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THE FORESTS OF VASHISHTHI RIVER BASIN

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ABSTRACT : Forests are an important natural resource in the basin of river Vashishthi, situated in the central part of Konkan, in Maharashtra. This paper attempts to describe various aspects of forest ecology of this small river basin. The study is mainly based on the forest map prepared by the author from the aerial photographs of the region. The photographs used for the purpose depict the forest cover in the year 1983.

INTRODUCTION :

A detailed study of the distribution of forests in an area is a difficult task. This is especially so in the rugged mountaneous areas and the areas with poor accessibility.

The forest department in India prepares the maps showing the distribution of forests. However these maps have a very limited use since they depict the geographical habitats of natural vegetation under the administration of said department. The best method, now available for such a study is the use of aerial photographs.Aerial photographs or their enlargements on a suitable scale provide first hand and authentic information about the forest distribution; hill slope and forest association, the area cleared for cultivation and the areas of tree-felling. A well equipped photo interpreter can identify forest types and their associations, alongwith the tree heights, canopy etc. The area which are inaccessible and thickly forested can be mapped sufficiently accurately from the aerial photographs.

The present paper tries to study some aspect of forest ecology of Vashishthi river basin, a major river basin from North Konkan region of Maharashtra.

THE STUDY AREA :

The basin of river Vashishthi occupies northern part of Konkan lowland of Maharashtra (Fig. 1) It extends from 17° 22'N to 17°52'N latitudes and 73° 10'E to 73° 45'E longitudes. The total area of the basin is 2442 km sq. Physically the basin is a dissected lowland. Its eastern margin runs along the crestline of the Western Ghats. The central part of the basin is characterised by north-south flowing Jagbudi river and east-west flowing Vashishthi and their tributaries. The western part is characterised by a series of lateritic tablelands and detached hills.

The region is climatically humid with an average annual humidity of 75%. The year is divided into 4 seasons. The summer from March to May, South west monsoon from June to September, Post monsoon from October to November and winter from December to February. Maximum temp seldom exceeds 35° C on the sea coast and 40° C in the interior. The rainfall increases rapidly from coast to Western Ghats. Average annual rainfall of the region is 2000 mm.

METHODOLOGY

In addition to field observations made at some sites, the present study is mainly based on the aerial photographs of the study area enlarged on a scale of 1:15000. Since the year of photography was 1983, the information obtained from the photographs is very recent.

To achieve as much accuracy as possible, the total area covered by each enlargement (121 sq.Kms.) was divided into required quadrats each measuring an area of 1 km.sq. The percentage area covered by the forest was carefully measured for each smaller grid square. The information thus obtained was transferred to the basin map on a scale of 1:300,000. The map thus prepared was used

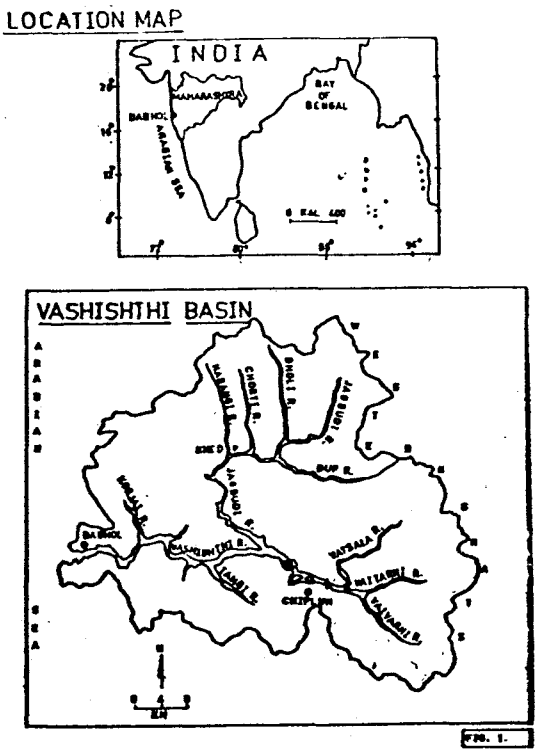


Fig.1

for further analysis. The aerial photographs for the S.eastern part of the basin are not available and hence this part of the basin appears as a gap in final forest map. The diagrams showing the vertical zonation in forest types have been prepared from the field observations.

Since the vegetation in the estuaries and creeks is an important forest resource of the basin, it was studied for a few sample estuaries.

In addition to the forest map of the basin, the maps have also been prepared for areas representative of different geomorphic setting, namely scarp and scarp foot zone, zone of central hills and ridges and western zone primarily by the techniques of isosilva lines i.e. by the lines joining places having equal percentage of forested area.

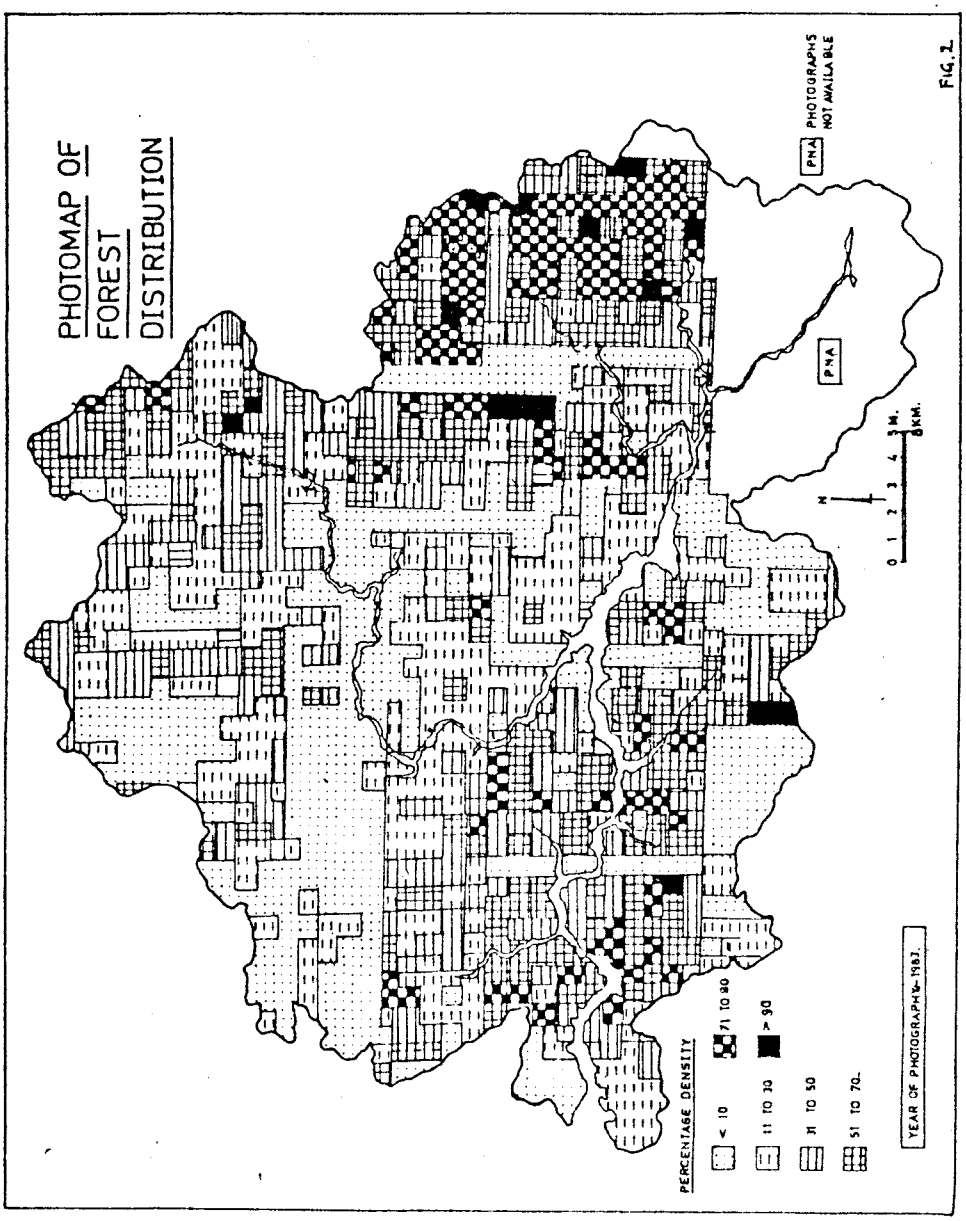
MAJOR FOREST ZONES :

On the basis of the forest map prepared from the aerial photographs (Fig. 2) the basin area has been divided into the following major zones:-

1. Scarp and scarp foot zone in the east
2. Northern and north-eastern hills
3. Central and North central hills; and
4. The lateritic hilly area.

It can be seen from the fig. that the density of the existing forests is closely related to lithology, topography and precipitation in the region.

Dense forests with a density of more than 90% occur in isolated patches. With a few exceptions in the south, these dense forests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11 TO 30
31 TO 50
51 TO 70
71 TO 90
> 90
YEAR OF PHOTOGRAPHS-1982
Fig. 2

Fig. 2

are restricted to the Western Ghat region to the east. The source regions of Vastala and Vaitarni are characterised by dense forest cover (density more than 70%). It is interesting to note that the Western Ghat region in the north eastern part of the basin is significantly devoid of dense vegetation cover. Here the dense forest occurs in patches only. The study of the weathering processes operating in the said basin shows that the northern and north eastern hill slopes are being eroded fasted that the slopes elsewhere in the region. This is reflected in the low forest densities in this area. The barren lands and scanty forest cover are associated with the lateritic hills and plateau of the west and on the steep hillslopes everywhere in the region. The low forest densities are also found in the central region around Khed, Chiplun and all along the Bombay Goa highway passing through the rapid industrial development in and around Khed and Chiplun and easy transportation facilities provided by the highway are the main causes of the forest destruction to the north of the Vashishthi, thus, have low density of forest. The lateritic surface, east-west, running to the Vashishthi is yet another area of scanty vegetation cover.

The southern boundary of the basin is a steeply sloping hill range. A clear association between scanty forests and steep slopes could be found around the southern margins of this area. An important aspect of forest cover in the basin is that a relatively dense forest (density 50% to 70%) is still retained closer to the Vashishthi creek. Field observations however show that these forest around the creek are restricted to the foot hills and gentle slopes in the lateritic areas.

There are clear indications that the forest cover in the basin has been reduced significantly in the last ten years.

The local people in the area are definitely aware of this fact. According to these people, illegal tree felling, increasing tendency of grazing of cattle on every possible grassland, road constructions in many parts of the basin and changing technique of terracing the hillslopes are some of the major factors which are responsible for the degradation of the forest cover.

An attempt was made to compare the forest cover of the year 1983 with the previously reported forest cover in the area. (District census handbook 1981). These previous maps were based on the village-wise forested areas reported by the Forest Department. These maps give a very generalised picture of forest distribution since they were prepared for the district as a whole. The generalised forest map thus obtained shows a forest cover with a density of less than 25% all over the region.

Forest-Photo map of the year 1983, thus in no way could be compared with the general maps prepared form the forest department data. However, according to the information obtained from the local people, there is no doubt that the forests in the basin are presently in a degraded state and there are no signs that the rate of destruction will decrease in the near future.

The scarp, scarp foot, central ridges and western lateritic areas exhibit distinct pattern of forest cover. To bring out more details in the distribution of forests in these major areas, maps were prepared from aerial photographs. An area admeasuring 12 sq. kms was selected from each zone. A network of 1200 grid squares, each measuring 0.01 sq. kms was superimposed on these and the area under forest was measured. The isosilva maps were then prepared to show the distribution. The table No.1 shows the amount of forested areas under different categories.

It can be seen from the table No.1 that the area covered by the dense forests is maximum in the Western Ghat (24.62%) region and minimum in the central hilly region (0.58%). Most of the land in the central hilly region is under cultivation. The Bombay - Goa National Highway runs almost through this central hilly region, and connects major settlements like Khed and Chiplun. This has affected the forests in the nearby areas, since the transportation of fuel wood has become an easier task.
It was observed that cattle grazing is maximum in the central hilly areas. This has exerted a heavy pressure on the forested lands in this

zone. The extensive open patches around Chiplun and Khed are the results of rapid industrialisation, although on a moderate scale. Regions which are less encroached upon by human beings are still preserving forests in appreciable amounts. Felling of the trees has been on the rise in the last few years due to these factors in the central hilly zone. The plain areas in the central zone, have been brought under cultivation extensively.

As mentioned earlier, Bombay-Goa national highway running across the area, is serving as a better mode of transportation.

Table No.1

Table showing % of forested area in major terrain zones

Density	Lateritic Areas	Central hilly region	Western Ghat
Barren/or cleared with scattered trees (Occasional) Less than 25%	36.17%	00.32%	01.51%
	28.91%	96.25%	55.72%
26 - 50%	12.50%	01.29%	15.46%
51 - 75%	11.92%	01.56%	02.62%
More than 75%	10.50%	00.58%	24.62%

However, it has encouraged the illegal cutting and selling of wood and collection of forest products and their sale in the cities.

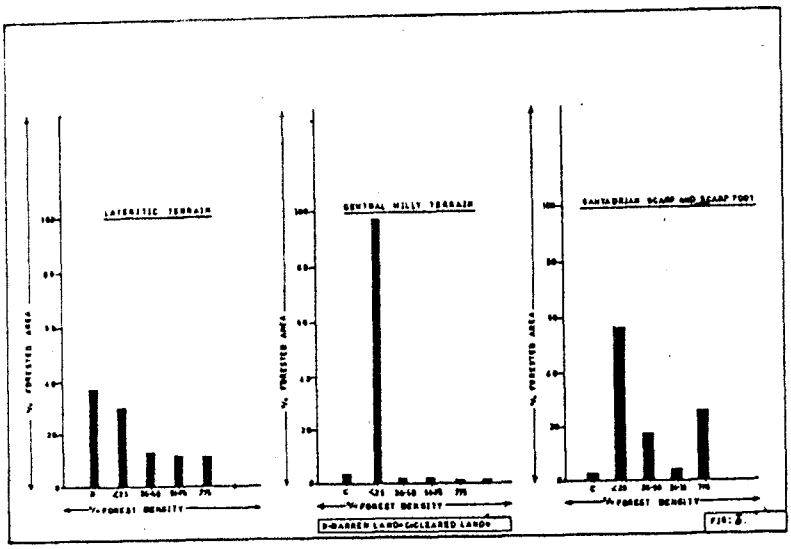
The thick forests in the central zone are retained on the hill tops and slopes in isolated patches surrounded by barren lands. In the western lateritic areas, thick forest with a density of more than 75% occurs on the margins of the plateaux and in some cases at the foot of the hills. In the lateritic areas, the thick forest cover about 10.50% of the area and they consist mainly of teak. The growth of trees is stunted due to laterite which does not allow root penetration deep into the earth. Furthermore the lateritic soils are poor in plant nutrients and hence do not support thick vegetation. Due to absence of well developed soil profiles and hardening of crust, the forest density is negligible, although the climate in the zone is favourable for a thick growth of vegetation. Though the Western Ghat region shows maximum area under thick forests (density more than 75%) are compared with the central hilly and Western lateritic regions, in the Ghat zone itself most of the area (55.72%) has a forest cover with a density of less than 23%. This is again a result of frequent forest fires and reckless cutting of trees for fuel wood. The western slopes of the Ghats with an altitude ranging between 600 and 1100 metres are very steep. All over the region a slope component could be found at an altitude of 1050 metres ASL. The climate is such that the soils have low temperature and have more moisture. This moisture is available to plants for most of the dry season of the year. The thick growth of the forest in this part is a result of low relative temperature in winter, high humidity in monsoons, and high soil moisture in dry season. The lower hill slopes and valleys in this zone are the main areas of thick forest growth. This is obvious since the weathered material moves downslopes and gets accumulated in the valleys. The soils here are enriched from time to time by plant nutrients.

In the central hilly areas of the basin 96.25% of the sample area has a forest density of less than 25%. The amount of land totally cleared by tree felling is 1.51% in Ghat zones and only 0.32% in central hilly areas. The flat topped lateritic hills and lateritic surface do not support the growth of vegetation. Therefore most of the flat topped lateritic hills and plateaux in the western region are barren. Such barren areas account for 36.17% of the lateritic areas. Generally, the forests in the region are confined to lower sloped and hill tops which are relatively more inaccessible and away form the major settlements. Even here they occur in isolated patches.

ALTITUDINAL ZONATION OF THE FOREST TYPES :

The forest in the basin could be classified altitudinaly into the following four major groups (Fig. 3)

1) Evergreen hill forests
2) Semi evergreen forests



3) Moist deciduous and
4) Dry deciduous forests

This variation is basically a result of the altitude and consequent variation in rainfall. Detailed studies indicate that this variation is also a result of the amount of slope and dissection of the terrain. The steep hillslopes of Western Ghat are and elsewhere in the basin are not conducive to the growth of thick forests. Field observations suggest that the most favourable slopes in the eastern non-lateritic areas for the growth of thick forests is between 10° and 15° and 5° and 9° in the lateritic areas.

It was observed that the lower limit of evergreen forest in the area is roughly between 600 and 800 metres and that of semi evergreen form 300 to 500 metres and deciduous from the sea level to 200 metres ASL.

The pattern of zonation given above became apparent when the forest identification was made along the following transects in the west to east direction.

i) Anjarle to Makarandgad (17° 47'N)
ii) Dapoli to Rasalgad (17° 46'N)
iii) Khed to Mahimangad (17° 43'N)
iv) Shivkhurd to Vasota fort (17° 38'N)
v) Are to Dicholi (17° 30'N)

Although a variety of trees constitute these forests at different altitudinal levels, following tree types were identified as the dominant specie occurring in respective forest groups.

Forest Group	Dominant Trees
1) Evergreen	i) Jambul *(Eugenia jam bolana)* ii) Anjan *(Hardwickia Binnata)*
2) Semievergreen	i) Mango *(Mangifera Indica)* ii) Anjan *(Hardwickia Binnata)*
3) Deciduous	i) Teak *(Tectona Grandis)* ii) Khair *(Acacia Catchu)* iii) Mango *(Mangifera Indica)* iv) Ain *(Terminalia Tomentosa)* v) Arjun *(Terminalia arjuna)* vi) Karwanda *(Carissa Carandas)*

COASTAL FORESTS :

The area immediately adjacent to the Vashishthi creek is characterised by numerous funnel-shaped estuaries. These sheltered, shallow inlets are most favourable for the growth of mangrove forests. The high density and distribution of mangrove swamps along the tidal creek is basically the result of saline soil conditions prevailing in these inlets.

The density of mangroves, as a rule, goes on decreasing inland. Although the tidal water penetrates upto a distance of about 38 km. inland, the frequent input of transported soils, leaf litter and to the fresh water estuarine areas inhibits the growth of mangrove swamps in the estuaries located inland.

Mangroves in the area are the mud flat halophytes, of the semi evergreen type. The thick mangroves along the Vashishthi creek are effective natural sand binders. These forests occupying salt or brackish part of the estuaries, however, are being destroyed to a last extent. The mangrove trees in the area are mainly used as a fuel wood.

The Common varieties of mangroves which grow in the estuaries along Vashishthi creek are given below :

1) Rhizophora Mucronata
2) Aegialitis
3) Acrotochun Aureum and
4) Kendelia rheedoi

Since the mangrove forests filter surface water run off on the kharlands, they help in the accumulation of rich nutrients on such lands. These forests can also act as an effective barrier to the wind and tidal waves. Mangrove forests are known to provide shelter to the sea life like prawns and fishes. Their use, therefore, in the areas of sandy-clayey substratum where coastal erosion is strong, is unparalled. The increasing proctise of mangrove cutting in the basin is indirectly helping the process of coastal erosion and is hampering the process of natural land reclamation. The protection of creek and estuary banks from erosion can only be achieved by mangrove restoration in the area. There appears to be a basic need to develop mangrove forest along the creek.

The Government of Maharashtra has undertaken a kharland development scheme, all along the western coast of Maharashtra. The report of the kharland development programme committee suggests that, the alignment of the kharland bund's may be decided by taking the advantage of mangroves and bunds may be constructed well inside (About 30 m from mangrove forests) so that mangrove vegetation can serve as a protective barrier to the bunds. Fig.4 shows the alignment of Kharland bunds in an area near the confluence of Jagbudi and Vashishthi, where the Kharland Development scheme has been completed. The maps depicting the location of these sites was prepared from the aerial photograph of the region.

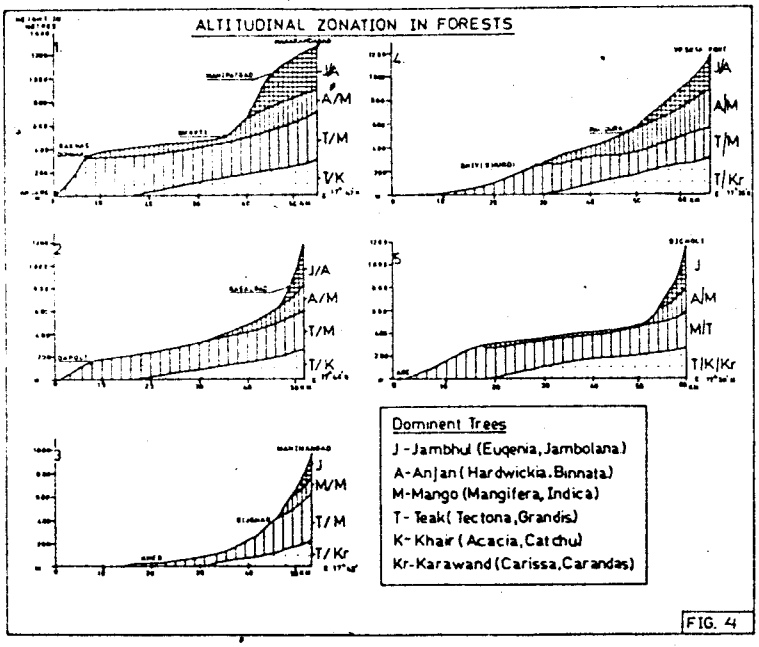
Many of the incomplete ongoing Kharland Schemes should be completed by taking advantage of these mangrove barriers.

DISSECTION OF THE TERRAIN AND THE DENSITY OF FORESTS :

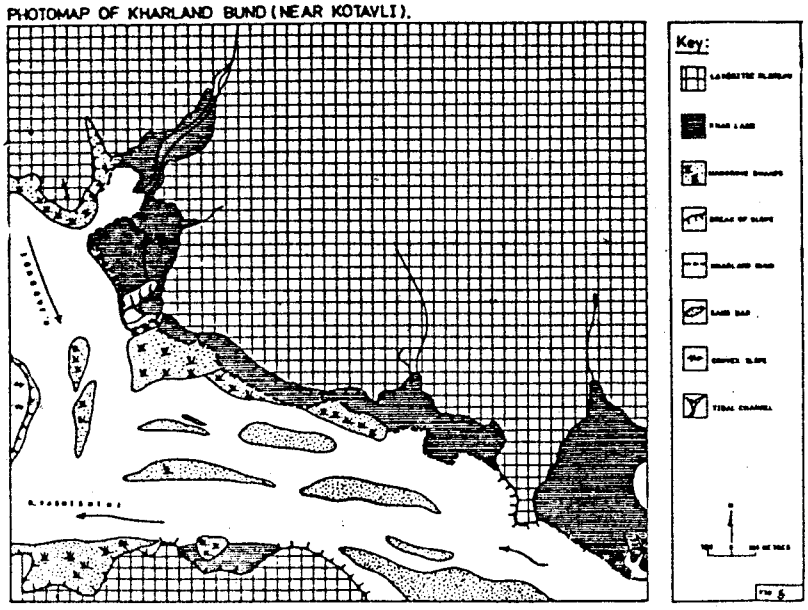
Fig. 5 is a dissection map of the basin. It can be seen from this map and the forests density map that the areas of high forest density are the areas of higher dissection. Although the correlation is not always very strong. The forest density is over 70% in the areas where the dissection of the land is more than 70%. These areas are not favourable for the cultivation and hence the forest in these areas is more dense.

Areas with the dissection of less than 30%, show a low percentage of forested area. This is due to the gentle slopes favouring agriculture.

Areas with less then 10% dissection are covered by laterites. Due to the resistance of laterites to the erosion, the interfluves and the hilltops in the lateritic area have remained intact. Even the footslopes and valleys are covered with detrital laterites. This situation has resulted in the lower dissection of the land.



PHOTOMAP OF KHARLAND BUND (NEAR KOTAVLI).



Density of the forest in lateritic areas is very low (<10%). The forested patches occupy moderately sloping valley sides only.

FOREST RESOURCE MANAGEMENT :

Forest is the most important resource of the said basin and is presently subjected to severe destruction and degradation. The effects of forest destruction in the catchment of Vashishthi are many fold. The severe soil erosion, recurring floods, siltation of Vashishthi creek and its estuaries are some of the most dangerous effects of forests degradation in the area.

A meaningful management of forests in the basin area requires a thorough knowledge of forest ecosystem.

The different biological processes in forest ecosystem are mainly governed by topographic, geologic and climatic variables. A unique forest system is developed as a result of these variables. The area under study is an area of Tropical forests comprising wet evergreen, semi evergreen, moist deciduous, dry deciduous forests and littoral swamps.

Removal of vegetation from a stretch of land leads to the destruction of soil surface through change in micro climates, run-off and leaching. Although this situation is now clear to the local people and government authorities, the forest management and management decisions do not reflect the needed awareness.

It is high time that the people and the government understand the principles of forest ecology and know that (1) The ecological stability of these forests heavily depends on the biological diversity of the plant species and (2) Large scale practices of monoculture upset the ecological equilibrium and lead to outbreak of pests and diseases.

In many areas of the basin, especially in the western lateritic regions the plantation programme is focused on one or two aspects viz. cashewnuts and mangoes. The forest maintenance is a completely neglected aspect. The stress is on immediate benefits from forests and forests produces rather than on the purposeful utilisation of the resources.

The terrain of said basin is dominated by hills and steeply sloping western wall of the Sahyadris. Lateritic hillocks are very common in the western part of area. These dominant landscape components have created local microclimates. Along the western slopes and in the coastal areas rainfall is as high as 3000 mm and extends for more than 4 to 5 months of the year. Humidity is also high and temperature fluctuations are much less. Due to humid tropical climate and geological stability of the region the area of the basin has rich biotic communities. The complex topography with a wide range of microclimatic and soil conditions have resulted in a diversification and association of plant communities. Therefore from the point of view of environmental conservation their importance cannot be overlooked.

The cultivation on the hilly and undulating central part of the basin, as well as the eastern hilly tracts depends mainly on the stream flow through Vashishthi, Jagbudi and their tributaries. The coastal zone with acidic alluvial soils and saline subsoils growing coconuts and paddy need regular fresh water supply. Therefore the construction of irrigation dams of different places is very essential for the economic development of the region.

The area submerged under such major and minor dams are not significant, but they have definitely affected the ecological balance due to the submergence of some local forests.

The forests in the Sahyadrian foot hill zones are more intensively cut along with the forests around major urban settlements like Chiplun, Khed and Dapoli. Most of the forests on the Western Ghat slopes are of tropical evergreen type mostly consisting of softwood species. The teak bearing deciduous forests of the foot hills and lateritic areas consist of commercial hardwood species. These, are being rapidly overexploited. The construction of roads in the Ghat area have increased the access to these forests.

Forested hilly areas, elsewhere in the basin under individual ownerships are being used for intensive agriculture. Soil erosion in such hilly tracts is severe and uncontrolled.

The topography, climate and biotic systems in combination have made the area potentially very valuable. But the reckless cutting of trees and sale of forest products to nearby cities have made the region more and more barren and devoid of this valuable resource. Increasing reduction in the number of trees in the Western Ghat region and the decreasing coverage of grass in the central hilly forests area the major effects of forest degradation in the area. It is likely that a significant imbalance in the ecosystem will be caused in near future due to rapidly diminishing trees alongwith the grasses, shrubs and other vegetation.

Present study indicates following major causes of forest degradation in the area -
(i) The changing landuse pattern, due to construction of roads, dams and industries near the cities.
(ii) Development of gullies and increased hill slope erosion due to tree felling activities.
(iii) Increasing practice of cattle grazing in central hilly region.
(iv) Increasing demand for land suitable for agriculture.
(v)Developed techniques of terracing of hill slopes.
(vi) Large scale practices of monoculture particularly in the western lateritic areas.
(vii) Destruction of teak forest in lateritic areas.
(viii) Excessive use of mangrove trees as a fuel wood.

Afforestation is therefore very essential to increase the population of trees and maintain the ecological balance of the forests. A new variety of grasses and fodder crops may be introduced. Certain patches of grasslands may be kept protected seasonally, so as to avoid simultaneous use of grasslands. This will ensure the grass growth in specific planned areas. The illegal tree felling should be checked and the monoculture practices should be controlled. A meaningful management and the maintenance of forests can only protect this valuable natural resource of the said basin.

ACKNOWLEDGMENT:

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