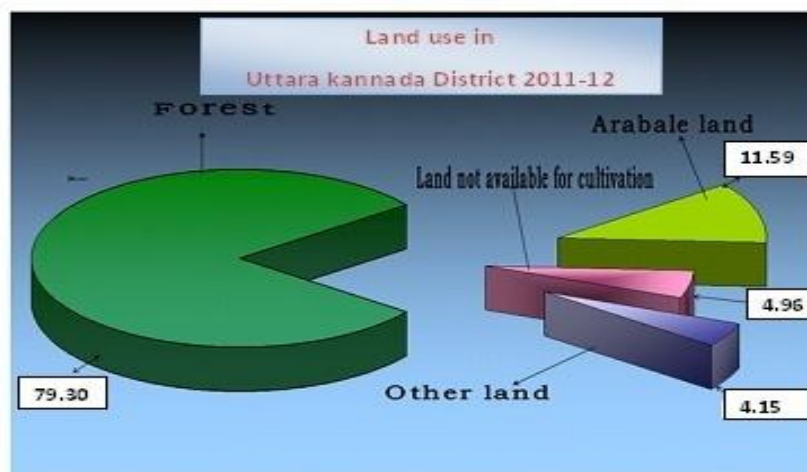
Land Use

The general land use pattern of the district has to be seen in the light of its overall natural and changing socio-economic conditions. It is mainly

controlled by relief, soil and s-w monsoon. The decrease of rainfall from coastal to semi-malnad region exerts influence on different method of cultivation of crop. The wet zone is associated with rice, areca nut, coconut and evergreen forest. The moderate zone in the upper ghat region associated with fruit gardening under the influence of soil and climate. Forest land occupies 79.30 per cent of the district area (Fig.No.2).

Only 11.59 per cent of land is available for cropping. Kharif is the main cropping season with rice. A very less water potential is utilized for rice and groundnut during rabi season. Arecanut and coconut are the main horticultural crops in the coastal and malnad regions. Fruit gardens are important horticultural crops in the semi-malnad region.

Fig.No.2



Agriculture and horticulture are the main occupation. Fishing is confined to coastal strips. The industrial structure of the district is very poor. Medium and large scale industries rarely exist. Only very small scale industries are distributed in the district provides basic needs. The district entirely depends on specialized industrial products from outside.

Water Potential of the District

The location of the western Ghat across s-w monsoon precipitates heavily. The terrain condition of the western Ghat and the rolling eastern slope, lithology, edaphic factors has given much scope for the origin and distribution of rivers and tanks. On an average it receives 25.10 cubic km of

water potential every year. Out of the total water potential available for utilization only 13.80 per cent is utilized for different purposes. The ground water aquifers of the district are the weaker weathered and fractured zones of meta volcanic and meta sedimentary rocks. Hence the developed primary porosity fissures and faults acts as porous media which stores ground water drafts of more than 70,765 ha.m. The perennial and mighty rivers and about 922 tanks are the surface sources of water.

Causes of Forest Degradation

Forest is the master controller of environment in the district. Earlier the intact forest coverage of the district protected the land surface and there was a balanced flow and storage of surface and underground water. The increased activities are spread over the district naturally gave way to different needs of the people. As a result, quite a lot of vast dense evergreen forest has been converted into open jungle and scrub land even in the wet zone. Such alteration in forest cover affected natural environment and initiated surface degradation. The following are the causes of forest degradation.

- 1 Demand for green twigs for manure
2. Demand for fencing of crop land
3. Mining and quarrying activities in forest
4. Demand for fuel wood
5. Forest diseases
6. Encroachment of forest land
7. Installation of plans and projects
8. Demand for grazing
9. Illegal forest cutting
10. Cutting of forest for curry leaves, wild fruits and other uses

11. Wind hazard
12. Industrial demand for raw material
13. Wood for the preparation of charcoal
14. Others

The result of co-relation co-efficient analysis concludes that there are many detrimental factors responsible for changing forests density and pattern. Out of 14 variables 13 variables are positively co-related in forest degradation. The factors like cutting of green twigs for manure, wood for fencing seasonal cropland, demand for fire wood and encroachment of forest land, installation of plans and projects, mining/quarrying activities are highly correlated. Executing of development work like construction of roads, railway, building construction, and earth excavation are moderately co-related in forest degradation. Other factors are also affect forest degradation considerably.

Cutting of green twigs for manure and Land degradation

Among the identified causes the cultivation of plantation crop is severely affected forest degradation in the district. It consumes large quantities of green twigs from the surrounding forest and degrades regeneration of forest and its density which has serious impact on environment. It is a major threat to forest density in the coastal and Malnad region of the district where hill gaps and valley plains are utilized for plantation crops like coconut, arecanut, banana and other mixed crops like cardamom, pepper etc. Their dependency on green manure to maintain fertility and moisture in the soil destroys considerable forest around these cropping regions. The severe cutting of green twigs and undergrowth destroys regeneration of forest and keep the barren surface easy ground for soil erosion and impact on water pollution in the lower streams and tanks (Photo No.1)

Photo No.1

Degraded evergreen forest due to cutting of green twigs for manure in the horticultural cropping region of the district



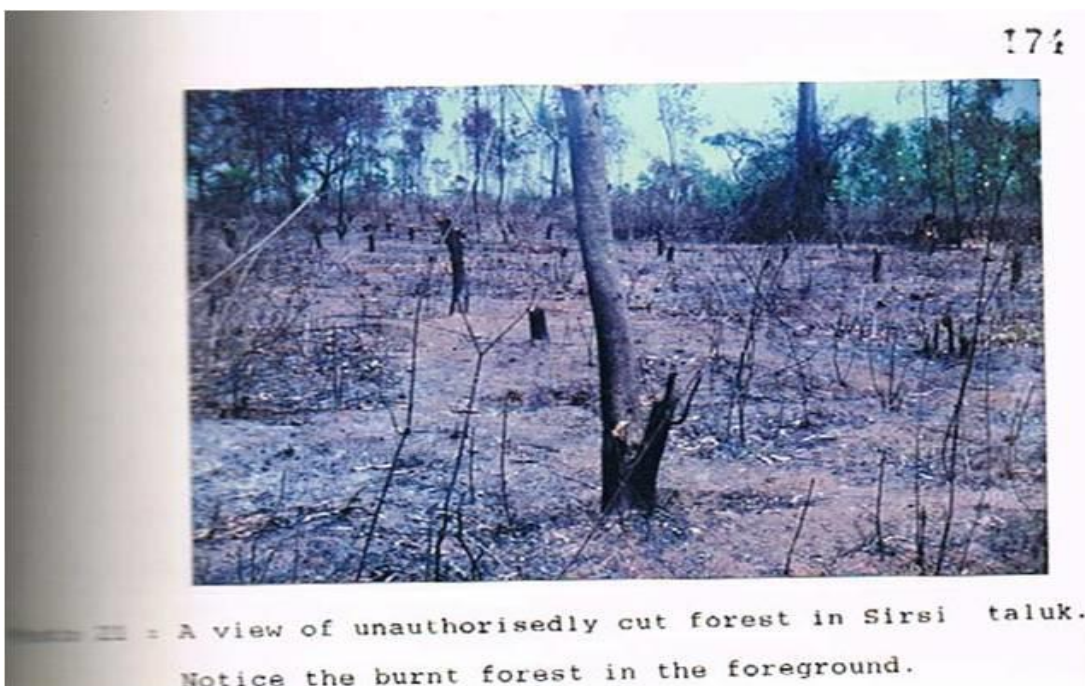
Forest Fire and forest Degradation

Fire incidence is more common in all the sub-regions. But it is more deadly in the deciduous belt of semi-malnad. The dried up grass, undergrowth, shaded leaves and other vegetative matter are more sensitive to fire during dry season. It destroys lower and middle canopy of forest considerably and affect regeneration. It carries large quantity of vegetative matter into river courses and nearby tanks. Farmer intentionally put fire to grass land and crop residue with an intention to get better crop yield in the next season and also for encroaching the adjacent forest land. (Photo No.2). Some time it also spreads to the entire forest and destroys the undergrowth

Photo No. 2

See the illegal forest cutting and burnt undergrowth

Keep the soil surface open to degradation



Mining/quarrying activities and forest degradation

The district has rich sources of minerals. But mining activities is stopped to conserve forest and natural environment. Laterite is the main source of

building constructional material in the district. Its quarry is widely distributed and severely damaging forest cover at quarrying site and inroad into it. It exposing new loose soil surface to heavy rainfall on the steep slopes joins the nearby water bodies and affects the water quality. The digging of the earth for execution of plans and projects also severely cleared forest permanently and exposes new surface to severe erosion. It degrades the surface and adds silt in the river courses and nearby tanks. (Photo No.3)

Photo No. 3

Laterite quarry and loose exposed surface to heavy rainfall

See the degraded forest in the background



Demand for fencing of crop land

Protection of crop is a major problem of agricultural operations due to stray cattle and wild animals attack on crop. Fencing around agricultural fields and house compound is being done by using immature trees stumps and undergrowth bushes. The reckless chopping of trees degraded surrounding forest during every cropping season.

Uttara Kannada district

Construction of seasonal wooden fence to crop land

Sl. No.	Sub-region and Taluks		Cropping seasons		Total fence length
			Kharif crop (fence length)	Kharif crop (fence length)	
	I. Coastal		732.61	150.86	883.47
1	Karwar		160.78	18.04	178.82
2	Ankola		157.00	24.19	181.19
3	Kumta		164.23	36.00	200.23
4	Honavar		150.16	38.25	188.41
5	Bhatkal		100.44	34.38	134.82
	II. Malnad		876.21	99.46	975.67
6	Joida		116.18	10.69	126.87
7	Yellapur		172.72	19.14	191.86
8	Sirsi		339.46	40.61	378.07
9	Siddapur		247.87	29.02	276.87
	III. Semi-malnad		933.74	130.04	1063.78
10	Haliyal		554.65	75.84	630.49
11	Mundgod		379.09	54.20	433.29
District total			2542.56	380.36	2922.92

A random survey has been conducted in each taluk of the district to estimate the average length of fencing per hectare of crop land. It was estimated that a total of 2922.92 km. length of fence is to be erected depending on forest every year. However the wood fencing is destroyable due to heavy rainfall and by termite attack during every cropping season. Re construction of fence for every cropping season consume voluminous wood and degrades undergrowth and regeneration of forest.(Photo No.4)

Photo No. 4

See the fencing of cropland by using wooden stumps and bamboo



Demand for fire wood

It is estimated that the official demand for fire wood for domestic use is more than 4, 71,002.85 metric tons per year. The forest dweller and the rural people totally depend on surrounding forest for fire wood. All these demand is much more than what the forest regenerates every year. As a result, the forest type and pattern is completely changing.

Encroachment of forest land

Generally encroachments were attempted in the most suitable site of forest land for agriculture or for the extension of existing cultivated land where most suitable lands available till today. In the outskirts of town the forest land is encroached for residence. It is estimated that 6497.298 hect. of land is reported to be encroached in the district.

Installation of plans and projects

The developmental activities like hydro-electric project, transport lines, industrial centers, rehabilitation centers, naval base, atomic power project, extension of urban colonies are also leading to permanent loss and degradation of forest. Totally 22,189.104 hectars of forest land is released to these activities.

Illegal forest cutting

The illegal forest cutting is practiced by local people for their basic needs. People exploit forest produce like eucalyptus poles, bamboo and other jungle wood for roofing their houses and agricultural equipments. Cutting of wood for fuel purpose and to bring on head load has become customary in the district. The other purpose of illegal forest cutting is for commercial profit by smugglers. The valuable wood like teak, rose wood, sandal wood, large quantities of bamboo, canes and other valuable jungle wood plants are affected by smugglers. Forest becomes sparse in these areas and supports degradation process.

Other causes like grazing by domestic and wild animals, demand for curry leaves, collection of wild fruits from forest, wind hazards, Preparation of charcoal etc, are less affected forest degradation.

Impact of forest degradation: Landslide

The proneness of the region to landslides has increased in the recent past due to raising human impact on forest. The degraded and barren hill slope, the river valley sides, the type and structure of soil, the loose and embedded laterite boulders in the clayey soil become sensitive and develops slippery surface during s-w monsoon which exert pressure and slides on hill slope. The rotten tree root opening acts as capillaries raises water in the openings and soak up the soft soils in the interior triggering mudslides due to rupture of the hills (Photo No.5)

The execution of projects, urban construction, unscientific hill cutting on the weaker zones for the construction of transport lines, village and private roads, the activity of quarrying, pediment cutting, soil removal and stripping of vegetation increases risk and posing wide spread and frequent landslide problems. The new surface exposed to heavy rainfall and the steep terrain support the removal of soil and adds much silt and turbidity in *water bodies*.

Photo No. 5

Uttara kannada District: Land slide probability Zone

Western Ghat and Foot hills of Coastal Region





Impact on Cultivation and Land Degradation

The traditional method of paddy cultivation is practiced in all the three sub-regions. The degradation of forest on the hilltop affected maintenance

of crop land. The hill slope terraces, mismanaged bunds, heavy rainfall leads to swift flow of over flooded water which carries large quantities of soluble particles. The higher cattle density provides large quantity of dung and cutting of huge quantities of green twigs for manure. It degrades forest which support soil erosion and reduce fertility status and crop yield. It carries large quantity of silt, turbid water and biotic materials in to nearby tanks and river courses (Photo No.6)

Photo No.6

Mismanaged bunds and soil erosion in crop land



Forest Degradation: a source of water pollutants in the district

Earlier the thick forest cover of the district kept the natural set up intact. All by-products produced either by man or by nature were re-cycled back into the environment by nature. However with the increased act of man in nature producing overload of pollutants which is allowed to continue and the environment has little chance to self-cleaning today (Photo No.6)

The systematic investigations of the *chemical* parameters of water were carried out, which reveal the fact that quality of water of the district in generally is not polluted as per conventional standard except some specific area and seasons by point-source.

The pH value of water, temperature, salinity, electric conductivity and dissolved oxygen, B.O.D. total hardness, calcium, magnesium, chloride, nitrite phosphate, magnesium hardness obtained were compared with the (BIS) Bureau of Indian standard of water quality and is found satisfactory, except some local areas. Whereas the physical property of rivers and tanks of the district are much affected by surface degradation. The pollutants that get into water from nature include voluminous sediments and other biotic matter. The pollutants added by both rural and urban activities are less except some specific places of the district.

The accumulated sediments in the river valley provides low water yield as well as the wide impact on regular flow which increases temperature and turbidity of water during summer and effects on hydrological regimes. *Sediments are rich in nutrient due to its flow through forest area of the district* which promotes eutrophication process, especially in shallow stream. The increased levels of Nitrogen, phosphate are also the leading contributions to reduce water quality.

The physical evidence of waste accumulation is commonly observed such waste materials often leads to organic enrichment of the bottom sediments

resulting in the change in physico-chemical and biological quality of aquatic eco-system in the deciduous forest belt of semi-malnad region.

The construction of dam for power generation in the upper courses of the river Kali and the Sharavati, dilutes salinity level in the estuary and affects salt water mangroves (*Sonneratia*), edible bivalve shells and many other creatures have disappeared in estuaries (Photo No.7)

The increased silting and turbidity of water and leads the formation of mud flat and pollutes river bed of the lower course of the streams and its original style of flow of water which has much affected the local aquatic life. It destroys fish spawning beds, reduces storage of water in river beds and clogs streams. The increased silt and gravel provide no platform for fish to lay eggs and has less chance of hatching. The increased mud flat causes suffocation of fish eggs and breathing of macro invertebrates and also destroys natural spawning substrate. Suspended sediments generate bloomy or murky water which blocks sunlight and process of photosynthesis. It has serious effect on breathing through their gills and locating food which reduce aquatic plant life and altered streams ecology in the upper courses of river. Large quantities of ash produced by forest fire every year and the partly burned wood pieces also carried by streams and river courses and pollute water.

Aquatic plants and roots serve as natural nursery for variety of fishes and crustaceans. The organism in the aquatic system decomposes algae and use as a food source. In the process the initially low oxygen is further lowered which affected aquatic life.

Photo No.7

See the shallow tributary bed soon after s-w monsoon due to degradation in the evergreen forest. See the lateral erosion and silting.



Degradation of forest and its Impact on Tank Pollution

Tanks are the main sources of water for domestic use, cattle strength, inland fishing, local wild life and aquatic eco-system. Earlier the recharge

and discharge system was in equilibrium and the quality of water was satisfactory. With the introduction of drinking water schemes most of these tanks are mismanaged at many places. The barren surface affected by sheet and rill erosion on the hill slope finds its way to these tanks. It adds eroded materials and soluble salts, organic matter, nutrients like phosphorus carried from surrounding forest and crop lands. It damages the fresh water ecosystems of tanks. The enriched nutrients stimulated growth of algae in most of the tanks in the district. At Places tanks water turns to deep greenish where the ability of light to filter through is diminished it can directly affect aquatic plants glade and plankton which reside at the bottom of the food chain. The tanks which are located in the town and nearby are affected by sewage at many places. The cleaning of vehicles adds toxic contaminants in to these tanks. The increased oil and grease film floating is reducing visibility of water (Photo No.8 & 9)

Local survey conducted with the rich experienced and elderly people of the district revealed the fact that there is much change in the local micro-climate. These days land dries up immediately after rainy, the perennial and deep water streams in the upper ghat regions becomes shallow and dries up during early summer. The fresh water streams are very rare to exist. As a result the abundant inland fishing grounds are much affected. Bigger size fishes completely disappeared due to shallow streams. Fresh water crabs once abundantly available in the upper ghat streams become rare.

The wild life abundantly seen in the forest becomes rare. Its attack on crop land and domestic animals become very common in the nearby settlements. The entry of cheetah, python, king cobra, elephant and other animals become frequent in the nearby settlement in search of food. Different varieties of wild fruits and medicinal plants also become rare. Once the district was abundant and abundantly available honey become rare to get.

Photo No.8

Uttara Kannada District

See the silting and growing of weeds due to mismanaged tanks



Photo No. 9

Polluted tanks due to mixing of sewage and other pollutants in and around the towns of the district



Findings:

The spatial analysis of the district proves that loss of forest is the main cause for environmental degradation.

The increasing population and limited economic activities in the district is the initiative for forest loss.

The limited crop land available for economic activities put pressure on forest land for their livelihood. Encroachment of forest land for cropping and residence cleared permanent forest cover.

Cultivation of horticultural crops like arecanut, coconut and the traditional agricultural practice recklessly cut huge quantity of green undergrowth for manure. It degrades forest without proper regeneration.

The demand of fire wood, fencing of cropland and house compound clears large quantities of forest by local residents. People's entry into forest for varied produce and illegal forest cutting is very difficult to stop.

At present mining activities are stopped but the large area utilized for mining is not reclaimed. Digging the earth, quarrying for constructional materials is unavoidable in forest.

Installation of Kali and Sharavati hydal projects, Kaiga atomic power project, Naval Base and minor irrigation and transport lines cleared permanent forest cover.

The loose and newly exposed surface materials are the main source of pollutants. It damages the natural entity of water and eco-system. The sources of point and non-point pollutants are very less.

Suggestion

It is one of the sick districts of the state, where forest cover is the master controller of environment and eco-system. Step should be taken to reduce dependency on forest by introducing eco-friendly economic activities.

The district has ample scope to go for regeneration of forest with native and other species in the degraded and lost area by employing more number of local youth to bring back the original eco-system.

The dependency on forest should be avoided by providing more attraction towards crop land. The rich water potential should be utilized by implementing extensive local minor irrigation projects to bring land under rabi crop. It will give regular employment and avoid pressure on forest resources.

The waste and fallow land should be brought under cultivation. The irregular and mismanaged bunds, stream lines and field boundaries should

be brought to regular shape to avoid wastage of land. It increases cropping space and yield and also reduces fencing length and conserve forest.

The major power projects installed in the district cleared much of its forest area permanently. As such no any further major projects are advisable.

The district is known for its scenic beauty. Most of its attractive places are yet to be made known to people. There is wide scope to develop eco-tourism.

Forest department should take precautionary measures to avoid fire incidence by taking local people in confidence. They should be given awareness of immediate involvement to control it.

Construction of seasonal fencing should be avoided by introducing either power fence or by permanent wall structure by giving attractive subsidy to farmers. It avoids usage of voluminous wood and thorny undergrowth from forest.

Priority should be given to immediate regeneration of forest in the degraded mined and quarried areas. It will reduce turbidity and silting in the lower course of river bed.

Rejuvenation of tanks is a must to increase surface storage and enrichment of underground water. It brings back the natural environment and ecosystem.

The success of forest conservation and regaining the natural environmental set up is fully depending on the co-operation of the local People. It is necessary to arrange frequent awareness programs at grass root level to reach the sense of belongingness of their survival with environment.

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