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Contents

LANDUSE CHANGES DUE TO MINING ACTIVITY IN THE HILLY TERRAIN OF SIRMOUR DISTRICT, HIMACHAL PRADESH

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Abstract

One of the striking impact prevailing in the Sirmour district of Himachal Pradesh is the changes in the landuse pattern due to mining activities on limestone deposits. Statistical data on landuse pattern for nearly 25 years (1968 to 1994) indicate significant changes in landuse units especially after the initiation of mining operations during 1985. Fallow land has remarkably changed in response to the changes in the work culture i.e., from agriculture to mining. Decrease in pastureland and tree crops are in critical stages, which have direct impact on cattle population and economic returns of the district. Landuse map has been prepared from satellite data in a large scale for further management studies. Detailed mapping and analysis around intensive mining areas show the present status of impacts on landuse due to mining and forms a data set to design a best landuse planning for the future.

Introduction

Mining activities cause significant changes in landuse pattern, thereby resulting in geomorphological modifications. Due to this, one can witness a chain of impacts in the sourrounding environment (Loveson and Dhar, 1995). This type of impact is still more significant and severe in the case of hill mining areas (Banerjee, 1993; Loveson *et al.* 1996). A proper management plan would minimise such adverse impacts on land system, which necessarily based on the landuse assessment. It has been always desired to design best post-mining landuse before initiation of any mining activities.

Sirmour district has number of small-scale mines in limestone deposits belonging to Krol formation of Permo-Carboniferous Period (Auden, 1934). The ban of limestone mining Dehra Dun areas was the main reason for intensive mining in the nearby Sirmour district of Himachal Pradesh's, the state's major limestone belt.

In the Sirmour district, agriculture, cattle and horticulture are dominating activities. Landuse assessment has been attempted to evaluate adverse impact on the above factors relevant to agriculture land, pastureland and tree crop plantation respectively. One of the other striking problems prevailing in the district is the land damage due to mining activities. One can witness such damages in land in multiple dimensions. In order to assess and evaluate such

damages, much importance has been given in this paper to landuse analysis, which reflects the land set up and people's choice of usages in the district.

The Study Area

Sirmour district is in the southern part of the Himachal Pradesh state, spreading over 2,825 km^2. The district lies in the outer Himalayan ranges, commonly called as Siwalik range between 77°01'12" and 77°49'40" East longitudes and 30°22'30" and 31°01'20" North latitudes and is predominantly a mountainous terrain with deep valleys lying between ranges of varying elevations. It is bounded on the north by Simla district, on the south and west by Ambala district of Hariyana and on the east by Deradun district of Uttar Pradesh (Fig. 1). As the elevation varies 560 m to 2068 m above MSL; climate changes from exceedingly hot in the southern part to snowy heights of the northern hills. Average annual rainfall is 1104.9 mm in 170 to 180 days of rainfall.

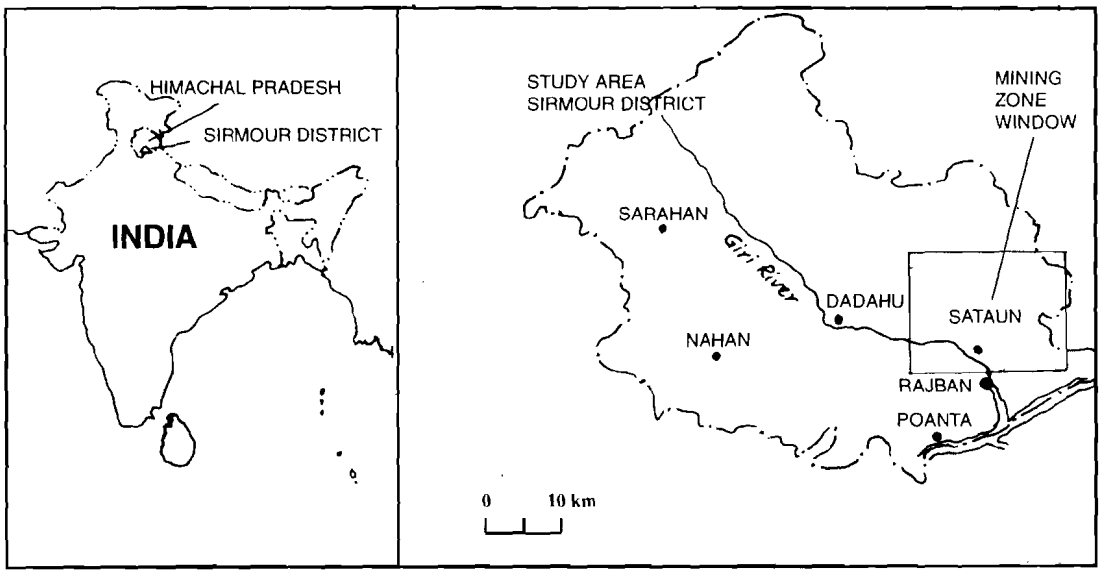

Fig. 1 : Location of the study area

Geomorphology

Geomorphologically, the entire terrain is dominated by structural hills. These hills vary in heights, and are provided with multi-directional ridge system. But main trend is observed as E-W direction. These structural hills display a tight fold system with prominent anticlines and

synclines. The area has anticlinal valleys and synclinal hills with steep slopes. Most of the val-leys are guided by structural elements and follow faults and lineaments. Major drainages such as the rivers Yamuna, Giri and Tons have influenced some fluvial landforms like river terraces, levees and narrow flood plains. Number of the places along the Giri River has witnessed the formation of river terraces of varying heights and it is a common feature even along other tributaries. Sataun area is located on a structural river terrace of about 100-200 m above the riverbed. Southern part of the district is with low lying hills and associated with a few denuded ridges. This is followed by shallow and buried sediments and rolling uplands towards the south.

Mining Scenario

Limestone is the major industrial mineral employed for various industrial purposes in the state. According to recent Geological Survey of India estimates (as on 1.4.90), proved category is about 1428.26 MT in the state with probable and possible estimates in order of 39.46 MT and 2135.48 MT respectively. Altogether, it is estimated that total of about 3603.2 MT of limestone is available in the state.

Sirmour is one of the districts in the state where limestone mining is being done extensively. More than 50 per cent of the state limestone production is achieved in Sirmour limestone areas.

Until early 80's there were merely six quarries in the district apart from those owned by Cement Corporation of India. But the ban on mining in Dehra Dun in 1985 and the decontrol of cement marketing in 1986 boosted mining in this belt. Number of leases were sanctioned during 1980 to1986, as a result, about 82 leases of limestone, barytes and gypsum were in operational status. After the cancellation of about 17 leases, 65 leases are now in operation (as on 1995) covering about 1228.77 hectare area which is of 0.434 per cent of total area of the district. At present more than an estimated 800,000 tonnes of limestone are being produced from Sirmour every year, part of it illegally.

Methods and Materials

In order to prepare landuse maps, satellite images (1:250,000, 1:125,000, 1:50,000) and aerial photographs (1:50,000) were widely used. Base maps have been prepared from topo-sheets of Survey of India. Notified forest boundary details have been transferred to base map from forest maps of Forest Survey of India. Aerial photographs have been interpreted using photo element keys like tone, size, shape, shade, associates etc., Satellite images have been interpreted using various interpretation keys. Pre-field land use maps have been prepared and field data were incorporated widely to substantiate the landuse maps. After the fieldworks in

different seasons, landuse maps have been updated. Based on this, previous year land use maps have also generated from earlier dated satellite data.

Land degradation maps have been prepared using satellite data with a view to demarcate landslide areas and damaged land due to mining. Present as well as past year scenarios have been generated and they have been used to understand the growth trend of damaged land due to mining during various years. In order to substantiate land use / land cover and land degradation mapping, other thematic maps such as drainage, drain-age density, tectonics, relief and forest maps have been also prepared. Change detection analysis has been attempted to assess the changing pattern in land use and trend in land degradation in the district.

Landuse Studies

As extensive mining is in progress in Sirmour district, one can observe prominent changes in the land use pattern in recent years. Mapping the changes in the landuse pattern would indicate the impacts due to mining on various categories of land units. This also helps to draw plans for future development. Detailed discussion on landuse pattern with reference to the entire dis-trict as well as mining zones is presented here. For the purpose of the present study, landuse details from 1968 to 1994 have been collected from District Authorities (District Statistical Abstract, 1968-94) and analysed. The results have been tabulated in Table 1.

According to the data during 1968, forestland occupies about 21.05 per cent. Agriculture is practised in about 18.77 per cent of total Sirmour district. Grazing land amounts to 28per cent with tree crops about 17 per cent. Barren land is about 3 per cent. It can be observed that about 86 per cent of the total areas was under various usages and only 14 per cent were under wasteland category.

When compared to baseline data of 1968, significant changes have been found in fallow land, grazing land, barren land and cultivable wasteland during 1994. All these directly have bearing on mining activities in this area (Table 2).

Change Detection Analysis

Changes in landuse pattern in the district have been analysed with the available data for about 25 years. There is an alarming increase in fallow land where as significant decrease in pastureland, tree crops, cultivable waste and barren lands. The marked changes have been noticed after mining activities. The following discussion support the above mentioned statement

Fallow Lands

Agriculture is one of the main occupations in the district. The status of fallow land in the

district shows a remarkable change from 1968 to 1994. The beginning of intensive mining during mid 80's has been well acknowledged in respect of changes in the work culture ie., from agriculture to mining. A significant increase is noticed from the given data. This is an alarming situation as far as the district is concerned. Other reasons such as low rainfall or diseases in the crops reported in this area earlier may be considered for this cause of changes. But, these significant changes have been noticed during 80's where intensive mining activities had started. This fact indicates that mining may be the prime cause, making local people to shift to mining work from native agricultural practices.

Table 1 : Area and changes in landuse pattern during 1968 and 1994

Sl. No.	Landuse Unit	1968 Area in '000 ha	1994 Area in '000 ha	Per cent to Total (1968)	Per cent to Total (1994)	Difference
1	Forest land	47.26	48.49	21.05	21.57	+0.52
2	Area sown	42.20	42.35	18.77	18.84	+0.07
3	Fallow land	2.56	13.14	1.24	5.86	+4.62
4	Grazing land	63.85	60.68	28.08	26.99	-1.09
5	Tree crops	38.18	36.96	16.98	16.44	-0.54
6	Area not available/ suitable for agriculture	9.08	10.01	4.24	4.45	+0.21
7	Cultivable waste	14.83	7.66	6.60	3.42	-3.18
8	Barren land	6.83	5.46	3.04	2.43	-0.61
	Total	224.79	224.75	100.00	100.00	—

Pasture Land

Besides agriculture, animal husbandry is an important occupation in the area. But the available data indicates decreasing trend in pasture land in the district. More or less a stable status is observed upto 70's with little variation. But, a sharp decline is recorded in 80's when more mining activi-ties have started. During the 90's, the status of grazing land is at an alarming level. This situation needs to be taken care of as grazing land is one of the important factor to support cattle population of the area.

Tree Crops

Tree crops have maintained the status as that of the 1960's and 1970's though a significant fall has occurred in the 1980's. Since, people are opting for mining works as they gain appreciable economy, the tree crop plantation may sharply decreased. This has warranted an immediate step to encourage the plantation especially fruit plants as these were once popular in this area.

Cultivable Waste

Cultivable wasteland is another one category which is de-clining to around 7000 ha during 1994 from 15000 ha during 1968. Especially, during 80's, the decline status is so sharp which acknowledge the intensive mining practices.

For the purpose of the further study, landuse data of three years have been considered. They are as follows :

- During non-mining period (1968)
- Beginning of Intensive mining period (1986)
- Recent Period (1994)
- During mid 80's, the mining activity has picked up with appreciable momentum and during that period, number of mine leases were approved. Comparative data for above mentioned periods are given in Table 2.

Table 2: Statistics of landuse categories for selected periods (in per cent)

Sl. No	Landuse unit	Area during 1968	Changes in 1986	Changes in 1994
1	Forest land	21.05	0.64	0.52
2	Area shown	18.77	0.41	0.07
3	Fallow land	1.24	4.54	4.62
4	Grazing land	28.08	0.22	-1.09
5	Tree crops	16.98	-1.29	-0.54
6	Area not avail able/ suitable for agriculture	4.24	-0.05	-0.21
7	Cultivable waste	6.60	-3.37	-3.18
8	Barren land	3.04	-1.10	-0.61

No appreciable changes are noticed in forest and agricultur-al lands. There was a surprising rise in fallow land from 2560 ha to 12980 ha. This is about 4.62 per cent rise in the total district area coverage. This fact is well supported by the de-creasing trend in barren land, cultivable waste land and other wastelands. It is seen that most of the mining operation are being practised in the wastelands which is a positive impact due to mining, in this area. It is also worth the while to mention that there is a remarkable decrease in grazing land and tree crops to the tune of 990 and 2880 ha. respectively. Table 3 shows the net usages of land for different purposes.

Table 3 : Percentage changes in various categories in Sirmour district

Category	1968	1986	1994
Land under various uses	84.88	84.79	83.84
Fallow land	1.24	5.78	5.86
Wasteland	13.88	9.43	10.30
Total	100.00	100.00	100.00

For the purpose of the calculation of the above details, categories such as cultivable waste, areas not suitable for agriculture and barren land were grouped into wastelands. It is assessed that area of wasteland coverage attained 10.30 per cent from 13.88 per cent to the total of the Sirmour district during 1968 to 1994. In some of the steep areas, limestone terrain is not supporting vegetation, resulting in wasteland (barren type). Some of the mines are located in such places. Using such wastelands for mining purpose may be viewed as one its positive impact, apart from socio-economic development of the area. But very alarming situation is the steeply increasing trend in fallow land. If fallow land and wastelands are put together, it shows on increase trend i.e., 15.12 per cent, 15.21 per cent and 16.16 per cent respec-tively with respect to the above mentioned periods. The analysis clearly shows the decreasing trend in areas under various useful categories like agriculture and grazing lands.

Landuse Studies from Satellites Images

According to the administrative records prepared out of conventional surveys, a broad classification of landuse catego-ries are in present usages. Still, the present classification lacks in minor details on sub-divisional categories. In order to fill up this gap, satellite data

are widely used, now-a-days. Owing to its capability of synoptivity, repetitive coverage and multi-spectral information, satellite images are much useful in preparing landuse maps during various seasons/years. In order to differentiate minor details and for effective practices of landuse mapping, generally, two season data i.e. Kharif and Rabi are essential and different categories of landuse units could be mapped out of them. Such exercise is not practicable in conven-tional surveys (i.e., two time survey per year), especially, for larger areas within short time of duration. In general, such surveys used to consume more time and man power for detailed studies. This difficulty would be overcome, if satellite images are used for landuse mapping purposes.

For the purpose of the present study, multi-date (1994-95) and multi-sensor satellite images have been utilised extensively along with aerial photographs. False Colour Composites (FCC) of Indian Remote Sensing Satellite (IRS-1B LISS I and LISS II Sensor Data) images and Landsat (TM Sensor data) images have been used. Satellite data in the form of photographic prints in various scales (1:250,000, 1:125,000 and 1:50,000) and as well as FCC positives (1:1 million scale) have been utilised.

Standard methodology as adopted for national level landuse mapping by National Remote Sensing Agency (NRSA), Department of Space, Hyderabad has been used, here.

Regional landuse map covering entire district has been prepared in 1:250,000 scale. For this purpose satellite data acquired during different seasons of 1994 were considered. In addition, landuse maps around mining zones as detailed maps have also been prepared from geo-coded satellite data acquired during 1994 and 1995. Table 4 provides more details on the area coverage by each category in the district.

Area under forest accounts for 52.85 per cent of the total district. categories include all type of forests such as government and private forests. For the purpose of the present study, all forest types like government and private etc., are categorised into three units viz., evergreen, deciduous and degraded forests. Evergreen forest and deciduous forest cover about 25.45 per cent whereas degraded forest accounts for 27.40 per cent. Area under cultivation occupies nearly 22.6 per cent of the total district in which about 15.78 per cent falls in double crop category. Settlement occupies around 0.2 per cent. Grazing land covers about 21.82 per cent. Industrial areas occupy about 0.12 per cent of land. Wasteland category includes about 5.86 sq.km of the area which is only 0.22 per cent of the total district. Mining is mapped only to 0.05 per cent ie., about 1.34 sq.km. Landslide area ac-counts about0.1 per cent which is about 2.76 sq.km in the total district area. Since the definition of landuse classes in case of conventional survey and image interpretation are quite different, a comparative analysis could not be made (Table 4).

In order to have a clear picture on degradation due to mining, a detailed study around

intensive mining zone located in the eastern part of the district has been attempted and is discussed as below.

Table 4 : Landuse details of Sirmour district (based on satellite data,1994)

Sl. No.	CATEGORY	AREA (in ha.)	per cent of Total Area
1	BUILT-UP LAND		
1.1	Built-up land	556.04	00.20
1.2	Industry	325.16	00.12
2	AGRICULTURAL LAND		
2.1	Agricultural land	16916.84	05.97
	Rabi	2915.25	01.03
	Double cropped area	44574.22	15.78
2.2	Fallow land	897.57	00.32
2.3	Plantation	862.38	00.31
3	FOREST LAND		
3.1	Evergreen/Semi-evergreen forest	44601.83	15.79
3.2	Deciduous forest	27302.15	09.66
3.3	Degraded forest or Scrub land	77413.12	27.40
3.4	Grassland	61654.09	21.82
4	WASTELAND		
4.1	Barren rocky	71.09	00.03
4.2	Steep slope	104.17	00.04
4.3	Mining	134.63	00.05
4.4	Landslide	276.22	00.10
5	WATER BODIES		
5.1	River/Stream	3895.24	01.38
	TOTAL	282500.00	100.00

Landuse Studies in the Mining Area

Extensive mining is being practised around Kamroo area of Sirmour district and following discussion is made only to this intensive mining zone. Number of operative mines are more in this area. Due to this, area under visible degradation is naturally more in these places. A study window has been marked out to study and assess landuse practices in these areas. Fig. 1 shows study window in the Sirmour district.

Total area of the Sirmour district is about 2825 sq.km. The study window around mining zone selected here covers about 187.96 sq.km i.e., 6.65 per cent of the total district area.

For the purpose of landuse mapping, geocoded satellite images acquired during Kharif (April/May 1994) and Rabi seasons (October 1994) have been considered. All landuse categories have been quantified and given in Table 5.

Table 5: Landuse categories around Kamroo mining zone

Sl. No.	Category	Area in ha.
1.	Built-up land	37.89
2.	Agricultural land	5060.23
3.	Forest land	8076.42
4.	Wasteland	5115.80
5.	Water bodies	181.89
6.	Others	323.77

Land Degradation Assessment

Based on the satellite data interpretation, about 1.29 km^2 falls under active mining areas. About 0.2 km^2 (about 16.13 per cent of 1.29 km^2) and nearly 0.67 km^2 (about 51.8 per cent of 1.29 km^2) were under utilisation for mining activities respectively from agricultural and forest areas. Details are presented in Table 6. Field study indicates that this part of agricultural lands were not much potential area and thus it is being used for the mining activity. Likewise, forest area mentioned here is entirely belonging to non-government parties and thus called private forest.

Table 6. Mining at various landuse categories around Kamroo mining zone

Sl.No.	Category	Area in Ha.	Percentage
1.	Agricultural land	20.88	16.13
2.	Forest land	67.05	51.80
3.	Land with/without scrub	41.51	32.07
	TOTAL	129.44	100.00

A comparative study has been made with 1994 satellite data interpretation with 1988 data (aerial photographs) analysis. The results are given in Table 7.

Table 7: Land degradation comparative analysis

Categories	1988	1994	Increase (ha)
Mining Area	28.81	129.44	100.63
Degradation due to Mining	43.13	70.49	27.36
Landslides	38.08	80.77	42.69
Total	110.02	280.70	170.68

Mining area has increased from 28.81 ha to 129.44 ha during 1988-94 period. Degraded land due to mining also increased to 70.49 ha from 43.13 ha. At the same time, natural landslides also increased and at least doubled the area affected by it during 1994 compared to 1988. It is not clear that the significant increase in landslide area is due to reactivation of nearby faults due to intensive mining activity in this area. A detailed study is warranted in this regard.

Conclusion

Analysis of data on landuse pattern for about 25 years (1968 to 1994) shows significant changes in the landuse practice in the Sirmour district. An alarming changes have been noticed in fallow land, pasture land and tree crops. Generally, agriculture, cattle and fruits are dominating activities in this district which have been affected appreciably. In order to facilitate sustainable planning, a detailed mapping has to be carried out especially in and around mining areas. This would substantiate the development planning by a way of designing a best landuse plan. It is suggested that the post-mining landuse plan should be prepared before any mining activity in any area, especially in the case of hill mining operations.

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TOWARDS SAVING PRECIOUS SOIL RESERVES : A PLANNING EXERCISE WITH LIMITED RESOURCES

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Abstract

The soil resources deserve a sort of care that is hardly dispensed with. Cardinal objective of the current exercise is to achieve a segmentation of the soils on the basis of their vulnerability to degradation. This in turn is translated into the amount of sediment it keeps producing that ultimately reaches the sink. The latter here is the terminal point of the watershed where the entire run-off coalesces. A small watershed—'Jaipanda'—situated in the Bankura district, West Bengal, India was selected as the area of study. Input layers like landuse / land cover, soil layer and microwatersheds layer are generated using IRS-1B satellite data. Supervised classification was done using IBM-RS-6000 with EASI/PACE software package to prepare landuse and soil layer. Two important parameters viz. slope and rainfall, although very important in abetting wearing of surface soils were be omitted owing to the relative isotropy of a small watershed with very gentle undulations. Suitable algorithm was designed to manipulate the input layers in GIS environment to create the desired output.

Introduction

Soil, the crucial life supporting system is often a subject of exploitation in developing countries, with little regard to its sustainable productivity. About 53 per cent of the soil resources of our country suffer from some kind of degradation. It is a fact that the demand of the burgeoning population can not be satiated by a concomitant hike of area of arable lands (Anonymous, 1984). Here comes the necessity for a sustainable device for utilisation of these precious resources. A thorough inventory and characterisation of the soils are paramount for a sustainable plan (Kellog, 1950). A sustainable land resources development strategy warrants appropriate investigation and mapping of soils followed up by the actual implementations to avert the degradation of these natural resources. This also indicates the nature of problems that can be tackled through various soil conservation and reclamation measures. Soil and landuse are two vital inputs layers for any planning process involving natural resources (Burley, 1971). In fact the soil, land at-tributes and the water resources together should dictate the kind of land use that would be sustainable. Soils being the nucleus of the natural resources call for enumeration and are to be mapped in a manner they deserve. No sustainable development can be thought of without a proper soil map.

In the face of the enormity of degradation problems and con-straint of resources, any scientific approach to land resources warrants a clear identification of critical areas for treatment. Prioritisation of areas into very high, high, medium, low and very low vulnerability helps in addressing the conservation efforts to secure maximum benefit. Watershed delineation and soil survey provide useful data on soils, terrain characteristics, landuse, and status of land cover and degradation profile. Sediment yield is the total sediment outflow from a catchment or drainage system that can be physically measured at certain points and at specific interval of time. The Silt Yield Index (SYI) methodology provides a scientific and pragmatic tool for such prioritisation of watersheds. Many sediment yield prediction models are avail-able and have been used for various studies. The total soil loss of an area is composed of sheet, rill, channel and gully erosion within the basin. The SYI model has found wide acceptance at national and international level (Anonymous, 1991). The methodology used here involves not only collection of data on the ground but employs other Satellite Remote Sensing data. A software package has been developed for automated delineation of priority micro-watershed in one watershed under study. The proposed algorithm takes microwatershed map, soil map and landuse map as inputs and enjoins these for decision making (Pal, 1998).

Study Area and Input Data

It was mooted that the study would be carried out on a geographical entity having a natural boundary. Thus Jaipanda river (a tributary of Silai River) watershed was selected for the study. A watershed is the unit of decentralisation chosen by Mother Nature. It is defined as the focus of those points from which runoff reaches the outlet of the stream. It is a geographical unit with a certain degree of uniformity. Even though the parameters alter, the variations within a certain watershed show a common trend. Further, a watershed is a limited, convenient, clearly defined and unambiguous topographic unit, available in a nested hierarchy of sizes on the basis of stream ordering. It can be taken as a basic erosional landscape elements where land and water resources interact in a perceptible manner (Sebastian *et al.*, 1995).

Jaipanda watershed is situated in the district of Bankura, West Bengal. It is located between 86°51'35" and 87°12'13" East longitudes, and 22°53'01" and 23°10'44" North latitudes. It occupies an area of 39,282 hectares approximately. The watershed is covered in Survey of India (SOI) 1:50,000-scale toposheet nos. 73M/4 and 73N/1. The watershed is drained by Jaipanda river having a general direction of flow from northwest to southeast. Optical satellite data IRS1B L-2 were used for the study. The data provides 36 m spatial resolution and is available at 4 narrow spectral bands with an on-board radiometry of 7 bit.

Method : Landuse / Land Cover

Remote sensing has been used as a tool to the maximum extent possible to generate these inputs that can be used by the watershed managers for sustainable development of watersheds. Landuse / land cover (lu/lc) output was generated using stratified approach to avoid the agriculture-forest spectral confusion. A landuse/ land cover classification system with 24 catego-ries (level-2) under 6 main categories (level-1) was used for generation of the classified output. The watershed has been mapped by digital technique using IBM RS-6000 systems with EASIPACE software at the Regional Remote Sensing Serv-ice Centre, Kharagpur. The framework of the classification system (Anderson, 1971), suitable to the requirements of Agroclimatic zonal planning and at the same time amenable to Remote Sensing was taken up for the present discussion. Landuse/land cover mapping using remotely sensed data needs careful planning of various activities. The following activities are particularly relevant to successful transformation of remotely sensed data into landuse categories (Pal *et al.* 1992).

- Collection of Remote Sensing (RS) data (cloud-free and of appropriate time)
- Collection and study of collateral data
- Geo-referencing
- Ground Truth collection
- Digital Processing & Post-classification verification
- Generation of output

It is absolutely important that before proceeding for digital processing the satellite data have to be georeferenced. Using the Survey of India (SOI) toposheets the input satellite data were geometrically corrected to impart proper planimetry (suit-able map projection-polyconic), uniform scale and orientation *vis-à-vis* the reference SOI topo-maps. Rabi season data were similarly rectified, except that the rectification was done with respect to the already rectified Kharif scene.

Non-forest areas were classified by digital classification of IRS L-2 data by supervised mode with maximum likelihood algorithm using necessary ground truth information, while the forests and the water bodies were segregated by density slicing of Normalised Difference Vegetation Index (NDVI) using appropriate field information. Round the year lu/lc outputs were generated by processing separately both Kharif (monsoon season) and Rabi (winter-post monsoon) seasons' satellite data and finally creating one aggregated output showing the agricultural information of both the seasons. Prior to aggregation, the individual lu/lc layer of either season was refined with reference to each other in order to eliminate any gross error

that might have crept in the individual season's output, using a software program that works in GIS mode.

Segmentation into Different Vulnerability Categories

The methodology essentially employs Satellite Remote Sensing data to unravel the landuse/ land cover, geomorphology and soils to arrive at the two vital inputs viz. `erosivity' (weightage) and the 'plausibility of the detached material to reach the sink' (delivery ratio). Also the pattern of rainfall, slope, shape, sizes and physiographic position of the microwatershed play a major role in deriving the weightage and delivery ratio. So the role of satellite images and the collateral data in the form of topographic sheets become vital. The area of each mapping unit in each microwatershed was com-puted developing suitable software. Current round the year landuse / land cover layer and the size of the micro-watersheds were used to condition the `weightage and delivery ratios' objectively in GIS mode. Using the weightage and delivery ratio the average silt-yield index were obtained for each microwatershed. Thus the software takes care that each and every microwatershed gets a quantitative priority value. The microwatersheds were arranged in the descending order of the silt-yield index values and graded in order of priority into 5 categories such as 'very high' (³ 1350), 'high' (1101-1349), 'medium' (901-1100), 'low' (701-900) and 'very low' (<701). Evidently the higher values of index suggests graver proneness to degradation. A map was generated for the watershed with these five categories to enable the watershed development planners to take up conservation measures in a phased manner.

Efforts were made to consider an area of 500-1000 hectares approximately for delineation of each microwatershed in the study area. This was done directly on the IBM terminal on properly stretched FCC of the watershed. Drainage map showing all orders was generated interactively on the terminal. Later water divides were meticulously interpreted on the FCCs by adjudging the drainage channel of the lower orders. Thus microwatershed boundaries were drawn interactively on the terminal and microwatersheds output was generated in the form of bitmap. Suitable software was used from the IBM RS-6000 with EASI/PACE image processing software package to convert the bitmaps into raster microwatershed maps of the watershed. This forms the base layer for the prioritisation. Soil map was contrived to consist of the Erosion Intensity Mapping units. Each of the soil mapping units has been assigned a weightage value and a delivery ratio by subjective assessment of the combined effects of erosivity determinants and the parameters affecting transportability of detached sediment. Weightage purports the erosion susceptibility or the expected detachment of the surface soils. This was arrived at by the critical analyses of the relevant factors affecting soil erosion like slope, physiographic position, surface conditions,

inherent soil charac-teristics, clay mineralogy, etc. A factor K is defined as equal to a value of 10 when the particular erosion unit is in equilibrium with a no loss - no gain situation. The factor has been assigned a value *viz.* (K ± n), where n gets +1, +2 and so on depending on probability of the extent of soil-wearing and the negative sign signifies plausibility of the extent of deposition in the particular soil unit. A truth table was prepared that lists the type factor (ranging between 0.8 and 1.2) for each landuse category. This factor essentially renovates the silt-yield weightage value objectively. Furthermore, a proportionality factor (ranging between 0.8 and 1.2) was designed to account for the size of individual microwatersheds. While landuse / land cover layer was used to condition the weightage factor, area of microwatershed was applied to condition the delivery ratio, both quantitatively.

Results and Discussion

Landuse includes 'everything land is used for by residents of the country from farms to hospital, parks and gravelands' (Jackson, 1981). The term 'use' often carries abstract proprietary connotation, which is not always amenable to remote sensing. A typical example may be that of a treeless stretch of land classified as 'forest' under ninefold revenue land classification system because it is under territorial control of Forest Department. On the other hand, land cover refers to 'vegetational and artificial construction covering the land surface' (Burley, 1971), a fact that can be observed, verified and recorded. Digital classification of IRS-1B L-2 data of Kharif and Rabi seasons yielded aggregated arable land categories (Table-1).

Remote sensing of soils is largely limited to the delineation of the boundaries between the mapping units. This is possible as the physiographic and soil boundaries are closely linked. Perhaps it is quite pertinent to recognise that remote sensing can at best visualise the 'soil-physiography-complex' boundaries and perhaps can not realistically assess the properties of the individual soil units. Delineation of the boundaries is the most cumbersome job because over 70 per cent of the efforts have to be diverted to this task alone. It is no mean savings obtainable with the use of remote sensing as ground survey component can be reduced to 10 per cent and savings of 60 per cent effort can be achieved. Identification of landform-soil relationship forms the basis of image interpretation in soil mapping. Soil mapping was carried out in tune with the procedure followed by many workers (Manchanda and Hilwig, 1981; Karale *et al.*, 1985; Kudrat *et al.* 1990, 1992). Study of soil resources of the watersheds yielded vital inventory of soils as Taxa in accordance with USDA norms of taxonomic classification - highest level of specificity was the target and thus soil series (association) were abstracted (Table-1).

Table 1 : Landuse / land cover and soils of Jaipanda Watershed

Category name/ Watershed	Area (ha)	Per cent	Major series / (Association)	Area (ha)	Per cent
Built-up land	104.33	0.27	Dahala/ (Ekaria & Benajira)	6265.51	15.95
Kharif only (single)	8824.98	22.47	Ramgarh/ (Manik-dipa & Danmari)	8220.27	20.93
Rabi only (single)	860.54	2.19	Danmari/ (Ramgarh & Manikdipa)	2919.24	7.43
Kharif + Rabi (double season)	4806.73	12.24	Manikdipa/ (Ramgarh & Sijua)	9569.15	24.36
Residual fallow	3756.46	9.56	Jamsala/ (Supur & Nayagram)	4164.31	10.60
Tree/ bamboo vegetation	8137.97	20.72	Ekaria/ (Supur & Nayagram)	2361.31	6.01
Dense forests	2166.91	5.52	Gorabari/ (Supur & Baligeria)	5516.04	14.04
Open forests	4119.47	10.49	—	—	—
Blank/degraded forests	1909.66	4.86	—	—	—
Marshy wastes	21.38	0.05	—	—	—
Upland/scrub wastes	3923.38	9.99	—	—	—
Water bodies	347.07	0.88	—	—	—
Rivers and major tributaries	265.81	0.68	River /nala	265.81	0.68
Others (roads, unclassified etc.)	36.94	0.09	—	—	—
Image total	39281.63	100.00	Image total	39281.63	100.00

Various parameters representing the agricultural status have been computed and presented (Fig.1).

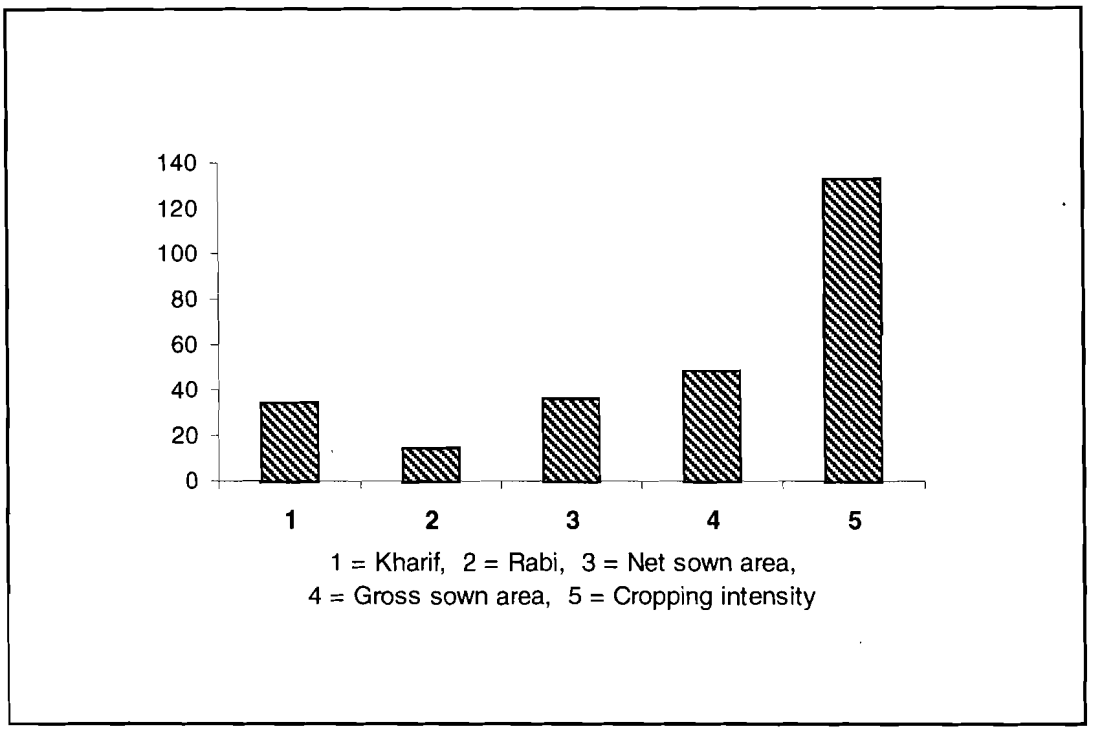

Fig. 1 : Agricultural Practices on the cultivated lands, Jaipanda watershed, 1992-93

The physiographic setting of the soil units with their taxonomic lineage has been studied in detail (Table-2). Eventually the soil units were assigned proper weightage (erosivity) and delivery ratio (plausibility of the detached material to reach the sink) in the form of a truth table (Table-3). An algorithm for estimating sediment yield index (SYI) was formulated which was got translated into a software package for prioritization of microwatersheds with soil information, lu/lc layer and the microwatershed layer as the inputs. Development of such package is imperative in the face of resources crunch for conservation / remedial measures of watersheds. With the help of the output the watershed managers would be in a position to choose objectively the most vulnerable microwatersheds for soil conservation.

The microwatersheds were arranged in the descending order of the Silt yield index values and graded in order of priority into 5 categories such as `very high', `high', `medium',

'low' and 'very low'. Evidently the higher values of index suggests higher priority. The distribution of various microwatersheds in the above five categories is indicated in Fig.2.

Table 2 : General description of physiograpic units

Name of physiographic unit	Parent material	Average slope	Ground water potential	Dominant land use	Name of predominant taxonimic soil family	Name of prominent soil series
Predinent crest	Granite -gneisss	1.3%	Slight to nil	Scrub/deg. forests	Coarse loamy typic Ustorthents	Gorabari,
Upper pediment	-do-	1-5%	Moderate to slight	Forests	Fine loamy Typic Ustochrepts, Loamy skeletal Typic Rhodustalfs	Benajira, Baligeria
Lower Pediment	-do-	1-3%	Good to moderate	Forests/ upland paddy	Fine loamy Typic Haplustalfs, Fine loamy Udic Haplustalfs and Fine loamy Udic Rhodustalfs	Ekaria, Supur Dahala, Jamsala, Nayagram
Valley-fills	Allu vium	0.1%	v. good to excellent	Paddy	Fine loamy Typic Plinthaqualfs	Ramgarh
Flood plain	-do-	0.1%	do	do	Fine Aeric Ochraqualfs	Danmari, Manikdipa
Levee	-do-	1-3%	do	Tree/grass	Coarse loamy/Thyupic Ustifluvents	Sijua

About 30 per cent of the microwatersheds under Jaipanda watershed occupy 'very high' priority category, while 'high' rank comprise 31 per cent. Thus a total of 61 per cent of the microwatersheds align real vulnerable class. Low to very low category together occupies only 20 per cent and the median is the remnant 19 per cent. So one needs to bother much about this particular watershed and the conservation measures have to be rushed in to save a major chunk of soils from getting washed away.

Table : 3 Brief description of soil series with assigned weightage and deliver ratio

Sl. no.	Erosion Intensity Mapping Unit	Description	Wt. age	Deli. ratio
F1.	Dhala-Ekaria-Benajira (DEB)	Strong brown and reddish yellow, moderately deep to deep, sandy loam, weak medium subangular blocky, pH=5.0, excessively drained, on slightly undulating land of 1-3% slope, unbunded, with moderate to severe erosion.	20	0.90
2.	Ramgarh-Manikdipa-Danmari (RMD)	Light brownish gray and light gray, very deep, sandy clay loam, weak medium subangular blocky, pH=5.7, imperfectly drained, on 0-1% upper valley plain, incidence of flooding during monsoon, well bunded, very deep with slight or no erosion.	12	0.85
3.	Danmari-Ramgarh-Manikdipa (DRM)	Pale brown and light gray, very deep, loam, weak medium subangular blocky, pH=4.9, poorly drained, on 0-1% flood plains, incidence of flooding during monsoon, well bunded, very deep with slight or no erosion.	12	0.85
4.	Manikdipa-Ramgarh-Sijua (MRS)	Yellowish brown and very pale brown, very deep, silty clay loam, moderate medium subangular blocky, pH=5.3, poorly drained, on 0-1% flood plains, incidence of flooding during monsoon, well bunded, very deep with slight or no erosion.	11	0.60
5.	Jamsala-Supur Nayagram (FSN)	Dark brown, deep to very deep, loamy sand, weak medium subangular blocky, pH+6.3, well drained, on undulating land of 1-3% slope, poorly bunded or unbunded,with moderate erosion.	16	0.90
6.	Elaroa-Supur-Nayagram (ESN)	Strong brown, very deep, loamy sand to sandy loam, weak fine subangular blocky, pH=52,well drained, on undulating land of 1-3% slope, poorly bunded or nubunded, with moderate to severe erosion.	17	0.90
7.	Gorabari-Supur-Baligeria (GSB)	Yellowish red to reddish yellow, shallow to moderately deep, sandy loam, weak medium subangular blocky, pH=5.3, excessively drained, on slightly undulating land of 1-3% slope, unbunded, with moderate to severe erosion.	19	0.95

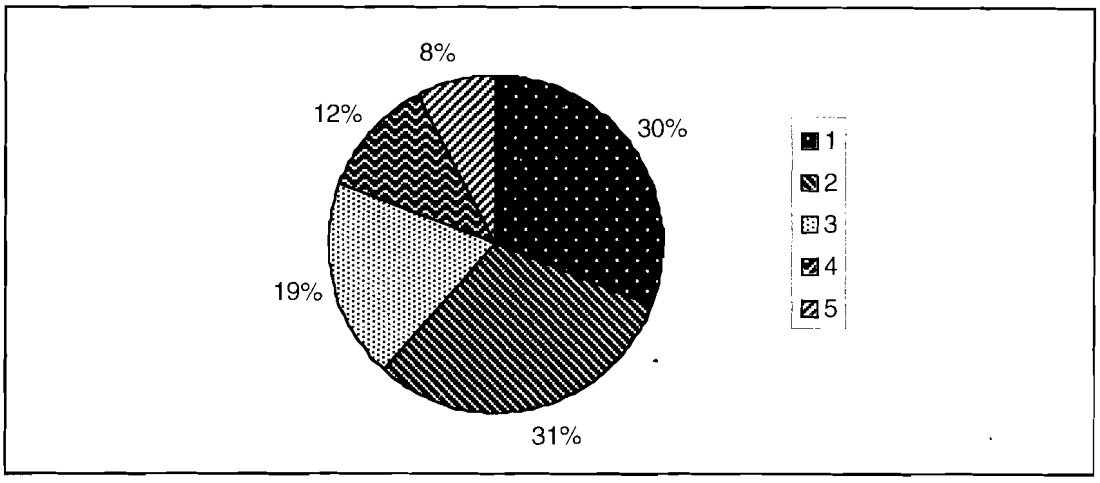

Fig. 2 : Prioritisation of Jaipanda microwatersheds. 1 = 'very high', 2 = 'high', 3 = 'medium', 4 = 'low' and 5 = 'very low'

Conclusion

A comprehensive, multicategoric, natural system of landuse classification is a primary need for developing any meaningful programme of landuse planning. The landuse map statistics reveal that agriculture is the primary occupation of the watershed. Remote sensing has been used as a tool for study of 'soils'. Also the latter is defined as a three-dimensional body in contrast to 'land' that extends in two dimensions. The third dimension is virtually obscure to optical mode of remote sensing. But there remain some vital links between the geomorphology and the soil category. This link can be harnessed to arrive at a worthwhile classification. Obviously the exercise must be supplemented by sufficient field truth and information garnered from the results of the laboratory analysis.

The advent of satellite data has made the soil mapping less tedious. Modern remote sensing data obtained through air-borne and satellite multispectral scanners are concerned mainly with those spectral reflectance and emittance of object features on Earth's surface which are function of topography and aspects, chemical and physical composition of surface soils, surface roughness, landuse / land cover etc. These parameters are also directly or indirectly related with pedogenic processes and will give the guideline for extracting soil variability and delineating the boundaries (Kudrat *et al.*, 1992).

The compilation of soil maps is one of the most complicated problems of cartography based on remotely sensed data. Its intricacies are connected with the difficulties of interpretation, which is founded on the interconnection between the horizons of soil genetic

profiles with their properties, and the spectral signature of the surface layer of the soil. Further, a significant part of the surface is covered by vegetation. Natural vegetation can be of great help due to its indicative correspondence with the soils. But crops have mostly the screening effect and decrease the possibility for application of remotely sensed data for mapping soils in regions with extensive agriculture. The existing methods of soil interpretation based on digital processing of remotely sensed data are developed mostly for bare soil conditions. Also the fact should not be disregarded that the quality of soil and its moisture supplying capacity is reflected in the greenery. The extent and gradation of the former is scrupulously deciphered in the FCCs - the loss of greenery is an excellent indicator of the extent of denigration the land has suffered.

In view of large scale land degradation problems and constraint of resources in the developing countries, a scientific approach to land resources management war-rants a clear identification of critical areas for treatment in the first place. Sustain-able development is contingent on the prudent use of the land resources, their conservation and development. Prioritisation of areas into different vulnerability levels helps in addressing the conservation efforts to secure maximum benefit. The intent behind selecting small watershed is to have a relatively homogenous entity as an individual watershed. Here it was sought to preclude any substantial variation of the rainfall and slope factors within a single watershed so that the prioritisation package yields a worthwhile output. Thus the veracity of the relative priority values of microwatersheds within a particular watershed remains unscathed.

Acknowledgements

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ECONOMY AND CULTURE OF THE MALANESE TRIBE IN THE HIMACHAL HIMALAYA

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Abstract

The Malanese tribe lives in a very secluded valley at about 8,000m elevation in the Himachal Himalaya. A.F.P. Harcourt, the first British District Magistrate of the erstwhile Kullu, Lahul and Spiti district, explored the existence of this tribe in 1868 and since then over more than hundred years only a few social scientists have managed to make a thorough study of their life and culture. With only about one thousand population and living in complete seclusion for generations this tribe has not only developed a unique social and cultural system but also got used to an administrative set-up which can be described as purely democratic. The economy of these people is basically agricultural of primitive type and sheep rearing. The people have their own language, which has no distinct similarity with those spoken by the other people in the Kullu valley around. Over generations they continued to grow certain food crops on the mountain terraces, extract dress material from the hair of sheep and goats and never depended on the outside world for anything to support their living. In recent years with the interference of growing number of tourists from different parts of India and abroad certain changes of their outlook and transformation of life style have already begun and if this trend continues the originality and indigenous culture of this tribe is suspected to disappear within another decade.

Introduction

Malana is an insignificant river within the catchment area of the upper Beas Basin in Kullu district in the Himachal Himalaya. In a very remote and secluded part of this river valley, at a considerably high elevation (about 8,000 ft. or 2,500 m.), there lives a group of tribal people with certain cultural identity, who is known as Malanese. The existence of Malanese tribe, comprising hardly one thousand people, was explored about one hundred thirty years back when A.F.P. Harcourt, the then District Magistrate of Kullu arrived in this part of the mountain in 1868. Mr. Harcourt was on a reconnaissance survey at that time and his aim was to compile the first gazetteer of Kullu district. He was basically an administrator but had a good sense of anthropological observation. He visited this village twice, in 1868 and in 1870 and studied numerous aspects of life and culture of this apparently strange tribal community, with which he compiled an account in 1870. Since then, over more than a century, several environmentalists and anthropologists paid visits to this amazing world of ethnic life but little could have been explored about their society, culture and economy because of the complete

apathy of these people towards the outsiders. After Harcourt, Colin Rosser, an well-known British anthropologist visited Malana in the seventies and eighties of this century and described his experience in his book Indian Villages, in one whole chapter titled 'The Hermit Village'. It remains, as ever, amazing to realise how this small ethnic group, who remained completely cut-off from the neighbouring parts of the Kullu valley and thereby from the rest of the civilised world, developed an entirely independent and unique cultural and socio-political system within their territory. In 1987 a documentary on the village, made by Ramesh Pathania, a Kullu resident was telecast on the Doordarshan. In fact this was the first visual recording of what continues to happen in the village, with its customs and traditions and the life of the inhabitants. This author, through his adventure-oriented field investigation in 1988, 1989 and 1996 tried to explore some aspects of this Malanese tribe for a systematic understanding of the culture and economy of this ethnic life.

Access to the Malana village : Malana remained quite cut-off from other settlements of the Kullu valley and the footpaths that lead to this village pass through most difficult terrain, steep upslope and dense forests. There are two different tracks to reach Malana village from the possible transport points; one from the Kullu valley itself, through Naggar (2,000 m) and across Chanderkhani Pass (3,500 m) for a distance of about 21km, and the other from Jari (1,400 m) in the Parbati river (a tributary to River Beas) valley through the narrow gorge of Malana river for a distance of about 18km.

Economy, Culture and Society of the Malanese Tribe

Village plan and house types : The Malana village is situated in the Malana river valley at about 8,000 ft (2,500 m) on a relatively flat terrace. The approximate length and width of this terrace are 600m and 400 m respectively. Locally available slabs of schistose rock and planks of wood (generally of Chir Pine) are used as building material. Slanting roofs are made up of thinner rock slabs. Most of the huts are two-storied, in which the ground floor is often used as the shelter for their domestic animals (sheep and goats) or storehouse of fire wood collected during the drier months as fuels for the winter months to follow. There are about seventy houses in Malana and the village is divided into two parts: the upper part or Dhara Berh and the lower part or Sara Berh. The central part of village has an open courtyard adjacent to the main temple, which is very sacred, no one is allowed to enter therein with leather shoes on.

Economy : The economy of the Malanese people is based on both subsistence agriculture and sheep rearing. Agriculture is the main stay of the people, supporting about 70 per cent of the requirements of life. Due to high altitude winter is not only harsh, but also continues through the greater part of the year, and the growing season extends only for 4 months, from May to

September. Around the village itself there is approximately 40 hectares of agricultural land in successive terraces on which the inhabitants cultivate. Away from the main village within four to ten kilometres distance there are three other sectors of temporary habitation of the Malanese where markedly wide terraces have facilitated them to practice seasonal farming. These sectors are a) Thusko (about 4km away on the mountain wall opposite the Malana river channel), b) Bekhli (about 3km before the Malana village), and c) Kiksa (about 10km upstream).

Certain types of grain crops, namely *Kathua* and *Mandua*, from which they extract flower for bread making. Flour from these grains is extracted through *Panichakki* using the perennial flow of springs or stream channels under controlled conditions. Due to the lack of advanced technological knowledge among the farmers the yield per acre is not high enough. The only vegetable grown here is red potato. The total amount of production of food crops is inadequate to feed about one thousand people who live in this village and, as a consequence healthy persons are of rare sight. People often rely on other supplementary food like wild mushroom (*guchhi*), honey (*mahu*) and small wild fern weeds (*lingri*) as vegetables. Lamb and goat meat (obtained from their herd of grazing animals) is also consumed but occasionally.

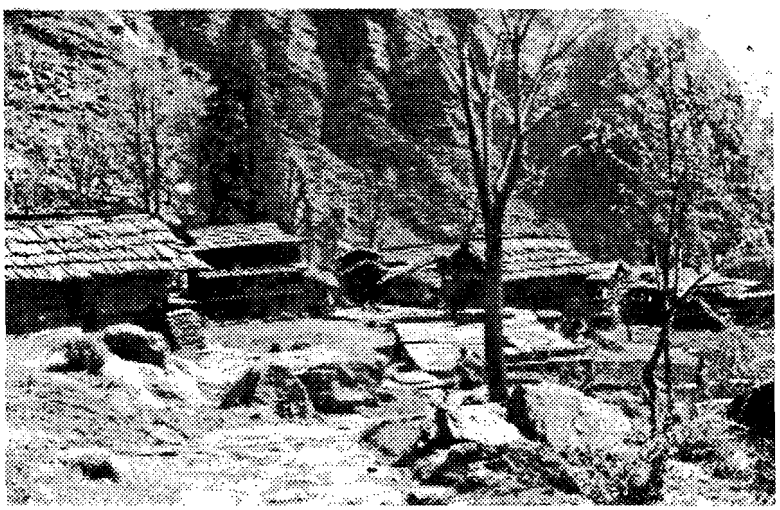

Fig. 1: A view of the central courtyard of Malana village

Agricultural works, including toiling land, sowing and harvesting of cropsare done almost entirely by the women in the community. Male persons engage themselves in

collecting firewood, mushroom, honey etc. from the adjacent forests. During the warmer season (from May to September), some groups of people take their herds of sheep and goats to the high altitudes above the tree line at the pasture lands of the alpine meadow. They maintain a nomadic life with their entire belongings (their family including children) during these months of the year, moving from one level of gassy meadow to the other, and as the winter approaches (by late September) they return to their homes in the village with the herds of animals. Wool collected from their goats and sheep is used for making all kinds of garments. Since these people have been living in seclusion since long wool has been the only ingredient for their dress making.

Culture and Society of the Malanese

Origin of the Malanese : History of the culture and society of the Malanese is very old. The earlier workers like A.F.P. Harcourt and Colin Rosser indicated that these people might have descended from a generation who were not indigenous. Malanese people often claim themselves as the descendants of the army personnel who accompanied the Greek emperor Alexander thousands of years ago, not knowing exactly was that great emperor. Some anthropologists believe that in the fourth century B.C. when Alexander invaded India a group of soldiers deserted from the army and fled to this most remote part of the Himalaya. On their escape, before they took their final refuge in this secluded valley, they captured some local mountain girls as their life partners, and in this process a mixed generation emerged thereafter. However, this view is yet to be logically established. Wood carvings on their main temple wall showing sculpture of soldiers with seemingly Greek army uniform on, and processions of camels and elephants (the animals never seen here) would suggest that their ancestors might have come from somewhere outside this mountain tract.

Physical feature : The average height of the Malanese people would be about 5′ ft. 8" inches. Male and female persons of the same age group are almost of equal height. Compared to the people in the surrounding Kullu valley areas their health is poorly developed, with longer face and markedly projected nose. More than one hundred years back Mr. Harcourt described the Malanese in this manner 'the eyes have a startled and frightened look, and the nose projects over the vacillating mouth, which with the narrow chin, gives a character of feebleness to the entire face'.

Religion, festivals and rituals : Malanese consider themselves as the subjects of the God *Jamlu* (Rishi Jamdagni in the Hindu Mythology). All the social and family functions, including worships, festivals, weddings and other rituals are conducted by the direction of this great God, whose message comes through *Gur,* the supreme authority of the village. Sagrat festival, observed in the middle of the month of May, is the annual festival of the

village, when all people must assemble in the village courtyard and worship their God *Jamlu*; the *Gur* supervises the celebration. The main temple, located on one side of the central courtyard, is the storehouse of precious ornaments and instruments like silver flutes and bugles and large drums. On the festival day, the villagers, being headed by their *Gur*, make a procession to the holiest tree *(Jamlu's tree)* at the uppermost level in the village, where a lamb is dedicated to the God *Jamlu* by chopping off its head. The rest of the day following this ceremony is observed as the festival day with dancing, singing and eating of meat and bread. As the most devoted subjects of God *Jamlu*, the villagers do not allow outsiders to enter into their territory with any leather items, may it be shoes or leather jackets the camera case or even the trouser belts.

Fig. 2 : A group of Malanese ladies on the festival day of *Sagrat*

The system and age of marriage in the Malanese society is very interesting. Since women remain engaged in all kinds of household and farming works they finally get recess in the busy life to get married at the age of over thirty when their youth is almost over. The male persons, however, usually go for wedding much earlier, at the age of below twenty. A young man of age twenty is getting married with a lady of about forty years of age is not uncommon. Both male and female choose their life partners at their own at their own will and a simple wedding ceremony takes place before the village temple by offering one rupee to the God *Jamlu*. Since they confine themselves within this only village it is obvious that the marriage remains restricted within the same community. There are two consequences of this peculiar marriage system; first the birth rate (and thereby the population growth rate in this

village) remains very restricted, and second the average length of life remains short as compared to the cases in the surrounding Kullu valley areas.

Dress and Ornaments : As mentioned earlier the Malanese maintain a tradition of preparing all parts of their dress from animal hair, like wool. Women wear woollen sallower and blouse and wrap their body with a colourful blanket-like chadar. They also have fascination for wearing a number of necklaces and earrings - all made up of silver. Women wearing as many as fifteen earrings in each ear, is a common spectacle. Their slippers and shoes are made up of weeds and grass. Men also wear pyjama and kurta-like dress in the body and cover their head with a woollen cap. Harcourt found much similarity of dresses between the Malanese and the Kullu valley people as he described: 'The men dress much as do the peasantry in Kuloo, and the women wear the round brown cap and plaids of a sober grey; but here, as in other villages, is to be seen the curious monk-like cowl of madder-brown cloth, that is carelessly adjusted across the head-piece and allowed to hang down the shoulders'.

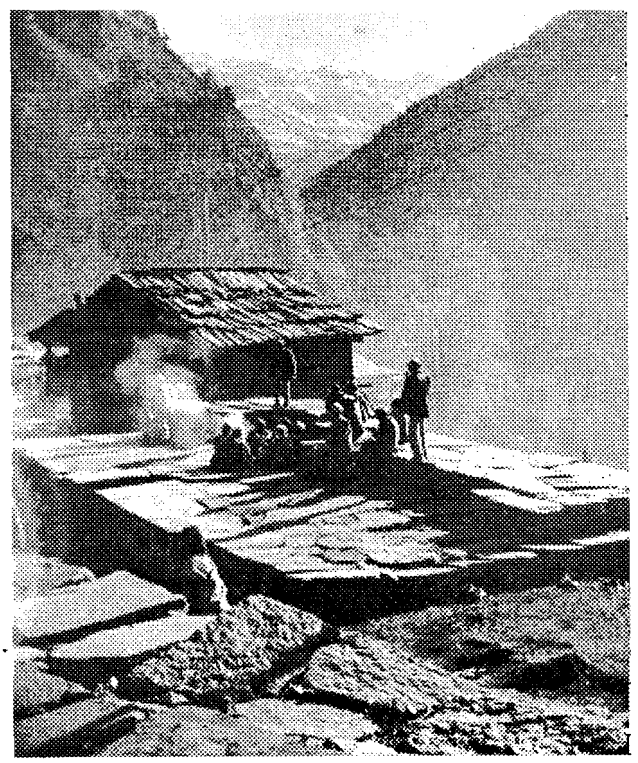

Fig. 3 : The *Choutara* where the members of *Harcha* assemble for decision making

Administrative system : The administrative system in the Malana village is very unique in the sense that they have been observing a democratic system since time immemorial. Malana has its own government, which does not accept the sovereign rule of the country. Mr. Harcourt noticed and recorded an account of it in his book in the last century and mentioned that they never conceded to any administration from outside the village. Some social scientists, who find a possible link between the invasion of Greek culture and the origin of the Malanese suggest that this system is a reflection of the idea of 'City State' that the Greek people maintained even more than two thousand years ago in Greece. However there is also an antithesis of this concept. History says that over 2000 years ago when Aleaxander invaded India there already existed numerous small independent sovereign democratic village states, like Licchabi, Malla etc. in parts of Northern India which could also have influenced other sectors as well in those days. In administration the Malanese have a pyramidal system in the top of which has the position of the *Gur* (like the Lama in the Tibetan society), the supreme authority in all decision making processes. Below *Gur* there are *Pujari* (the religious head) and the *Kardar* (the administrative head). Under this body of authority there is a parliament (Harcha), made up of two houses: *Jathera* (the Upper House) and *Kore* (the Lower House). Four representatives from each, *Dhara berh* (the upper segment of the village) and *Sara berh* (the lower segment of the village) form *Jathera* and *Kore* respectively, and thereby the *Harcha*. Certainly this parliamentary system is in its infancy and the representatives to the *Harcha* are chosen by common consensus of the villagers under the approval of the *Gur* rather than by elections, and a member is allowed to hold his position a maximum of four years. Both the houses are presided over by the *Gur*, the representative of God *Jamlu*.

It has been a traditional custom in Malana to settle all dispute before their local tribunal, the *Harcha*. The role of *Harcha* is not only to settle disputes among the villagers but also to decide over the type of grain crops to be cultivated in the ensuing year and prepare festival schedules of the year. For these purposes the members of *Harcha*, headed by the *Gur, Kardar* and *Pujari* meet on the large platform in the central courtyard, called *Choutara*. Crimes like theft or murder are never heard of, and disputes among the people usually occur over the counts of the number of sheep and goats particularly before the start of the winter season when the herds of animals are driven back from the highland pastures by the shepards. If the claimants fail to reach an amicable settlement on their dispute the matter is placed to the Lower House of the *Harcha*, and in extreme case, where no option remains open for reconciliation, the matter is forwarded to the *Gur*, whose decision can never be challenged. When the *Gur* has to intervene, the system of judgement becomes quite interesting. Each of the two persons involved in dispute are directed to bring a lamb or a goat at *Khorona*, their Supreme Court, which is virtually another open courtyard about two hundred metres away

from the *Choutara* with two gigantic Pine trees standing on one side. The animals are then poisoned and tied with the two trees. The claimant, whose animal dies first, would be declared guilty, and his penalty would be to give some offering to the God *Jamlu* in the temple and arrange for a feast with full meal to all the villagers.

Language Spoken : The language spoken by the Malanese has a certain phonetic identity (more of howling or shouting) and has no similarity with those spoken in the Kullu valley areas. This language has no script of its own, hence the people have never had any culture of reading or writing. However, it is amazing to realise how a group of hardly one thousand people, living in seclusion for centuries, developed a complete language. Although many linguists claim that the Malanese language is completely different from those spoken in other parts of Himachal Pradesh, some similarities of it have been found with Lahuli (spoken in Lahul and Spiti district) and Kinnauri (spoken in Kinnaur district). Some words also sound like Sanskrit. A few examples of the words spoken by the Malanese people are presented in the following chart:

English	*Malanese*	English	*Malanese*	English	*Malanese*
One	*Id*	Rice	*Lar*	Mother	*Ya*
Two	*Nish*	Wheat	*Jhand*	Father	*Ba*
Three	*Shum*	Barley	*Chahg*	Son	*Chhah*
Four	*Pooh*	Milk	*Kheerang*	Daughter	*Chumee*
Five	*Nahan*	Butter	*Boohur*	Man	*Laro*
Twenty	*Beech Nabya*	Honey	*Was*	Woman	*Lari*
One Hundred	*Nabeeha*	Bread	*Hod / Hora*	Mine	*Aka*
Forest	*Reeyas*	Cooked rice	*Ful*	Your	*Toa*
Fire wood	*Shing*	Cloths	*Gasa*	I	*Goo*
Water	*Tee*	Beautiful	*Sovilas*	White	*Chhog*
Cow	*Hooch*	Wool	*Cham*	Yes	*Hoe*
Sheep	*Khas*	Ice	*Chous*	No	*Maee*

Examples of some sentences: 1) This village is nice > *Ee gramang sovilas*; 2) Do you have bread? > *Hod Toa?*

Present trend of change of the Malanese society and culture : Malana has maintained its indigenous tradition, culture and social system almost entirely unaffected since hundreds of years because of their complete seclusion from the outside world and of the ingrained values of co-operation among the people. But the things are changing in recent years at a rate faster than expected. Since the nineteen hundred eighties thousands of tourists (including the foreigners) have been pouring in during the summer months. Previously the Malanese were very much reluctant to accept anything from the outside. But they have now changed their notion and learned how to acquire different foodstuff and fashionable dress materials from the Kullu valley markets and other outside areas. The Himachal Pradesh Government has now set up a primary school (teaching only in Hindi medium) in Malana and connected the village with electricity lines, providing each house free supply of electricity. At the time of the installation of the electric poles in 1987-88 the Malanese tried to resist with all their efforts, but eventually accepted it. It will not be a matter of surprise if within another decade Malana transforms itself to a condition when, to the outsiders, this will be just another village within the Kullu district in Himachal Pradesh.

Acknowledgement

Author is grateful to the District Magistrate of Kullu for necessary information about the Malana village at the outset of the field investigation. Thanks are also due to Mr. Amitabha Sengupta for field assistance in the first phase.

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ENVIRONMENT, SOCIETY AND CULTURE : A CASE STUDY ON THE SCHEDULED CASTE COMMUNITY OF RAGHUNATHPUR, PURULIA

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Abstract

An enormous impact of environment on the cultural landscape in general and cultural and social ecology in particular of three selected villages of Raghunathpur block has been found on the basis of the field study. The groups and subgroups, living in an ecological transition zone, are largely backward and are completely dependent on subsistence farming. Majority of them are landless, illiterate and work as agricultural labourer or are enaged in casual work in the informal sector. In general their socio-economic and socio-cultural status are extremely low because of harsh environmental factors. The adverse ecological conditions have made an impact on their habitation, society and livelihood pattern. Although agriculture is the mainstay of the economy it is still in the subsistence stage. The intensive cultivation of either food or cash crops is not possible due to prevailing environmental and institutional constraints which act as deterrent for mechanised cultivation. The loss of valuable forest resource, on which the self provisioning system of these people was largely dependent at an earlier date created an endemic system of poverty and alienation over several centuries which is very difficult to alter unless some deliberate socio-cultural and economic revival schemes are adapted to tilt the balance in their favour. The transition between forest based ecotones to crop based farming has been evident in the habitat, society and culture of the scheduled caste community of the study region. Environmental factors such as rainfall, soil, and terrain characteristics determine and control the agricultural system, landuse pattern, density and distribution of settlements and occupational patters of the people. Social ecology of the region is further differentiated by the predominance of two communities namely Bauri and Mondal who trace their origin to the autochthonous tribes of the eastern Santal Parganas and Ranchi. They are at transition on the lineage/nonlineage continuum who need to be elevated from their present state of poverty and illiteracy through better provision of employment and income, education, health care and social mobility towards a higher material platform.

Introduction

In order to make a sample study on the interaction process of man-environment and society the western fringe areas of Purulia have been selected because of its transitional character. This region has distinctive characteristics in terms of physical factors such as terrain, slope, climate, soil, drainage and vegetation as well as cultural factors such as demography, economic function, occupation and landuse character which reflect a long adaptation process. Raghunathpur is selected for highlighting the backward area problems because of, its

consistent high percentage of Schedule Caste (SC) population from 1961-1991. A stratified random sampling procedure has been adopted to select a group of villages on the basis of the presence of Scheduled Castes in respective villages as percent of total population of the same villages, so as to achieve at a regional hierarchy of caste based community.

Table-1 : Percent distribution of Scheduled Caste (SC) to total population in selected villages, Raghunathpur, Purulia, from 1971-1991

Name of the Sample villages	Percent of Scheduled Caste to Total Population		
	1971	1981	1991
Taldi	100.00	100.00	100.00
Nutundi	30.93	20.80	30.01
* Jarukhamar	2.32	90.38	99.18

Source : District Census Handbook Purulia, 1971, 1981, 1991.

* : Mandals here are now non-scheduled during the 1971 census, although previously they were within SC group.

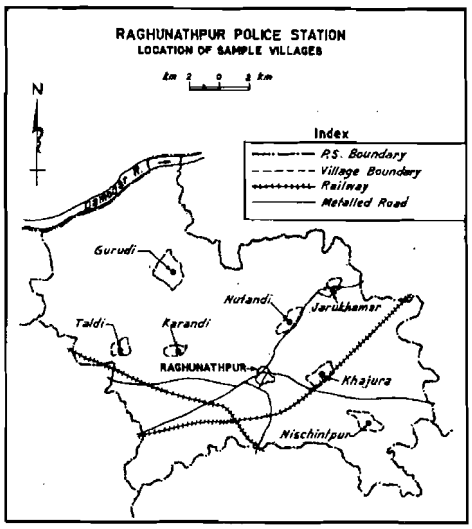

Fig. 1 : Location of sample villages in Raghunathpur Police Station in Purulia district of West Bengal

A Primary survey has also been conducted with the help of sructured questions to study the environmental impact on cultural landscape. The survey period covered three stages—(1) year 1985-86, (2) year 1990-91, and (3) year 1998 with the help of three field assistants for a duration of 10 years, 8 days and 7 days respectively for the purpose of checking and cross checking of data. The sample size covers 459 households.

Data base

The primary data base was the information collected in the field while the secondary source materials were from Census publications, District Gazetteers and Land and Land Revenue records. The relevant statistical information has been represented in the text for illustration and interpretation.

Aims and objectives

The purpose of this type of analysis is multidimensional. At one level it is to understand how environmental paramenters actually shape and predetermine the social fabric of the milieu. Environmental control still prevails inspite of technological development. The basic requirement and availability of resources *i,e.*, land, water soil and mineral give rise to economic, social and cultural landscape and give a region its personality and socio-cultural cohesion.

At another level, the regional disparity in economy, regional heirarchy in terms of spatial distribution of population, social cultural and ethnic pluralities in demographic and social attributes can be better understood if a correlative analysis is undertaken between environment parameters of both physical and non-physical.

The question of reqional integration has also been looked into from this type of micro-level studies which takes into account individual perception.

Physical environment

The terrain of Raghunthpur region resembles a low undulating surface with occasional highlands. The micro-relief is characterised by a relative relief of 7.00 m., with exposures of lateritic nodules.

The region has a low relief with occasional highlands. The climate is of semiarid type with low rainfall and low relative humidity (53%). Much of the rainfall is received during the months from June to September recording high variations from year to year. As a result the area experiences long dry spells and therefore becomes distinctly drought prone.

Table 2 : Physical parameters of three samples villages of Raghunathpur, Purulia 1991

Name of the villages	Total Area (ha)	Helevation from mean sea level (m)	Average relative relief (m)	Average annual rainfall mm.
Taldi	119.61	3.00		
Nutundi	153.07	3.00	7.00	1264.8
Jarukhamar	106.14	8.00		

Sources : 1. Field survey 1985, 1986, 1998.
2. District Census Handbook Purulia, 1991.

Table 3a : Climate parameters of Raghunathpur 1987-88

Average Annual Rainfall	1264.8 mm.
Relative Humidity	53 %
Mean Annual Temperature	21.0 °C
Number of Rainy days	71
Maximum Temperature of the hottest month (May)	40.3 °C
Minimum Temperature of the hottest month (May)	27.2 °C
Maximum Temperature of the coldest month (January)	25.5 °C
Minimum Temperature of the coldest month (January)	12.8 °C

Source : Annual Plan on Agriculture, Purulia, 1987-88. Office of the Principal Agricultural Officer, Purulia, Govt. of West Bengal.

The soil is of light medium texture, low in organic content and moisture retention capacity is also less. The soil is mostly composed of sand and gravel.

Table 3b : Environmental attributes of the sample villages of Raghunathpur, Purulia, 1998

Name of the villages	Total area (ha)	Area under forest (ha)	Area unirrigated as percent to gross cropped area	Area irrigated as percent to gross cropped area	Tank	Well	Tubewell
Taldi	119.61	Nil	99.80	2.05	5	11	1
Nutundi	153.07	Nil	99.00	1.00	2	Nil	Nil
Jarukhamar	106.14	Nil	99.00	1.00	3	10	1

Source : Field Work 1998. District Census Handbook Purulia 1991.

Table 4a : Demographic, economic and social attributes of the sample villages of Raghunathpur, Purulia, 1998

Name of the sample village	Total population (persons)	Total households (numbers)	Distance from Raghunathpur (km)	Roads	Settlement type
Taldi	535	86	25	Unmetalled	Clustered
Nutundi	1776	308	6	Unmetalled	Linear
Jarukhamar	482	65	10	Unmetalled	Linear

Table 4b : Economic parameters of the sample villages of Raghunathpur, Purulia, 1998

Name of the sample village	Average land holding size (ha)	Cropping pattern	Average monthly (Rs)	Occurrence of periodic market centres.
Taldi	0.81	Single and Double	200.00	Daily & Weekly
Nutundi	0.20	Single	100.00*	Daily & Weekly
Jarukhamar	0.33	Single	480.00	Daily

* The income figure is estimated

Table 4c : Social indices of the sample villages of Raghunathpur, Purulia, 1998

Name of Sample village	Number of primary centres	Number of educational institutions				Total number of literates	Literates as percent to total population
		Formal			Informal		
		*P	S	H			
Taldi	Nil	Nil	-	-	Nil	39	30
Nutundi	Nil	4	-	-	Nil	10	27.94
Jarukhamar	Nil	1	-	-	Female & adult centre	42	30

Source : Tables 4a-4c-Field work conducted in 198. Purulia District Census Handbook 1991

*P : Primary School

S : Secondary School

H : High School

The tables 4a-c. give an account of the existing socio-economic and demographic characters of the villages which reflect the personality of the region.

Environmental Ecology

After a study of the old land records and settlement maps (1862-63) a clear picture of the environmental ecology particularly that of the forest edge ecotone becomes apparent. The villages were originally located amidst forest lands adjacent to a stream or a tank. At earlier date the area had extensive forest cover which has been systematically felled over the last 200 or 250 years. At present the villages bear no forest, the percent of forest cover for the district as a whole is abysmally low coming to about 1.4 per cent (1991) ; the reason being mainly the demand for agricultural land and extension of settlements.

In the absence of any mineral resources, the chief occupation patterns from the earliest times were subsistence agriculture and forest-based activity wherever forest lands are available. For the former water is essential which is again scarce. Out of the three sample villages only Jarukhamar is situated near a stream which is non-perenial, the other two Taldi and Nutundi are completely devoid of surface irrigation water. The latter two mainly depend on water from wells and tube wells for supply of drinking water. Irrigation is practiced mainly from tanks, which could be only seasonal (Table 3b). Subsequent cadastral maps of 1908-9, and 1954 further substantiate the fact that there has been encroachment of agricultural areas on forest land, which has not always been conductive for development. As far as accssibility is concerned, it may be mentioned that out of three sample villages only Nutundi has developed rail and road connections, while the other two, namely Taldi and Jarukhamar have only unmetalled roads. Therefore communication is served largely by foot. Thus physical infrastructure *i.e,* transport, market, schools, post office etc, leave ample ground for further development. During the rainy seasons these village roads become extremely unsuitable for communication.

As a result the density of population per hectare shows that it is higher in Nutundi (7.68) and lower in Jarukhamar (4.54) and Taldi (4.47). The last one is very poorly connected with Raghunathpur and hence shows an even lower density.

In this way the relevance of the historical settlement maps of old Manbhum and present Purulia is not difficult to establish which have been consulted for research purpose. The spatial distribution of settlements and their types and forms relate to social phenomena. The index derived from the old maps reveals a variety of information. Poverty was endemic in the character of the land. Therefore much of the land was not yet settled. The characteristics of forest edge ecotones are clearly decipherable in the forms of small parcels of land which are transitional between forest based and agricultural ecosystems. The earlier politics adopted by the administration had done irreparable damage to the lifestyle of the autochthones of this regon. The Bauris and Mandals are the earliest settlers in this part. The present Bauris, Mandals and other scheduled caste groups and subgroups trace their origin to tribal

cimmunities (*e.g* Munda, Savaras, Bhumij etc.) In 1941 Census Bauris were categorised as scheduled tribes and in 1971 the Mandals were categorised as scheduled castes but at present Bauris have become detribalised and belong to SC group while Mandals are now non-scheduled. The tribals created the forest edge ecotones for survival and sustenance and have now become poorer after losing forestry as a source of primary occupation. Thus babitat transformation and politico-economic change have proved deterimental in that these have enhanced more poverty, unemployment, landlessness and deterioration in the quality of life.

Agricultural activity

The major souce of income at present comes from rainfed agriculture *(kharif)* dominated by rice production of aman variety. In the absence of regulated water flow the winter crop cultivation is practically neglible, in case of Taldi it is 1.21 hectares out of 58.71 hectares whatever little exists is in the form of wheat and vegetable production. The land is classified into four categories on the basis of soil-terrain and slope characteristics namely tanr, baid, kanali and bahal, starting from higher to lower elevation. These are put to different crop use, however, in these villages, rice is the staple crop. The first two categories are upland area, relatively less fertile, with low soilmoisture capacity and hence are generally avoided for rice cultivation. The third is of intermediate fertility while the fourth is the most fertile low lying valley bottoms which are best suited for rice cultivation.

If additional inputs and land treatment are given to the follow and waste lands, the area under cultivation will increase significantly. Unfortunately modern measures of improved land management *i.e.* contour bunding, terrace farming, crop rotation, application of chemical fertilisers, increased irrigation facilities have not been introduced here. These are the existing lacuna on the part of the Government and also from the people who are poor enough, and hence incapable for adopting farm inputs. Incidentally may be mentioned that Taldi comes under IRDP (Integrated Rural Development Programme) Scheme

Demographic Profile and Ethnic Composition of the Population

The growth of population in these three sample villages shows a distinct increase during the last forty years (cf. Table 6) although the household density shows a decrease in Jarukhamar in 1991 Census, it may be indicative of out migration (Table 5). But the figures of 1998 again show an increase which may reflect the seasonality of outmigration.

Table 5 : Change in average household density in sample villages of Raghunathpur, Purulia during 1961-1998

Name of the sample villages	1961	1971	1981	1991	1998
Taldi	5.77	6.61	5.81	6.37	N.A
Nutundi	5.58	5.59	5.47	5.78	5.76
Jarukhamar	7.62	7.02	9.50	5.28	7.41

Source : Same as tables 4a-4c

Table 6 : Change in decadal variation of population during 1951-1991 in sample villages of Raghunathpur, Purulia

Name of the sample villages	Decadal change
Taldi	+ 117.48
Nutundi	+ 76.54
Jarukhamar	+ 417.08

Source : Same as tables 4a-4c

The absolute number of households in the sample villages shows a remarkable change from 1991 to 1998 (Table-8), While in case of Taldi it has increased marginally, Nutundi shows the same without any change while in Jarukhamar the number has actually decreased. Jarukhamar is a relatively developed village in terms of income and educational status of the population. This may somewhat explain the outward migration behaviour occasionally depending on the availability of job opportunities. This shows an occupational mobility to the surrounding regions of Santaldih and Asansal-Durgapur industrial belt. The village has received electricity connection as well (1998).

Table 7 : Ethnic groups in sample villages, Raghunathpur, Purulia, 1998

Name of sample village	Total population (persons)	SC as percent to total groups	Major ethnic groups
Taldi	535	100	Bauri
Nutundi	1776	29.08	Bauri, Sarawak
Jarukhamar	280	2.32	Mandal, Bauri

Source : 1. Field work conducted in 1998.
2. District Census Handbook 1991.

The population composition is moderately homogeneous. Within the SC category Bauri community is predominant in Taldi while Jarukhamar is overwhelmingly dominated by Mondal, who are at present non-scheduled and are showing remarkable upward social mobility. Nutundi presents a greater beterogenity in terms of ethnic composition where only 29.08 percent are Bauri, rest being other non-scheduled groups. A fairly large number of fishermen belonging to (kaibarto) caste reside in this village.

Social Ecology

The social ecology of the villages are highly differentiated. The SC community particularly Bauris are extremely poor, without any permanent occupation. They are mostly landless, working as agricultural labourers or cowherds on daily wage (Rs. 20.00 per day) basis. They have no education, on the other hand, Mandals of Jarukhamar are quite wealthy and are educated. They are mostly owner cultivators. This subgroup is totally peasantised. They have greater occupational mobility. Thus it is seen that education and income are positively correlated, higher the income, greater is the educational status. This is true for female literacy also. Poverty is directly proportional to female illiteracy as is true of Nutundi and Taldi which are Bauri dominated areas and female literacy is extremely low here. During the course of the interview it was gathered that females (girl child) have no role in determing their future career, they are simply not offered any choice or a right of education by adult members of the family.

The entire social stratification is oriented towards occupational ranking and roles attained thereof. This is clear in case of Mandal Community who have attained a high social

economic and political status and at present have become non-scheduled. As Hinduism is said to have employed the occupational order as a model for the ritual and social expression of many basic religious values, the Indian caste system is labelled as ascription oriented (Gould, 1969)

At the base of the social pyramid are the SC caste who actually cultivate the lands as tenants and daily labourers. At the higher levels are the members of the dominant castes *i, e.* Brahmin, (or any others) in case of the study region the dominant caste is Jain or 'Laya' belonging to a higher status who own land (Srinivas, 1962). This varna based occupation system in fact still determines the social, economic, political and cultural hierarcly within the village community (Bose, 1975)

Although in recent years due to the works of Government and Non-Government welfare agencies awakening of social consciousness has taken place among the inhabitants, yet economic status determines the social and political status. The village head is often a member of the higher caste owning substantial protion of land.

The SC communities try and follow ritual, social customs, practices, usages, conventions and cultural traits of the dominant caste i.e. (Brahmin or Laya, latter a local caste) and at the same time attempt to preserve some of their ancestral rituals and customs. During the course of the interview it was revealed that Manasa Puja is quite strongly practised among the Bauris with greater grandeur than Durga Puja which is the most important festival and social occasion for the mainstream upper caste Bengalis at large. The former is the worshipping of the snake goddess during the month September which is the wet period in this part when occurrence of death from snake bites are more common even now. These interior villages are far away from the nearest health centre/district hospitals, where treatment is possible. Lack of access to medical care often results in death from snake bites. At a prior date may be this practise of worshipping of snake goddesses were more prevalent because of insecurity arising out of no control over such occurrence This kind of local ritiual has a long standing influence amongst the native people and is a result of direct environmental influence on folk life styles. By and large Bauris are now largely integrated with the mainstream population although in some rare occasson the practice of untouchability is still maintained within the society and social distance and caste endogamy are still prevalent within respective communities. Inter-community exchange of food and water is restricted in some cases. Thus rectification of social evils constitutes another facet of economic development which aims at qualitative improvement of the human resource.

Summary

In terms of material development still a good deal of work is to be achieved. The development

measures *i,e.* distribution of lands among landless cultivators. distribution of agricultural implements, farm animals, *e. g.* cows, goats, poultry etc., supply of potable and irrigation water, introduction of primary health centres and schools will go a long way in the development of these backward segments of population. Arrangement of credit facilities and encouragement of entrepreneurship among the people are other two areas of social engineering which may prove beneficial.

Acknowledgement

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IMPACT OF BIOTIC HAZARDS ON HUMAN LIFE : A STUDY OF SNAKEBITES IN SUNDARBAN, SOUTH 24-PARAGANAS, WEST BENGAL

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Abstract

A field survey on snakebite incidents was conducted for the year of 1993 to assess the nature and intensity of the problem in four blocks: Basanti, Canning I, Canning II and Gosaba. Together they cover an area of 1,059.7 km^2 with a population of 775,285 (1991) in the district of South 24 Parganas, West Bengal. The death rate among the victims was highest in Gosaba followed by Basanti, Canning I and Canning II. Males were bitten more than the females. Highest rates of snakebite as well as deaths, caused by snakebites, were found in the age group of 21 to 30 years. The rates increased during the monsoons. Most of the victims did not go to hospital or health centres because of lack of facilities, erroneous beliefs, misconception and due to the fact that the bites occurred mostly during the night. The study also showed that the common krait claimed most victims in this area followed by the common cobra. The death rate among the victims (57.3 per cent) was one of the highests in India.

Introduction

The Sundarban mangrove wetlands are situated in the North and South 24 Parganas district of West Bengal, India. It was started to be reclaimed from 1770 (Pargiter, 1934). During the next two centuries some 5,366 km^2 (65.6 per cent) of the former tidal forests were converted to farmlands in 16 police stations. The resident population, because of their proximity to the mangrove forests and underdevelopment, is exposed to a unique set of biotic hazards ranging from snake bites to tiger attacks that have greatly influenced their mental make up and socio-cultural set up.

Snakebite is a serious public health hazard in the reclaimed areas of Sundarban. The warm, moist climate, high drainage density and vast wetlands of this area provide an ideal habitat for the snakes. Among the most common poisonous snakes found in India—cobra, krait, viper and sea snakes—all are seen in Sundarban. Basanti, Canning I, Canning II and Gosaba are the four Sundarban blocks (Fig. 1) where the magnitude and intensity of snakebites and deaths are very high compared to rest of the region (Das, 1996). However, systematic data on occurrence of snakebites are extremely difficult to obtain from this area because neither all of the victims are brought to local government health centres for treatment

nor the health centres keep proper record of snakebite cases reported to them. In view of this, the primary aim of this work was to generate a basic database of snakebite incidents of the region.

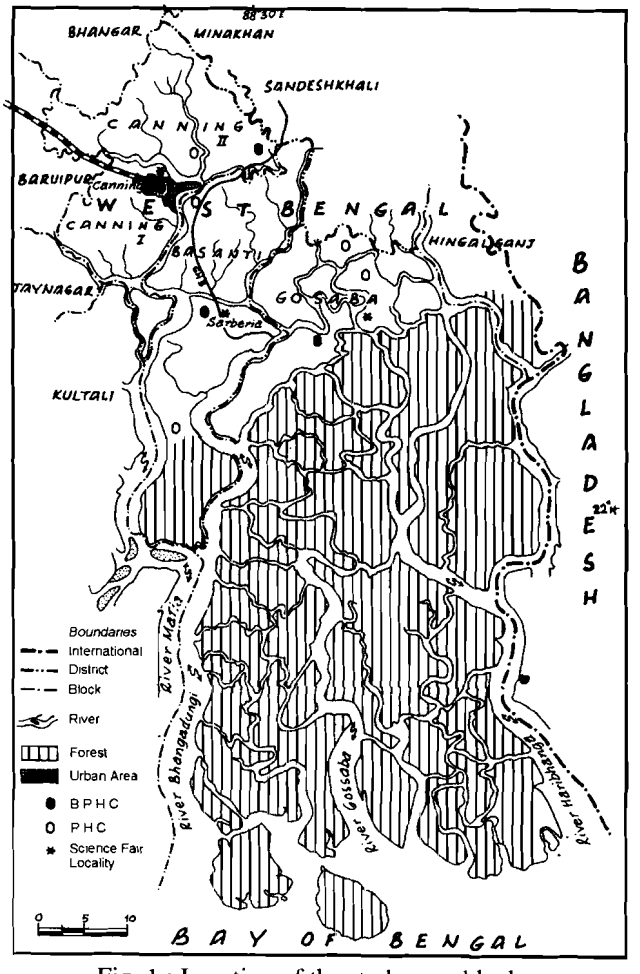

Fig. 1 : Location of the study area blocks.
(BPHC = Block Primary Health Centre; PHC = Primary Health Centre)

Objectives and Methods

A total of 223 mouzas in four blocks (Basanti, Canning I, Canning II and Gosaba), comprising 775,284 persons and 138,451 households, were surveyed during 1994-1995 with a questionnaire on snake bite incidents that took place in the year 1993. The main objectives

of the survey were :

- Identification of major types of poisonous snakes found in the region.
- Development of a detailed database of the intensity and magnitude of snake bites.
- Identification of the offending snake and epidemiological features of snake bite viz. age and sex of the victim; date, time & place of bite; body sites of bite; clinical symptoms etc.
- Classification of population groups according to their vulnerability to snake bites.
- Collection of information on the details of post-bite treatment.
- Correlation of the intensity and frequency of bites with climatic conditions.
- Evaluation of the existing methods of hazard prevention and
- Suggestion of preventive measures suitable for the area.

The data collected for the survey were completely primary in nature and involved filling-up of a questionnaire, prepared in Bengali. For door-to-door survey, volunteers from six local organisations were involved. These included the *Gosaba Science Club* of Gosaba Town, *Sarberia Krishi Chakra* of Sarberia, *Krishi Palli Unnayan* of Sonamali Hat, *Sundarban Bikash* of Marichjhanpi, *Unnayan of Marakhali and Juktibadi Sangstha* of Canning. The programme was co-ordinated through the *Juktibadi Sangstha* because of its central location and its experience in snake-awareness campaigns.

In addition to this, to collect data on local rituals and customs related to snakes and snake bites, mobile science fairs called *Bhramyaman Lokabijnan Melas* were organised in five localities of the study area (Fig. 1).

Major Poisonous Snakes of the Reclaimed Sundarban

Five types of poisonous snakes pose maximum threat to the population of the reclaimed Sundarban. The main characteristics of these snakes are described below following Zappler (1976) Madhusudana and Agarwal (1990) Hati (1994) and field observations. Their names are arranged according to decreasing intimidation.

Common Krait : In Sundarban as well as in West Bengal, common krait is the most widespread and most potent compared to other poisonous snakes. The head of a krait is only slightly distinct from its neck. Its colour is steel blue or black with white bars on the back. The scales are glossy and glistening. The kraits are usually found in pairs and if one is sighted or killed, the other is usually found nearby. It is a nocturnal creature living in dark places like rat holes, corner of the rooms and in straw heaps. It is most active during the nights and early hours of morning. It is common for a krait to crawl into one's bed during nights and to strike as one turns side in the sleep and disturbs the snake. Krait venom is neurotoxic and affects the nerves of the victim. However, bites are not painful, biting spots do not swell and often

go undetected. Symptoms include drowsiness and intoxication.

Cobra : Cobra is also common in the reclaimed Sundarban. It varies in colour from black or dark brown to yellowish white. The head of the snake is not very distinct from the neck. A white band is seen in the region where its head meets the body. It becomes most active at dusk, as it hunts along the edges of paddy fields for small animals like rats, mice and frogs. Rat-holes and straw-heaps form two of its favourite resting-places. The poison of the cobra is primarily neurotoxic. The venom affects the nervous system leading to respiratory and cardiac failure. The venom is very potent and is capable of killing a man within 15 minutes of the bite. The symptom includes pain, slight swelling and irritation.

Russell's Viper : Another important venomous snake of the area is the Russell's viper, although their number has sharply declined in the recent years. It is rarely seen in bushes and vegetated areas near villages where the coloration of its skin is in keeping with the surroundings. It is brown in colour with deep elliptical patches that run in three rows. At rest, it remains coiled. However, with least disturbance the snake raises its head and starts to hiss loudly and continuously which alert the people of its existence. A bite by a Russell's viper is extremely painful and affects the blood. The signs and symptoms of the bite include vomiting, sweating, local burning, swelling and oozing of blood from the wound.

King Cobra : The coloration of this snake is olive and light black with thick stripes of faint yellow. Its hood is longer and narrower than the common cobra. The king cobra is found in dense forests, particularly in the core areas of Sundarban, away from human habitations. Once disturbed, it raises its head often up to one metre in height and stand in an aggressive position. Owing to its large size, the amount of venom given out by a king cobra is more than that of a common cobra, although slightly less toxic. However, one bite of the snake is enough to kill any large animal. Symptoms of bite are very similar to that of common cobra but poisoning sets in more rapidly.

Banded Krait : This is a brightly coloured snake with alternating black and yellow rings. It commonly lives in rat holes in the peripheral areas of human settlements. The banded krait lives on other snakes, mostly the common kraits. They are nocturnal, sluggish in nature and generally do not attack humans. Its venom, however, is very toxic.

Table 1 : Common poisonous snakes of Sundarban and their characteristics

English name	Scientific name	Local name	Average adult size	Amount of venom carried	Lethal dose for an adult	Time taken to die if not treated
Common Krait	*Bukgaras cueruleus*	Kalach, Karayat, Kalchiti, Shiyerchand	1 m	22 mg	1 mg	3 h - 63 h
Common Cobra	*Naja naja*	Keutia, Gokhura, Kal-Keutia, Kharish, Padma-Keutia	1.8 m	200 mg	15 mg	0.25 h - 60 h
Russell's Viper	*Vipera russellic*	Chandrabora	1.6 m	150 mg	42 mg	15 h - 9 days
King Cobra	*Ophiophagus harirah*	Nagraj, Shankhachur	5 m	Not available	12.0 mg	Not available
Banded Krait	Bungarus fusciatus	Shankhini, Shakhamuti	1.7 m	22 mg	10.0 mg	Not available

Source: Hati, 1994 and field observations

Results and Discussion

The results obtained from the survey are summarised in Tables 2 through 4 and Figures 2 and 3. Different aspects of them are analysed in the following sections.

Table 2 : Block-wise distribution of area, population and snakebitesc

Blocks	Area (km^2)	population (1991)	House-holds (1991)	Mouzas	Number of snakebites (1993)	Death out of snakebites (1993)	Per cent of deaths to total snakebite cases
Canning I	216.00	196,217	35,211	44	40	22	55.1
Canning II	222.14	151,660	25,854	63	41	21	51.2
Basanti	289.10	226,902	40,344	65	39	19	48.7
Gosaba	332.50	200,506	37,042	51	30	24	80.0
Total	1059.74	773,294	136,460	223	150	86	57.3

Source: Directorate of Census Operations, 1997 and field observations

Table 3 : Distribution of fatal bite cases according to snake types, 1993

Type of snakes	Number of fatal bites	Per cent of all fatal bites
Common Krait	54	62.8
Common Cobra	30	34.9
Russell's Viper	02	02.3
All	86	100.0

Spatial distribution : In the four surveyed blocks, snakebite cases during the year 1993 were found to be 150, out of which 80 per cent were fatal. Per cent incidence of deaths was slightly higher in Gosaba and Basanti than the two Canning blocks. This can be ascribed to their backwardness in communication facilities and availability of proper medical treatment.

Types of snakes involved : Accurate diagnosis and estimation of poisonous snakebites are difficult. In clinical practice, efforts are made to identify the offending snake from

symptomatology and, in death cases, from local study and surroundings for sufficient clues to the incidence and the type of envenomation. For example, in four fatal cases encountered by the survey nearby persons or even family members of the victims failed to identify the snake and provide some related information. In these incidents, snake experts were consulted to analyse the associated symptoms and include them into proper category. In the surveyed blocks, common kraits caused maximum number of death incidents (62.8 per cent) followed by common cobra (34 per cent) and Russell's viper (1.2 per cent). The significantly low incidents of viper bites are probably linked to their rapidly dwindling number in the reclaimed Sundarban. Non-occurrence of a single banded krait or king cobra bite can be related to the fact that both of these snakes come in little contact with the humans. While the banded kraits are shy creatures, cobras are only found in deep jungles, away from the settlements.

Table 4 : Distribution of fatal bite cases according to time of strikes, 1993

Particulars	Night (7 am -5 pm)	Morning (5 am -7 am)	Evening (5 pm -7 pm)	Day (7 am -5 pm)
Number of fatal bites	55	13	14	4
Per cent of all fatal bites	63.9	15.1	16.3	4.7
Common Krait bites	49	3	2	—
Common Cobra bites	6	10	10	4
Russell's Viper bites	—	—	2	—

Time of incidence : Snakes are cold-blooded animals and hibernate during the winter. On the other hand, they are forced to come out for search of alternative shelter and food when water starts to flood their resting-places with the onset of the monsoons. The incidents of snakebite in the surveyed areas were conformed to this seasonal pattern. They were nearly non-existent during the winter and recorded peak values during the last phase of the monsoons (Fig. 2). With progress of the monsoons, as the rains gradually flooded increasing numbers of resting places of the snakes, bite incidents also soared in number. Deterioration of transport facilities in these rural areas during the monsoons also contributed to the problem by preventing quick

removal of the victims to health centres.

The study showed that only five per cent of the bites took place during daytime. This can be attributed to the cobras, which mainly attack the farmers in the paddy fields. On the other hand, about 81 per cent of the deaths occurred in the night and early morning, which correspond to the maximum activity of common kraits.

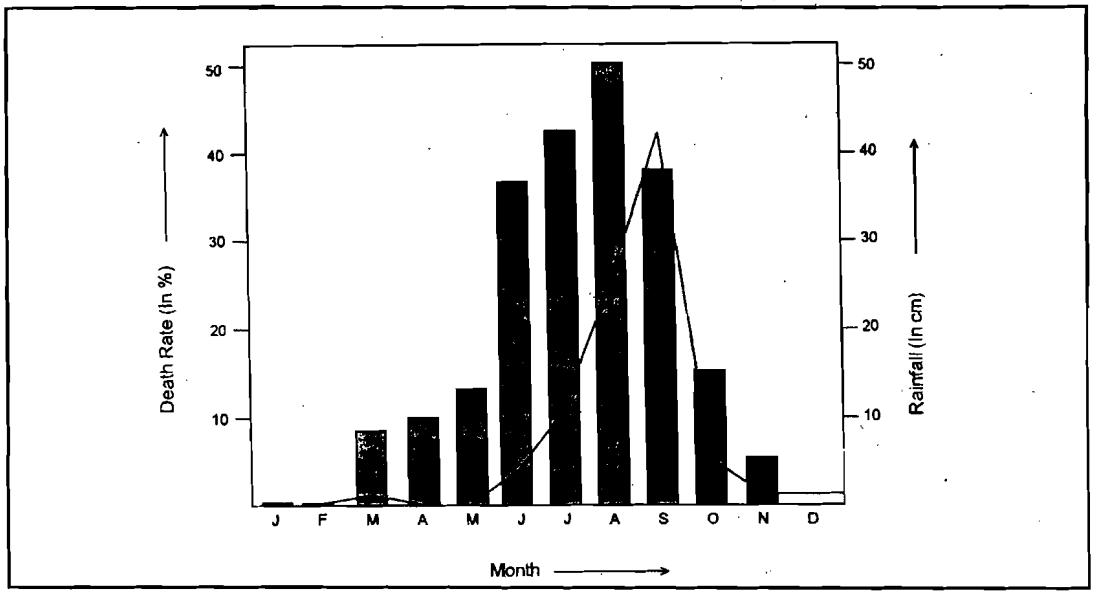

Fig. 2: Relationship between deaths due to snakebite (line) and rainfall (bar), 1993
(source of rainfall data: Department of Agriculture, Government of West Bengal)

Age and Sex : The female-male ratio of the bite victims was 1:3. Although bite incidents were observed in all age groups, the majority of the victims (62.8 per cent) were found in the male population between 11 and 50 years (Fig. 3). This group is most active in the outdoors that increases the risk of cobra bites. However, it was revealed by the study that 75 per cent of the bites occurred indoors and were caused by the common kairts. In the study area mosquito nets, which provide protection from the snakes, are insufficient and are mostly used for the women and the children apart from the elderly. This leaves the aforementioned age group most vulnerable to common krait bites. This has been well reflected in the statistics.

Mortality : Availability of prompt aid with Anti-Venom Serum (AVS) after occurrence of a poisonous snakebite largely determines the chances of survival of a victim. The minimum time available for medical attention after the incidence of a bite varies from snake to snake.

For example, this ranges between 15 minutes and a few hours in cases of cobra bites and between 3 and 5 hours in incidents of krait bites. In the surveyed blocks, it was found that the delay in seeking proper medical aid was largely attributable to the prevalent faith of people upon the traditional healers or ojhas, who claim to use black magic and other rituals to treat the victims. Inadequate numbers of health centres and poor stock of AVS in them are also responsible. In the four surveyed blocks, the health centres that stock AVS number only four and are situated in the headquarters of the respective blocks (These centres are called Block Primary Health Centres). This has led to a very high mortality rate among the bite victims. Out of 150 bite victims reported in the survey, 57.3 per cent succumbed to death. In the surveyed blocks, the annual rate of deaths due to snakebite was 1.1 per 10,000 people.

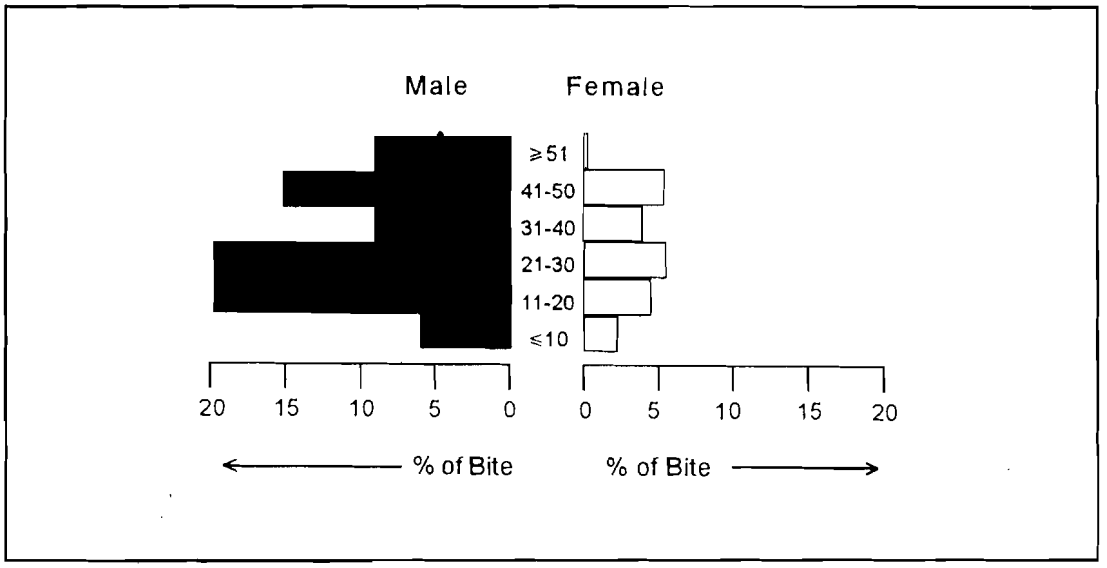

Fig. 3: Classification of deaths due to snakebite by age & sex, 1993

Conclusions

The problem of snakebite did not receive adequate attention in the area compared to rabies and other mosquito-borne diseases like malaria. However, the problem is often more serious than other micro and macrobiotic hazards. It is needless to mention that the public health programme against snakebite should not only involve community planning but also individual health education. The following are some of the basic recommendations for preventing deaths from snakebites.

- The common krait generally takes shelter surrounding the human habitation. Therefore,

junk and garbage heaps should be prevented from accumulating. Dark places of the rooms, mainly the corners, should be checked for occurrence of snakes regularly.

- A mosquito net provides protection from snakebites during sleep. In view of high incidents of bites during the night, the use of such nets should be made mandatory for the people of the reclaimed Sundarban. Measures should be taken to distribute the nets at a subsidised rate to the weaker sections of the population. As a secondary benefit, the nets would also prevent proliferation of insect-borne disease like malaria, also common in these areas.
- Farmers and labours working in the fields should be educated to use low-cost foot wears covering up to the knees and gloves to prevent bites of cobras.
- Introduction of primary health centres in every village with facilities of snakebite treatment and regular supply and storage of AVS are urgently required.
- Improvements of rural communication and transportation facilities are also needed urgently. To facilitate fast transfer of snakebite victims to health centres especially during the monsoons, the roads of the interior areas should be paved with bricks.
- Health education of the people regarding preventive measures against contact with snakes, first aid and promptness to bring the victim to the nearest health centre etc. are also needed for better prognosis of snake bite cases.

Acknowledgement

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ENVIRONMENT IN PERIL : UNPLANNED DEVELOPMENT OF TOURISM INDUSTRY IN THE MAHABALESWAR-PANCHGANI PLATEAU, MAHARASHTRA

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Abstract

The Mahabaleshwar-Panchgani plateau in the Western Ghats of Maharashtra constitutes a region of unique ecological character. However, off-late, the unbridled pace of tourism development activities accompanied by massive deforestation, loss of valuable fauna, unregulated construction spree and varied forms of pollution have resulted in severe environmental degradation and cultural decay threatening thereby, its pristine character. Although conservation efforts by various Government bodies and Non-Governmental Organisations (NGOs) as the Bombay Environmental Action Group (BEAG) have been pronounced, success has been limited till date. The paper argues for the enforcement of strict environmental regulations and architectural stipulations in the development and maintenance of tourism infrastructure supported by awareness programmes for the region's integrated and sustainable pattern of tourism development.

Introduction

The Mahabaleshwar-Panchgani plateau, situated in the lap of the Western Ghats at an altitude of 1372 metres, and in area of 23,735 hectares in the Satara district of Maharashtra, forms a region unique in character. The once summer capital of the erstwhile Bombay Presidency, Mahabaleshwar was the discovery of the General Peter Lodwick, it is learnt. Topographically dominated by the panoramic crest-line of the Western Ghats, characterised by an alternating succession of high flat-topped plateaus and occasional rounded peaks descending abruptly into the luxuriantly vegetated valleys below, the region forms the watershed to some of the important river systems of the Indian peninsula such as the Krishna, Koyna, Venna, Savitri and Gayathri.

Representing the single surviving patch of homogenous rain forests in the country, with a rich repository of unique bio-diversity, highly valued for its medicinal, botanical and aesthetic properties, the region forms a paradise for nature lovers. It also provides Mahabaleshwar-Panchgani with its unique selling points (USP) in its natural scenery. The region is also home to some of the rare species of fauna (like the Giant Indian squirrel, mouse deer, the Blue Mormon butterfly, etc.), highly prized on the conservator's list.

The rich diversity in natural tourism resources have enabled the twin hill resorts of

Mahabaleshwar and Panchgani lying in this region, in enjoying immense popularity among the domestic and international tourists visiting Maharashtra. Some of the popular attractions include several view points, the Venna and Tapola Lakes, the Ganesh temple at Wai, the Buddhist caves at Lonara, the Pratapgadh Fort, the samadhi of Ramdas Swami at Sajjangad, and Safara, the 17th century capital of the Maratha empire. Unfortunately, in the recent years, much of the picturesque natural splendour of the environment in the Mahabaleshwar-Panchgani region has witnessed an ugly pattern of unplanned tourism development accompanied by a phenomenal growth in the number of tourists and the resulting unregulated spree in urban construction, deforestation, pollution and cultural degradation.

The objectives of this paper are : • to focus upon the various aspects of unplanned tourism development in the Mahabaleshwar-Panchgani plateau; • to provide a critical assessment on the role of the Government and the Non-Governmental Organisations (NGOs) towards the preservation of the region's natural and cultural heritage; and • to suggest policy measures for the planned growth and regional development of tourism in the Mahabaleshwar-Panchgani region.

Unplanned Tourism Development and the Resulting Ecological Destruction

The Mahabaleshwar-Panchgani region in the recent years has witnessed a phenomenal growth in the number of tourists (an eight-fold increase from the mid-80's to the present figures) accompanied by an unbridled pace of tourism development activities. More importantly, much of this has been achieved at the cost of deterioration in the region's unique natural diversity. Large scale deforestation for commercial purposes have deprived the Mahabaleshwar-Panchgani plateau from more than 70 per cent of their verdant tree cover. The Devrais or the veritable treasure groves of natural wealth (revered by the local villagers and often worshipped by the tribals as a community deity), including varied species of trees, herbs, birds, insects, etc., located in a single ecological corridor straddling the Western Ghats have also been affected considerably (Koppikar, 1999). While the indigenous species as the Anjani *(Mamecylon umbellatum)* and Karvi *(strobilanthus callosus)* represent classic examples of being continuously uprooted for commercial purposes. Many unique orchid varieties extremely sensitive to the climatic perspective of the region are also on the verge of extinction. Head-loading activities for catering to the fuel-wood requirements of the locals have also depleted many woodlands leaving the last vestiges of the once thick primary forest covers confined to only a few selected points of the plateau like the Lodwick Point, Bombay Point, source of the Solshi river and near the Lingamala Falls (Deshmukh, 1997a).

The long-term implications if this on microclimatic characteristics (increasing temperature and decreasing rainfall), edaphic conditions (soil erosion, siltation, etc.) and

ground water resources (high run-off in the fragile tracts during monsoons and acute water shortage during summer) of the region have already been evident.

The loss of fauna, including many wild animals (bears, leopards etc.) and birds (Soneri Haldi, Haneskar, Pankhwala etc.), is quite evident. There has also been a sharp decline in the bat population as in the lavish areas neighbouring the Robber's Cave, Chinaman Falls and Dhobi Falls as a result of loss of habitat due to upcoming projects.

The unregulated spree in construction within the Mahabaleshwar-Panchgani Municipal limits, to cater to the accommodation requirements of the ever expanding tourism industry, besides contributing to deforestation activities have also resulted in the formation of urban scars on the pristine landscape. Most of these constructions are unauthorised and have come up in complete disregard to the specific regulations pertaining to height, floor limit levels, basement usage, etc., as stipulated in the existing building bye-laws (which permit only two storied structure of a height not exceeding 25 m from the plinth level, with a basement for vehicular parking in the bazaar area (Sector I) and prohibit development on leased properties as in private estates with bungalows in Sector II of the Municipal Hill Council (Deshmukh, 1997b). Others flout the local Development Control Rules (DCR) as outlined by the Mahabaleshwar-Panchgani Regional Plan (1984-2001), which do not permit hotels in three specific land uses viz. the residential, green and forest, demarcated as no-development zones. Besides, upcoming private tourist resorts, luxury bungalows and housing colonies of the Non Residential Indians (NRIs) on cultivable agricultural lands and greens have also contributed substantially towards the changing land use pattern of the region.

Preservation of the region's cultural heritage has also been bestowed little regard. The antique vernacular architecture of the ancient bungalows and cottages with their wooden walls, tiled sloping roofed structures, etc., in complete harmony with the natural surroundings have given away to concrete modern constructions of the latter day. Besides, the haphazard growth of countless unauthorised tacky stalls (as in popular view points including the Wilson Point, Bombay Point and Arthur Point) flaunting garish video entertainment games and selling food items to the noisy tourists thronging them during the peak tourist season have become a common sight. Places such as the Arthur Point have been converted into a scene of crowd and clamour—resembling an evening in a downtown city rather than a serene hill station. Besides contributing towards visual blockage of the picturesque scenery around, they also have resulted in noise and water pollution by affecting the traditional tranquillity and contributing towards littering through non-degradable plastics and other wastes (as in areas around the Venna lake with facilities for fishing and boating).

Role of the Government and the Non-Governmental Organisations

In view of the waning ecological importance of the Mahabaleshwar-Panchgani region, several promotional efforts have been undertaken by the State Government and NGOs for the preservation and conservation of its natural and cultural environment.

Some of the corrective measures adopted so far include, the Maharashtra Felling of Trees Regulation (1964), the Forest Conservation Act (1980) etc., which have prohibited non-forest activity in the forested tracts of the region. Besides, the Town Planning Department has stopped issuing permission for the construction of new hotels, lodges, holiday homes, private bungalows, etc., within the municipal limits of the region in violation to the provisions of the Maharashtra Land Revenue Code (1966). In areas elsewhere, where building proposals have been considered, several checks have been introduced to ensure against further violation of the region's building bylaws, DCRs and environmental acts. A few examples of these include submission of plot photographs by applicants along with plans for the proposed structure. Regulations stipulating failure of plan sanctioning in case of construction activity involving felling operations have also been specified. The Satara Collectorate has been advised by the State Government to put up a proposal for altering the Floor Space Index (FSI) in Sector I of the land use plan for the Mahabaleshwar-Panchgani region. Besides, it has also proposed plans for regularising some of the illegal structures and for charging hefty fines for the misuse of basements for commercial purposes.

As regards the NGOs, the role of the Bombay Environmental Action Group (BEAG), has been most pronounced. Apart from voicing their protests against the countless acts of ongoing environmental degradation in the region, the BEAG has been innovative in suggesting several strategies and guidelines for imposing specific controls for the preservation and development of the aesthetic and architectural appeal of the region, through immediate intervention. It has been at the behest of a petition filed by the BEAG (the first NGO to set a precedent) that an order was passed by the Division Bench of the Bombay High Court to direct the Maharashtra Government in appointing an eight member Heritage Committee (consisting of select civil servants and experts from varied fields) for monitoring development activity within the municipal and non-municipal areas of the Mahabaleshwar-Panchgani region (ToI, 1998). This was for ensuring protection of its natural and built heritage and in reporting to the Court upon any act of violation going on against the interests of the same.

However, according to the BEAG, the initiatives adopted by the State Government are neither substantial nor appropriate solutions for controlling the unhealthy pattern of development in the Mahabaleshwar-Panchgani region. Instead, they have wished to ensure protection against the ongoing deforestation through the strict implementation of the Supreme

Court order of December, 1996. Besides, they have supported for a complete ban on tree felling and the use of land for commercial constructions in the leasehold plots of the plateau, by the Environment Ministry for the next ten years at least. They have also exhibited complete disapproval against the Governmental efforts towards regularising unauthorised structures and have instead favoured their complete demolition. In addition, revocation of licenses and permissions granted to restaurants located within the illegal structures and immediate action against the offenders has also been recommended. The environmentalists of the BEAG have also opined for a ban on all proposed future constructions in the area from stopping property in being misused (as has been done in Mount Abu, Rajasthan). The BEAG has also sought to ensure that no additional FSI is given to any construction. It has also felt that the DCR as framed for the unique twin hill resorts of Mahabaleshwar and Panchgani (on the lines of standardised regulations as applicable to other Municipal Councils) need urgent modification in accordance with the provisions of the Maharashtra Region and Town Planning (MRTP) Act. Many long time residents of the region have hailed the commendable work of the BEAG activists under non-governmental initiatives.

Evaluation

In spite of the best efforts adopted by the State Government and NGOs as the BEAG, towards the preservation of the natural and cultural heritage of the Mahabaleshwar-Panchgani plateau, not all have yielded positive results. The prevention of rampant deforestation and head-loading activities has been a difficult task and has continued unabated in the ecologically sensitive tracts of the region to this day.

Although the Government allows locals to collect dry wood for domestic use (but not for sale), malpractice involving commercial gains from sale continue as a flourishing business. The nominal fines imposed by the Forest Department for tree felling (depending upon tree size and type and ranging from Rs. 50 to Rs. 100 in most cases) mostly go escaped. The existing loopholes and feigned ignorance and corruption of the forest officials coupled with their laxity have collectively contributed towards making fine collection an irregular affair.

So far, little concern has been exhibited by the Forest and Revenue Departments towards implementing the measures recommended by the BEAG for the protection and conservation of the region's vegetal cover. The Forest Department has been little successful in its contribution towards regulating tree felling and Head-loading activities in the plateau. In addition, it has also largely failed in abiding by the Supreme Court order of reviewing specific proposals for the survey and demarcation of forest lands, identification of wooded areas in non-forest zones including revenue and private land, adoption of strict action against

vandalism on such 'forest' tracts technically outside its jurisdiction, setting up a special nursery in Mahabaleshwar (with a grant of Rs. 10 lakhs from the Satara Collectorate) for providing alternative employment to head-loaders, stopping vehicles from entering into forested tracts, removing unauthorised stalls from tourist view points in forested tracts, etc (Balaram, 1998).

The authorities of the Satara Collectorate have also largely failed in drawing and sanctioning funds for a soil conservation plan in the eroded tracts in the Mahabaleshwar-Panchgani plateau. This has been largely on the pretext of a financial crunch and by stating that deforestation has been confined on the revenue lands alone. As regards the demolition of illegal structures in the region, in spite of notices being sent to specific irregularities time and again, no follow up action has been evident so far. The hoteliers have not bothered to dismantle their unauthorised extensions and are continuing with their usage of basements precisely for all commercial purposes other than parking. Cases pertaining to the regularisation of illegal constructions have till date mostly remained paper tigers. FSI fiddles towards hotel construction in Sector I of the landuse plan have also been largely ignored while cases involving illegal land transfer and farmhouse constructions still remain to be sorted out. Much of the impending action bears testimony to the corruption in the Mahabaleshwar-Panchgani Municipal Council and the Satara District Town Planning Department, which include, among its members, many promoters and hoteliers.

Policy Prescriptions for Planned Tourism Development

For the preservation of the vegetation cover of Mahabaleshwar-Panchgani plateau from further destruction, indiscriminate felling of trees should be stopped immediately. The State Forest Department should impose severe fines and step up vigilance throughout the forested tracts of the region. This can act as a deterrent on those engaged in illegal trading of rich medicinal species. Synthetic alternatives to commercial species (as the Anjani and Karvi) which are used for a variety of purposes should be worked upon and scientific usage of botanical species should also be reduced eventually. Since Anjani does not appear in the list of scheduled species under the Forest Act, the Forest Department is not in a position to prosecute those who cut these trees. What it needs is to urgently launch conservation projects and adopt all possible measures to save the existing vegetal cover, be they on forest or non-forest lands. The Forest Department's recent identification of a mere 32 hectares of non-forest land (conforming to the dictionary meaning of 'forest'), reveals a ridiculously low figure considering that there are 12,396 hectares of land under the Forest Department and over 10,000 hectares of non-forest land (as per the Mahabaleshwar-Panchgani Regional Plan) in the plateau.

The provision of subsidised kerosene to villagers can reduce their dependence on fuel wood from the forests and can act as a deterrent to the ongoing head-loading activities.

The State Government should adopt immediate steps to ban all upcoming constructions (mostly of hotels and other commercial ventures) in the region and local authorities should be advised from issuing fresh licenses for the same. Immediate efforts should be adopted for removing the unauthorised stalls flourishing in the Venna lake area and in the other popular tourist spots in the region. Perhaps, a better suited alternative natural location outside the lake's catchment, should be looked for the stalls at the earliest. An approval from the Maharashtra Tourism Development Corporation (MTDC) should also be made mandatory for the establishment of new tourism enterprises.

A Committee of planners and environmentalists could be set up to revise the existing development plan and formulate new laws which could expedite an action plan for the preservation and replenishment of the region's environment through sustainable development. The call for a Regional Environmental Impact Assessment (EIA) Plan and its immediate implementation by the agencies at the Governmental level is an urgent need of the hour. In order to provide a sound basis for the long run sustainable development of tourism infrastructure in Mahabaleshwar (in accordance with the tourist requirements and the region's carrying capacity) the evolution of a comprehensive data machinery is also required. This should involve periodic surveys involving the collection, compilation and publication of official data on the various aspects of tourism, viz. tourist profiles, demand for various kinds of tourism (as eco-tourism, adventure tourism, cultural tourism, etc.), provisions of adequate tourist facilities and support infrastructure to match the existing demand and supply requirements, etc. Besides catering towards greater tourist satisfaction and boosting tourism revenues, this could help in ensuring better upkeep and maintenance of these twin hill resorts. In Mahabaleshwar and Panchgani, where entry tax is collected, tourist inflow data can be compiled with relative ease.

The Mahabaleshwar Municipal Council, one of the richest hill station Councils in the country (in 1997 it earned Rs. 3.26 crores from tourism), has so far contributed very little towards the maintenance of the twin hill resorts. Even if not interested in saving the environment, clearance of garbage at the various tourist viewpoints is definitely the Municipality's job. So far little efforts have been made towards this direction. The antiquated system of septic tanks, largely inadequate in meeting the current load needs immediate attention. The development of a modern sewage system could reduce contamination in the local waterfalls, ground water systems, rivers and the Venna lake from waste water overflowing into them from the innumerable hotels in the high season and thereby rendering them largely unfit for drinking purposes.

In order to check the unregulated flow of tourist vehicles through the forested tracts of the region and thereby in controlling vehicular air pollution, the State Government should impose strict embargoes (as is being practised in some of the world's major sanctuaries as in the Yellowstone National Park in the USA) on the number of diesel operated vehicles (including tourist buses, trucks, cars, etc.), from entering these zones and thereby spoiling their aesthetic appeal. Perhaps, some parts of the plateau could be closed completely to tourist vehicles (as is the practice in Matheran, another hill resort in Maharashtra) and opened only to trekkers along sign posted routes. Adventure sports and camping could also been developed if such activities are institutionalised without clearing forested tracts.

The popularisation of tourism awareness programmes for the preservation and conservation of the natural and cultural heritage spots of the region needs immediate attention through effective planning and implementation at all levels. Prevention in the generation of biologically non-degradable items (as plastic bags), etc., could help in reducing pollution and degradation of the natural environment. The adoption of legislation promoting the growth of eco-friendly, local resource based industries (such as handicrafts, souvenirs, handlooms and cottage food products using locally grown strawberries and raspberries etc.), could help in generating revenues for the local craftsmen engaged in them and help in reviving their skills through training and research. The development of horticultural activities on fallow lands could help in revitalising the orchard economy besides being destinations for day-trips for the tourists to undertake (as in the vineyards of France).

In order to retain the character of anything representative of being 'typically Mahabaleshwar', strict architectural guidelines specifying building regulations (as on height, colour, angle of roof slope, tiling materials, etc.), should be adopted and adhered to. This can help all new constructions in blending with the existing natural ambience. Any new construction, which could interfere with the line of sight at the various tourist viewpoints, should be halted even if investments have been already sanctioned for such projects.

Conclusion

Mahabaleshwar and Panchgani's unmatchable diversity in natural and cultural tourism resources (both traditional and contemporary) spread within the geographical boundaries of its area, provide it with immense opportunities for tourism. However, the need of the hour lies in maintaining and enriching the same for the present and in ensuring a sustainable pattern of tourism development for the future. In order to promote Mahabaleshwar and Panchgani as unique tourist destinations, it is essential to take into consideration environmental sensitivity,and aesthetic charm of the existing tourism resources. These need to be planned and developed in a meaningful manner so as to retain their uniqueness and thereby help in

truly transforming the Mahabaleshwar-Panchgani region as a paradise for all those visiting the Western Ghats in the years to come.

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Short Communications

MAPPING AND MONITORING OF MANGROVE ECOSYSTEM, SUNDARBANS, WEST BENGAL, USING REMOTE SENSING TECHNQUES

Introduction : Sundarbans, one of the world's major mangrove ecosystem needs proper planning and timely execution of conservation measures to control further degradation. Satellite remote sensing, with its repeatability and synoptic coverage in separate spectral bands, has opened new vistas in the survey and monitoring of the inaccessible areas. Realising the importance of data base on the condition and areal extent of mangroves for a scientific forest management strategy, an attempt has been made in this work, to segregate three density classes within complex mangrove ecosystem in the district 24 Parganas (South), West Bengal using IRS-1A/B LISS-II data pertaining to November-December, 1988,1991 and 1994. The overall classification accuracy is more than 85 per cent.

The study area : The district is situated between latitudes 21 30 N - 22 37N and longitudes 88 03 E - 89 07 E. It is bounded on the north by Calcutta and 24 Parganas (North) districts, on the east by 24 Parganas (North) district and Khulna district of Bangladesh, on the south by the Bay of Bengal, and on the west by the river Hugli separating it from the districts of Medinipur (East) and Howrah

Data used : The satellite and collateral data used in this study were the following: (a) IRS-1A/B LISS-II data path/row 18-52 A1, A2, B1, B2; 17-52 A2; 18-53 A1, B1 and 17-53 A1 pertaining to November - December 1988, 1991 and 1994; (b) Survey of India topographical map nos. 79B, 79C, 79F and 79G on 1:250,000 scale and aerial photographs on 1:50,000 scale as collateral data. (c) Working plan maps pertaining to Sundarbans were consulted wherever necessary.

Methodology applied : (1) The different scenes under study were first merged on their paths and geometrically corrected with respect to the topographical maps. Standard False Colour Composites (FCC) were generated by assigning red, green and blue colour to bands 4, 3, and 2 respectively. Different stretching were applied to highlight the desired information for easy identification of earth features.

(2) Based on tone/texture along with the associated features, various "ground truth" points were identified and marked on the standard FCC. In view of inaccessibility to enter the vegetated swampy zones of Sundarbans, emphasis was given to the fringes of the mangrove

Islands during the ground truth collection. Aerial photographs were also consulted wherever necessary while assigning training areas for classification.

(4) Representative areas in Sundarbans were subjected to Normalised Difference Vegetation Index (NDVI) and Tassled Cap Transformation based on Kaunth - Thomas algorithms to understand the density classes within the complex mangrove vegetation.

(5) The total scene was then assigned different training sets based on the gathered ground truth information and by consulting outputs from Normalised Difference Vegetation Index, Kaunth and Thomas algorithm and aerial photographs. To avoid misclassification, the total scene was classified twice, once on the major area pertaining to mangrove zone of the Sundarbans and secondly on the area without mangrove zone. The classification was done using maximum likelihood algorithm. After classification, respective rows of the scenes were mosaiced to represent the entire area under study.

(6) The district, road, rails, range and Sundarban Tiger Project area boundaries were digitised. District mask file and the remaining boundaries as overlaying file were generated. Using the district mask file, the district was extracted and later other boundaries were superimposed from the overlaying files.

(7) Statistical data on different mangrove density classes for the periods 1988,1991 and 1994 along with other land use/land cover classes were also generated and monitored the changes.

Results and Discussion : Sundarbans, perhaps the largest single block of mangrove in the world has got nearly 20 species of flora. However, only two species namely, Sundri (*Heritiera fomes*) and Genwa (*Excocaria agallocha*) constitute the major part in the mangrove forests of Sundarbans.

Two-mangrove vegetation in Sundarbans can broadly be divided into two main soil-vegetation types. They are Euestuarine and Proestuarine. The later can be further divided into three subtypes, viz., Tidal Mangroves, Prohaline and Euhaline.

The euestuarine type in Sundarbans is composed of gregarious growth of Nypa fruticans and Phoenix paludosa. Often, they form pure strands along the elevated fringes and drier borderlands of protected tidal waves.

The tidal mangrove zone where the salinity is more or less same as that of the open sea is found to be covered with a single species—*Avicennia marina.* But with increase of elevation and consequent admixture of fresh water and sea-water, there is formation of mixed nature of vegetation mainly of *Sonneratia, Bruguiera, Aegialitis* and often *Excoercaria* species.

Due to complexity and mixed nature of different mangrove species, it is rather difficult

to segregate on species basis until and unless one is fully conversent with the phenological condition of different species. Efforts are on to make use of temporal data as well as utilisation of IRS-1C/D LISS III/Landsat TM for better accuracy in delineating species wise density classes.

However, in the present study emphasis has been given to segregate only three density classes within the complex mangrove ecosystem. In view of uniform canopy, the NDVI/Kaunth-Thomas output images have not yielded fruitful results in differentiating the area covered by trees from those covered by bushes. Therefore, in the present context, the total canopy cover has not been taken in segregating the density classes but only the tree canopy cover has been considered before assigning training areas for classifying three density classes. The identification of bush and tree canopy is found to be possible by different linear stretching in red (band 4), green (band 3) and blue (band 2) filters with further confirmation from aerial photographs. This remote sensing approach has helped to find out the good tree cover areas within the mangrove zone of the Sundarbans leaving bushy nature of the vegetation under the category of degraded forests.

No doubt this approach leads to some misclassification due to overlapping signatures within open and degraded type of mangrove forests but total accuracy with respect to aerial photographs and ground realities is quite satisfactory. Further, the classification of coastal vegetation proposed by other authors has helped to identify the zonation pattern within the mangroves of Sundarbans.

In the present study, the identification of estuarine, tidal mangroves and euhaline zones were accomplished. The vegetation in general was delineated into three levels viz. dense (canopy cover more than 40 per cent) represented along the fringes of Islands as estuarine and tidal mangroves; open (canopy cover between 10-40 per cent) constitute some species of tidal mangroves and prohaline zone represented by mixer of mangrove and fresh water taxa. The euhaline zone which is elevated with salt tolerant species, though sparse has been segregated under degraded forest (canopy cover less than 10 per cent).

The dense estuarine and tidal mangroves of 615.15, 799.93 and 860.94 km^2 open tidal/prohaline mangroves of 851.52, 869.12 and 830.13 km2 and degraded euhaline mangroves of 551.93, 425.40 and 404.86 km^2 during the period 1988, 1991 and 1994 were recorded respectively to that of total mangrove ecosystem area of about 4200 km^2. An area of 2104.07 km^2 out of the total mangrove ecosystem of 4200 km^2 is occupied by wetlands including river/sea water coarse in the Sundarbans mangrove ecosystem of the 24-Parganas (South) district. The monitoring of the mangrove forest with an interval of three years period clearly shows a progressiveness of vegetative cover and sustenance of total Sundarban ecosystem. However with the availability of high-resolution satellite multispectral data form

IRS-1C LISS III with 23-m resolution and panchromatic data of 5.8-m will revolutionised the concept and study of such important mangrove ecosystem.

Conclusion : Remote Sensing techniques have been widely used for forest related studies. One of the important areas of environmental concern is that of rapid deforestation and it has now attracted global attention due to a greater focus on increased global warming and the so called green house effect. Considering the importance of mangroves for nutrient recovery and recycling excess of nitrogen, toxins and absorption of heavy metals residues, the unique wetland ecosystem need to be intensively studied. Keeping in view of this, regular monitoring of the coastal ecosystem has been taken up for every three years for the periods 1988,1991 and 1994. The present investigation was able to reflect the changes manifest within the mangrove forest canopy and in general the changes are seen as gradual sequence except in few occasions

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EVOLUTION OF NAYACHARA ISLAND, HUGLI ESTUARY, WEST BENGAL

Introduction : In a tropical estuarine condition, colonisation of pioneer mangrove species on emerging shoals initiates the bio-tidal accretional processes. As one plant community is successively replaced by another, they raise the level of the shoal by inducing tidal sedimentation and thereby reducing inundation interval of a particular locality. This classical succession model of mangrove ecology is only observable in a regressive stratigraphic sequence and is rather difficult to apply in areas where the coastline is primarily eroding for a long time, such as in many areas of Indian Sundarban. The 46-km^2 Nayachara (22°01'28"—21°54'30" N, 88°03'18"—88°08'45" E), on the other hand, progressively accreted during the last 55 years and provides an ideal opportunity to test the succession model.

Methods : To identify vegetation zones of the island, IRS-1C LISS-3 data of 1997 were digitally classified based on Ground Truth Verification. Two digitally processed images, showing land-water interfaces and Normalised Density Vegetation Indices (NDVI) were also prepared. To study the changes in island area, Survey of India topomaps of 1967-68 and areal photomosaics of 1977 were digitised, geocoded and layered with fused LISS-3+PAN data of 1997 (Table 1). PCI EASI/PACE image processing software was used in the study.

Table 1 : Changes in area of Nayachara island, 1967-68 to 1997

Year of Survey / Date of Pass	Source	Scale / Resolution	Area in km^2 (Index: Base=1967-68)
1967-68	Survey of India Toposheet No. 79B/4 and 79C/1	1:50,000	15.88 (100)
6 March 1977	Survey of India Aerial Photomosaic : 5 Photos in 2 Runs	1:50,000	31.17 (196)
23 February 1997	IRS-1C LISS-3 and Pan data. Path108/Row57	23.0 m (LISS-3) and 5.8 m (Pan): fused at 5.0 m	45.59 (287)

Results : The results show that the present Nayachara has four distinct and semi-concentric Vegetation Zones that occupy progressively lower levels of the island and are bounded by palaeostrandlines perceptible from standard False Colour Composites (FCCs) and aerial photos. The central part—or Vegetation Zone-IV—is colonised by *Aegiceras corniculata, Ceriops decandra, Dalbergia spinosa, Excoecaria agallocha* and *Sonneratia apiculata.* This is fringed by Zone III, dominated by *Myriostachya wightiana* grasses in association with *E. agallocha.* At places, *Acanthus ilicifolius, Cynodon dactylon, Salicornia brachiata* and *Sesuvium portulacastrum* are also seen. In Zone II, *Porteresia coarctata, Cryptocoryne ciliata* and *M. wightiana* occur with sporadic *A. ilicifolius.* The outer-most section—Zone-I—is mostly mudflats, colonised by *Porteresia coarctata.* These zones have close affinity with vegetation indices and water or water-logged of the island. From Zone-IV through Zone-I, NDVI values decrease and extent of water-logged areas increase (Table 2).

Nayachara started accreting on a tidal sand ridge called Haldia from 1945. Between 1967-68 and 1997 the island progressively enlarged—yielding an average accretion rate of 0.88 km^2 yr^{-1} (Table 1). Most of this accretion took place on the southwestern part of Nayachara, giving it a highly elongated appearance (length: 17.25 km, maximum width: 3.75 km), characteristic of macrotidal conditions. The 1967-68 and 1977 perimeters (at High Water Level) of the island, when superposed on its present configuration, closely match the boundaries of

Table 2 : Vegetation zones of Nayachara and their relationship with maturity of the island

Zone	Dominating Species/Assemblage	Relative Maturity	Boundary Match/Remarks
IV	*Aegiceras corniculata, Ceriops decandra, Dalbergia spinosa, Excoecaria agallocha* and *Sonneratia apiculata.*	Most mature and least inundated. Lowest extent of watrerlogged area. Highest NDVI Values.	Matches closely with island perimeter of 1967-68
III	*Myriostachya wightiana* grasses in association with *E. agallocha.* at places, *Acanthus ilicifolius, Cynodon dactylon, Salicornia brachiata* and *Sesuvium portulacastrum* are also seen.	Intermediate.	Matches closely with island perimeter of 1977
II	*Porteresia coarctata* and *M. wightiana* occur with sporadic *A. Ilicifolius* and *Cryptocoryne ciliata.*	Intermediate.	No match with present datasets. Possibility of a match with c. 1988 perimeter exists. This calls for future investigation.
I	Mainly *Porteresia coarctata.*	Least mature and most inundated. Highest extent of waterlogged area. Lowest NDVI Values	Bounded by the present (1997) coastline

Vegetation Zones IV and III respectively, clearly bringing out the relationship between plant colonisation and accretion stages (Table-2).

Concluding Remarks : Extensive buffalo grazing in recent years has greatly affected growth of natural vegetation in Nayachara. A large part of it is also being reclaimed for prawn farming. Moreover, construction of a 2.8-km guide wall to divert ebb flow of the Hugli to successfully flush a navigational channel on its northwest has also intervened with its natural evolution and promoted accretion in its northeastern margin.

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