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STUDY OF ENVIRONMENTAL ASPECTS OF SHASTRI RIVER BASIN – A NORTHERN PART OF KONKAN COASTAL TRACT OF RATNAGIRI DISTRICT, MAHARASHTRA.

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ABSTRACT

The West Coast of India (WCI) has attracted the attention of many geo-scientists, due to its neo-tectonic set up, continuing seismic activities, sea-level changes and due to environmental aspects. The Konkan Coastal Belt (KCB) of Maharashtra is traversed by eighteen major and thirty-six minor west flowing perennial rivers originated in the Western Ghats. The study area represents microcosm of the most imposing and extremely threatened topographic, floristic and faunistic features. It has diverse and sensitive eco-systems ranging from tropical evergreen forest to estuarine and mangroves type. Most of the part of Konkan is blessed with outstanding scenic beauty and pristine environmental conditions. From the satellite imageries studies, followed by the field investigations, it has been observed that the study area i.e. Shastri River Basin (SRB), which is a part of konkan, experiencing environmental degradation through anthropogenic activities. It is therefore, decided to carry out the studies related with environmental aspects of SRB. It includes various aspects of the impacts with emphasis on the environmental and ecological consequences of different man-made activities.

KEYWORDS :ecological, environ-mental degradation, estuarine, konkan, neo-tectonic.

I.INTRODUCTION

Coastal environment is active, dynamic and transitional in nature. It is characterized by the interplay of continental and marine environments. Geo-morphologically, the Deccan Volcanic Province (DVP) in the western part of Maharashtra has been divided into two major geomorphic units viz. the low land Konkan plain and the Sahyadri Upland region (Kale, 2000). The narrow strip of DVP lies between the Arabian sea and inland up to the base of Sahyadri Escarpment. It is known as 'Konkan plain'. The KCB is traversed by west flowing perennial rivers originated in the Western Ghats. The Coastal tract of Maharashtra has been studied by many geo-scientists with respect to geology, geo-

morphology, tectonics and heavy mineral beach deposits (Powar, et. al., 1978, 1993; Sawant, P. T., 1980; Kale and Rajguru, 1985; Sukhtankar, R. K., 1989; Talwani, M. and Reif, C. 1998; Joshi et. al. 2012 and Dikshit, V. M. 2014). It has been observed that the study area is subjected to environmental degradation and effects of landslides. It is therefore, decided to determine various aspects, impacts of environmental and ecological consequences of different man-made activities within Shastri River Basin with the help of satellite imageries, Digital Elevation Model (DEM) followed by the field studies.

II. GEOLOGY

The area selected for the present study is a Shastri River Basin (SRB), lies in the West Coast of Maharashtra, (lat. 16^0, 57' N; long. 73^0,15 'E and lat. 17^0, 30' N; long. 73^0, 50' E) (Fig. 1a & 1b). It covers an area of about 2098 Km^2 and included in the Survey of India (SOI) topographic sheet Nos. 47 G/3, G/4, G/7, G/8, G/11, G/12 and 47 H/9. The important places of tourist's interest are Marleshwar temple, Jaigarh fort, Prachitgarh fort, hot springs of Tural and Aravali. In the area under investigation, Deccan basalt lava flows belonging to Diveghat and Purandargarh formations are mainly exposed along river valleys, valley sides and near shore. Most of the basaltic flows are capped by laterite. The Quaternary sediments are exposed along the banks of Shastri river and its tributaries (GSI, 2001). The detailed geological map of the area is compiled (Fig. 2) through field mapping using GPS and remote sensing data in the form of a FCC of 124 bands.

III .METHODOLOGY

The studies involve understanding of the environmental aspects viz. landscape, forest types and biodiversity, changes in land use and land cover patterns, landslides within SRB, using satellite imageries, DEM , topographic sheets, Arc GIS software followed by extensive field work .

3.1 ENVIRONMENTAL ASPECTS OF SHASTRI RIVER BASIN

3.1.1 Landscape

The study area lies within a triple junction of Koyana- Kurduwadi Lineament (KKL), West Coast Fault (WCF), and Panvel Flexure (PF) (Fig. 3). It is considered as one of the seismically active belt in the Indian shield (Murthy, 2002). The area is characterized by sloping topography, presence of shear zones, which accelerate rain-splash erosion, sheet erosion as well as gully erosion promoting the degradation of land. The agriculture fields without crops, railway and road cuttings, naked hill slopes are the areas of pronounced erosion. The region shows isolated patches of evergreen and semi-evergreen forest, experiencing an average rainfall of 3000 mm. The main hill range is about 10 to 20 km wide. The escarpment meets the coastal-plains abruptly in the west. The varied landscape elements, the sea-shore, the coastal-plains and estuarine eco-systems contrast sharply with the hill and forests of the Ghats. It lies adjacent to each other and are separated by a narrow distinctive ecotone. Ecologically sensitive landscape elements are viz. steep western escarpments that overlook the coastal plains, the river valleys and coastal estuaries. The geomorphology of the region is shaped due to the tectonic activity of the Peninsular India under the lithologial, structural and climatic controls. These factors along with basalt flows together have shaped the characteristic biodiversity of the regions. The area of investigation being very eco-sensitive, have been undergoing tremendous destruction due to man's interference.

3.1.2 Forests and Biodiversity

According to Champion and Seth (1968), the present study area is characterized by the

presence of bio-diversity in the form of high altitude evergreen forests (> 900 m) towards crest and deciduous forest towards coast. The red lateritic-soils at high altitude, support small relict patches of a special form of forest, consisting of Syzygium cumini (Jambhul / Jamun), *Actinodaphnae sp.* (Pisa), Mangifera indica (Mango) and *Memecylon sp.* (Anjan) (Plate 1). The forests present at low levels i.e. along the depressions and river courses, create a mosaic, with the dome-shaped hilltops, which are covered by open grasslands. The main watercourse includes forest patches with vegetation. The giant trees of the valley forests with the grassy slopes and crags that form vertical rock faces, which are devoid of plant cover. These valley forests are extremely dense.

The SW monsoon rains influence the area of investigation. According to Mayers, et. al. (2000), it is one of the globally recognized biodiversity hot spots of India. It harbours, diverse and sensitive eco-systems ranging from evergreen, semi-evergreen moist, dry deciduous, sub-tropical forest to estuaries and mangrove forest. The grasslands atop the lateritic hills and the forest along the slopes are both climax ecosystem and are important in maintaining the ecological conditions. The highly diverse mangrove forest patches along estuaries and other plantations are the most important components of the area and forms an important part of biodiversity.

Mangroves are part of tropical ecosystem found along the interface of land and water. It is present along the inter-tidal zones, backwaters. They are specialized salt tolerant plants. The patches of mangroves have been located in the close proximity near the Thermal Power Plant of Jaigarh. It is also extended inland along the estuary at Saitvade (17^0 17' N, 73^0 17' E), Kasari (17^0 16' N, 73^0 15'E), Jambhari (17^0 14' N, 73^0 18' E), Agarnaral (17^0 N 13' , 73^0 20' E). The main species are *Sonneratia alba, Sonneratia apetala, Rhizophora apiculata*. The mangrove cover in the area, has found to be reduced due to anthropogenic activities through urbanization and industrialization.

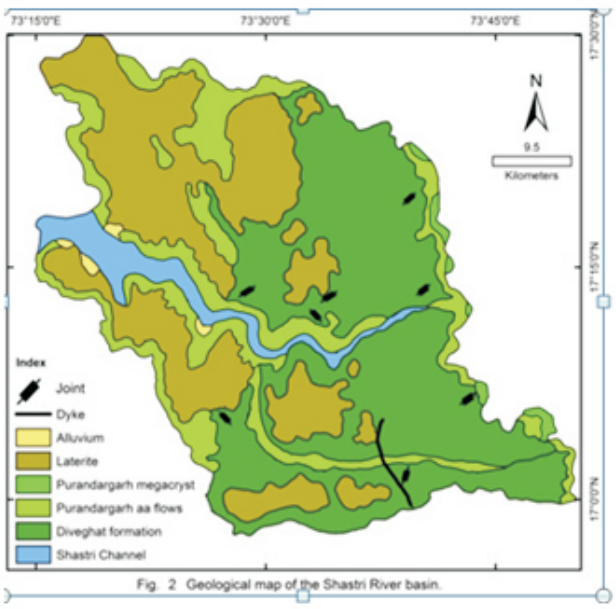

Fig. 2 Geological map of the Shastri River basin.

Fig. 1a Location Map of the Area

Fig. 1b Google Image of the Shastri River Basin

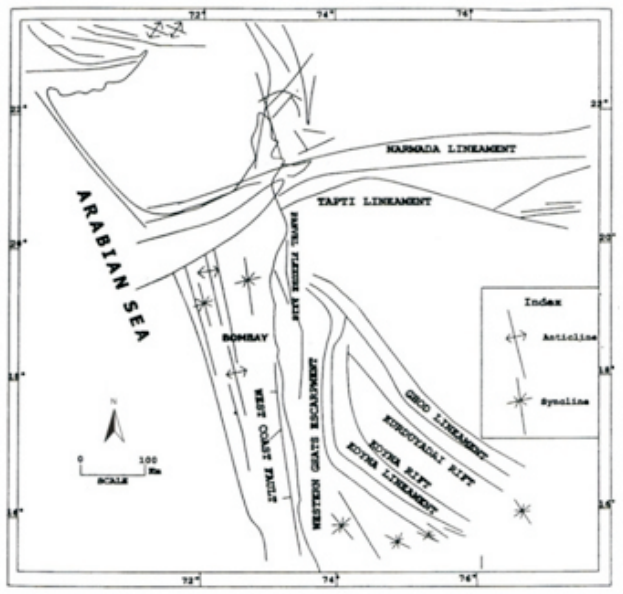

Fig. 3 Regional Tectonic Map of West Coast of India (Powar, 1993)

3.2 Land use and Land cover studies

The land use and land cover pattern of a region is an outcome of natural and socio-economic factors and is very important in current strategies for managing natural resources and for monitoring environmental changes. Land use/ Land cover changes involve the modification, either direct or indirect, of natural habitats and their impact on the ecology of the area. To understand the global, physical processes, affecting the earth in the form of LU/LC changes, remote sensing is found to be an important tool (Hudak and Wessman, 1998). The present study area has witnessed remarkable expansion, growth and developmental activities such as construction of roads, railway tracks (Konkan railway), thermal power stations, dams, harbours, buildings along with other anthropogenic activities. It is therefore, aimed to construct LU/LC maps of the area by using satellite imageries and GIS software to determine the trend, nature, rate, location and magnitude of land use, land cover change of SRB. These studies have been carried out to understand the environmental degradation (Fig. 4 & 5). During the present study, six land use and land cover (LU/LC) classes were established. They are viz. water, agriculture, forest, built up, wasteland and alluvium.

The LU/LC changes were estimated between 2008 and 2013. The statistical results of LU/LC and changes observed in terms of percentage and area have been given in Tables 1 to 3. The total basin area of SRB is approximately 2098 km^2. During the year 2008 and 2013, it is observed that there is no change in land use/land cover over the area of 1916 km2 in the basin. It covers about 91.33% of the total area. It is also observed that more than 80 km^2 (3.81%) of the forest area is converted to wasteland within a period of 5 years. This is the significant change in land-use practices. The total forest cover is continuously degraded and transformed into various land use/land cover category. The area is also experiencing number of anthropogenic activities. The degradation of the eco-system in study area, is due to the constructional activities in the erection of a huge dam, across the Gad tributary near village Kuchambe (17^0 17' N 73^0 38'E) (Plate 2), the constructions of roads (Plate 3), bridges (Plate 4), tunnels (Plate 5), rail tracks (Plate 6), construction of thermal power station (1200 MW Coal based TPP) at Jaigarh, (17^0 17' N, 73^0 13' E) (Plate 7), deforestation for International harbor (20 million tones

cargo/year near Tavsal, (17^0 17'N, 73^0 15'E) (Plate 8). The present exploratory study has clearly indicated that an integrated approach is warranted to protect the eco-system and natural land resource management of the region, in view of its rich bio-diversity and unique ecosystem.

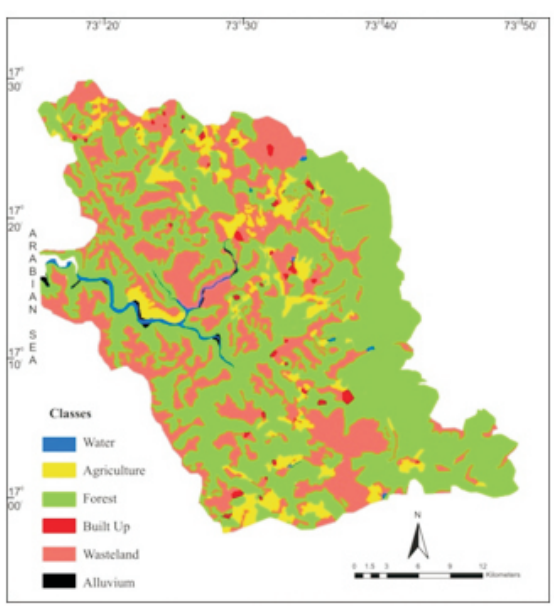

Fig. 4: Landuse / Landcover Map of Shastri River Basin (Based on Satellite Imageries –March 2008)

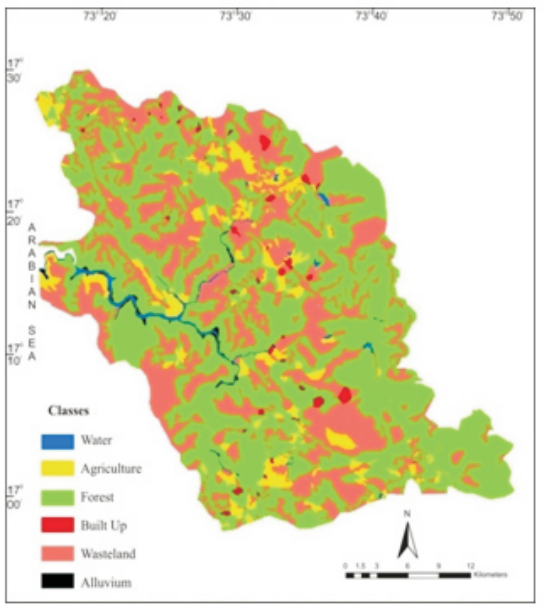

Fig. 5 Landuse / Landcover Map of Shastri River Basin (Based on Satellite Imageries – June 2013)

Table 1: Land Cover Classes of Shastri River Basin (June, 2008)

Sr. No.	Class Name	Area in Sq. Km.	Area in %
1	Water	20.50	0.98
2	Agriculture	156.00	7.44
3	Forest	1190.00	56.72
4	Built Up	16.50	0.79
5	Wasteland	710.00	33.84
6	Alluvium	5.00	0.24
Total		**2098.00**	**100.00**

Table 2: Land Cover Classes of Shastri River Basin (March, 2013)

Sr. No.	Class Name	Area in Sq. Km.	Area in %
1	Water	24.30	1.16
2	Agriculture	145.00	6.91
3	Forest	1110.00	52.91
4	Built Up	19.70	0.94
5	Wasteland	792.00	37.75
6	Alluvium	7.00	0.33
Total		**2098.00**	**100.00**

Table 3: Changes in LU/LC of Shastri River Basin (in %)

Sr. No.	Class Name	Area in %		Change in %
		2008	2013	
1	Water	0.98	1.16	0.18
2	Agriculture	7.44	6.91	-0.52
3	Forest	56.72	52.91	-3.81
4	Built Up	0.79	0.94	0.15
5	Wasteland	33.84	37.75	3.91
6	Alluvium	0.24	0.33	0.10

3.3 Landslide studies

Landslides are the natural processes, which occur and recur in specific geo-environmental conditions (Varnes, 1978). The studies have indicated that the various geo-systems like lithology, lineaments, geo-morphology, slope, land use / land cover etc. occur in different combinations, assign differing landslide vulnerability grades and hence the different provinces respond differentially to landslides. The susceptibility of the slopes for landslides can be influenced by land use and land cover changes, caused due to natural or man-made activities (Diaz, et. al, 2005). The present studies haves been carried out by using topographic sheets, satellite imageries (IRS-R2 LISS III (March, 2013), DEM, IDRISI 3 software for image raster analysis and Arc GIS software for vector analysis. It is followed by an intense fieldwork in order to delineate landslide vulnerable zones and to understand causative factors. The map showing landslide vulnerability zones (LVZ) is prepared and validated (Fig. 6). This was done by superimposing the landslide inventory layer over the final integrated GIS layer i.e. on landslide vulnerability map. From the above investigations, it can be concluded that about 29% of the area forms the highly vulnerable zone for land sliding (Plate 9).

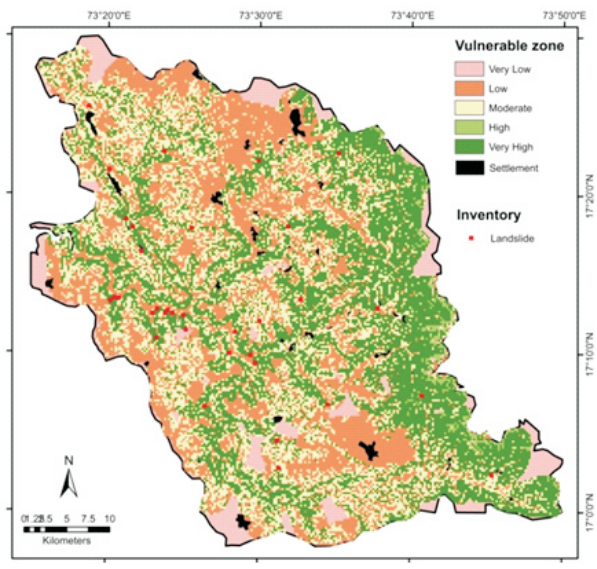

Fig. 6: Landslide Vulnerable Zone (LVZ) Map of Shastri River Basin

3.4 CONCLUSIONS

The studies of satellite imageries, DEM, followed by the field investigations indicated that the Shastri River Basin has been subjected to environmental degradation by various anthropogenic and

landslide activities. The region represents ecologically sensitive landscape area, which forms an eastern part of Sahyadri range. It is one of the globally recognized biodiversity hot spots of India and forms a part of Ecologically Sensitive Area (ESA) due to the presence of endangered bio-species, specialized ecosystems, sacred groves, undulating topography with steep slopes and river and tributaries originating at high altitudes. The region is facing remarkable expansion, growth and developmental activities in the form of construction of roads, railway tracks (Konkan railway), thermal power stations, dams, ports, stone crushing units, buildings etc. along with the other anthropogenic activities responsible for environmental degradation. The development due to impact of population cannot be controlled as well stopped but its effect on environment can be minimized by adapting measures like conservation of dense forest, adapting social forestry, developments in barren land, controlling the land sliding phenomenon etc.

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Plate 1: Vegetation on hill tops (Location – Manjre)

Plate 2: Pitching of a Dam (Location- Kuchambe)

Plate 3 : Construction of Road (Location – Marleshwar)

Plate 4: Construction of Bridge Across Shastri River (Location - Bhatgaon)

Plate 5: Construction of Railway Tunnel (Location – Karbude)

Plate 6: Alignment of Railway Track (Location – Sangmeshwar)

Plate 7: Thermal Power Plant Over Lateritic Terrain (Location – Jaigarh)

Plate 8: Deforestation for International Port Site (Location – Tavsal)

Plate 9: A Typical Debris Slide (Location – Asore)