



The Tista– Jaldhaka Interfluve, Jalpaiguri District, West Bengal: Geomorphology and Landuse

Mery Biswas

Department of Geography, Baruipur College, Baruipur 743610

Abstract: *The study area is located in the lower Brahmaputra river basin bordered by two perennial rivers, Tista and Jaldhaka. For micro level analysis two villages viz. Pathorjhora and Domohani, were selected. The area is formed of Quaternary deposits and is associated with distinct geomorphic processes like mudflow, debris avalanche, slab failure etc. The Pathorjhora village, located on the foothills, exhibit landforms like dissected slope, eroded scarp, paired terrace and incised meander. Here, the upper flood plain is used for paddy cultivation and jute is cultivated in the lower areas. During the rabi season agriculture suffers due to the unavailability of irrigated water. The Domohani village is located on the left floodplain of the Tista, where shifting nature of the channel influences the landuse practices. This region is used for irrigated agriculture. The landuse of 1980 shows that in case of both Pathorjhora and Domohani, there were seven and four types of landuse categories respectively, but the landuse of 2006 shows 10 and seven land utilisation classes in these villages respectively. The landuse pattern changed due to physical and social factors, mainly tourism and population growth. The landuse of Domohani village in 2006 shows that the amount of cultivated land has been decreased and about 40% land is seasonally cultivated. The area under settlement has also increased. It has been observed that with time and space the mode of land utilisations has changed respecting the geomorphic parameters. There is need to increase the awareness of people about social forestry, which will help to decrease the rate the soil and bank erosion and protect the agricultural lands.*

Introduction

The North Bengal plain along with the foothills presents a magnificent geomorphological setting consisting of meso and micro level land utilisation categories. Although, geomorphology does not always have a strong applied context, but in spite of this we need to develop the landuse based on geomorphic, economic and social characteristics of a region. The topological as well as geological complexities acted upon by the fluvial processes have

resulted in the formation of a unique assemblage of landforms. In this paper emphasis has been made by the author to show how use of land can be improved through introduction of agricultural planning, aided by new mapping techniques. The varied topographic expression of the study area includes the multicyclic development of landform affected by fluvial hazards. General geomorphological investigation is needed to plan a relevant land utilisation strategy, which

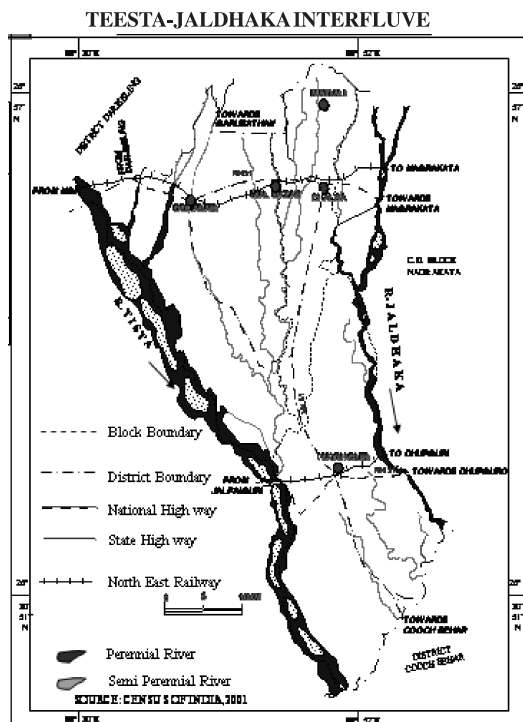


Figure 1. The study area

is compatible with a given unit of land. The paper also includes the study of two villages to show the micro level change in landuse pattern with regards to their respective geo-environmental problems.

Area and location

The study area is located in the lower Brahmaputra river basin bordered by the two perennial rivers, Tista in the west and Jaldhaka in the east covering 2,000 km² (Fig. 1). From the administrative point of view the area covers three blocks of Jalpaiguri district i.e., Mal, Maynaguri and Matiali extending from 26°25' N to 27° N and 88°30' E to 89° E. Geographically the area is well known as 'Duars'. For case study two villages have been chosen, one is Pathorjhora tea garden, situated on the foot hills of Mal block and the other is Domohani, situated on the left bank of Tista at Maynaguri. The Pathorjhora village is drained by two rivers Chel in the east and Lethi in the west.

Methodology and objectives

The work is based on field observations, empirical study and application of remote sensing and GIS techniques with the help of topographical maps (78B/9 & 10) surveyed in 1980 and IRS-1D LISS-III image of 26 January 2006 (path-108, row-52).

The primary objectives of this study are to identify and measure landforms and landcover characteristics of the region using two selected villages as case studies.

Geotectonic aspects

The terrain analysis basically depends on the geologic structure, variation of rock groups and litho-tectonic setting indicating the role of rock formations relating to the geomorphological set up of the Tista–Jaldhaka interfluvium area. Geologically this area is formed of Quaternary deposits. In this region, the Himalayan ranges are characterised by uplift caused by low angle thrust movements. This tectonic movement is still active at the rate of 1–2 cm yr⁻¹. The Quaternary deposits have five main formations like, (i) Shaugon formation, (ii) Baikunthapur formation, (iii) Chalsa formation, (iv) Matiali formation and (v) Samsing formation. The foothills and undulating plains are mainly fluvial in origin and the Quaternary rocks are deformed, fractured and overlain by fluvial sediments. The fluvial terraces, alluvial fans and cones are of recent origin and are abundant along the river courses. The Pathorjhora village is situated on Samsing formation and Domohani on Shaugon formation.

Climate

The physical landscape of the area is a cumulative function of the exogenetic and endogenetic processes which is influenced by the climatic factors like rainfall, temperature, humidity etc. During the monsoon period this area receives huge amount of rainfall 1,000 mm to 2,000 mm and the temperature

decreases towards the north. The topographic expression including landuse and soil formation over the study area has possible linkage with climatic changes in the Tertiary and Quaternary periods, particularly during the Pleistocene.

Landscape and landuse characteristics

The whole area is broadly controlled by the structure of the underlying rocks and associated with distinct geomorphic processes like mudflow, debris avalanche, slab failure etc. The entire study area has a terrain typical of a foot hill region and is situated on an unstable tectonic zone. The two villages are situated in two different geomorphic units representing different landscape and landuse characters. The Pathorjhora village delineates the boundary between the hills and piedmont zone very sharply as it is located at the foot hill zone. Series of dissected hillside slopes, highly eroded scarp, paired terraces, incised meander, and 'V' shaped valley are the main identified geomorphic landforms where different types of landuse are practiced. The terraces are used for tea garden, the hillside slopes are covered by dense evergreen forest, and the lower terraces near the river Minzging is suitable for rice cultivation because of easy water supply. The rejuvenated rivers i.e. Minzging, Chel and Lethi have formed spectacular micro-geomorphic landforms, sculptured by local geology, climate and soil character. The varied valley forms as well as the distinct breaks in slope along the river Lethi, Chel and Minzging have also been considered for the purpose of demarcating the geomorphic units where the village is situated. The sudden decrease of slope particularly in this village resulted in deposition of a huge amount of sediment on the river bed. The highly braided character of the rivers, at the confluence of Minzging and Chel, results in flood hazard during the monsoon period due to decrease in depth. The rivers become unable to carry the

Table 1. Patharjhora and Domohani villages: Selected information

Information	Villages	
	Pathorjhora	Domohani
C.D. Block	Mal Bazar	Maynaguri
Area	10.78 km ²	9.73 km ²
Population	2,972	1,889
Geological Formations	Quaternary deposits of Samsing formation	Quaternary deposits of Shaugaon formation
Nearest town	Odlabari (30 km)	Maynaguri (7 km)
Main erosional agent	Fluvial	Fluvial
Geomorphic unit	Foothill	Floodplain
Closest river(s)	Lethi (W), Chel(E)	Tista
Landforms	Terrace, scarp, waterfalls, etc.	Floodplain, braiding pattern, levees, etc.
Landuse	Tea plantation, orchard, forest, farmland, settlement etc.	Wasteland, seasonally cultivated land, settlement etc.

extra rainwater and overflow their banks. Here one can see the development of typical floodplain features like natural levee, back swamp etc. The upper flood plain is used for paddy cultivation. Sometimes jute is cultivated in the lower flood plain. During the rabi season the agricultural system of the village suffers due to the unavailability of irrigated water. So vegetable cultivation can only be practiced at micro-level. The low level of ground water is another evidence of geological control. The Pathorjhora fault, parallel to the Himalayas is observed to demarcate the Bhabar and Khadar regions. It is marked by percolation of water, thereby decreasing the irrigation potential. The 250 m contour line more or less demarcates this lineament. Very recently a new pumping station has been established by the government for the supply of drinking water and Pathorjhora falls is used for irrigation through pipeline (Table 1).

The second selected village, Domohani has developed a different landuse and cropping pattern. The major part is occupied by the

floodplain, as this village is located on the left bank of river Tista, at Mayanguri. This village provides an ample scope for studying the changing character of fluvial landscape that controls the land utilisation. The village is under the Shaugaon formation of Quaternary deposits. Measurements of rates of water and sediment movement on slopes in the area have demonstrated considerable variability even in apparently similar climate. The interacting processes have led to the development of a complex fluvial morphological entity including features like flood plain, natural levee, meander, braiding pattern, sinuous character of the river etc. The shifting nature of the channel influences the landuse practices. The area is used for paddy, jute and oil seed cultivation but at some places groundnut plantation and vegetable cultivation (potato, tomato, bean) are also practiced. Sufficient water is supplied through canals which are derived from the Tista and the agricultural lands do not suffer from scarcity of water. But during monsoon period problems of natural hazards like flood, bank erosion, and soil erosion affect the lands. During this period, heavy rainfall over the area combined with insufficient storage capacity of the streams instantly leads to flood. So the lower floodplain is used only for seasonal cultivation and in the wet season this area exists

as wasteland. The fertile islands are also designated as wasteland because of the same reason. But due to shifting of the channel, some islands are now connected with riverbank and are used by local people (Table 1).

Changing landuse pattern

The landuse pattern discussed above is related to the nature and quality of land resources. The crucial point is regarding land sustainability i.e. the potential capacity (related to changing geomorphic character) of a given tract of land to support different types of land utilisations. For this analysis, the author has taken data and maps for two years, (1980 and 2006) showing the changing landuse pattern. The landuse map of 1980 is based on topographical maps which show that in case of Pathorjhora there were only seven types of landuse i.e. forest (60%), farm land (5%), settled areas (10%), other trees (17%), wastelands (3%), river (3%) and sand deposits (2%) (Fig. 2).

It is one of the old tea gardens of North Bengal and with time production as well as labour colonies, have increased followed by population growth. The landuse map of 2006 is based on the IRS-1D LISS-III data of 26 January 2006. It is found that there is drastic change of landuse pattern. From this recent satellite image

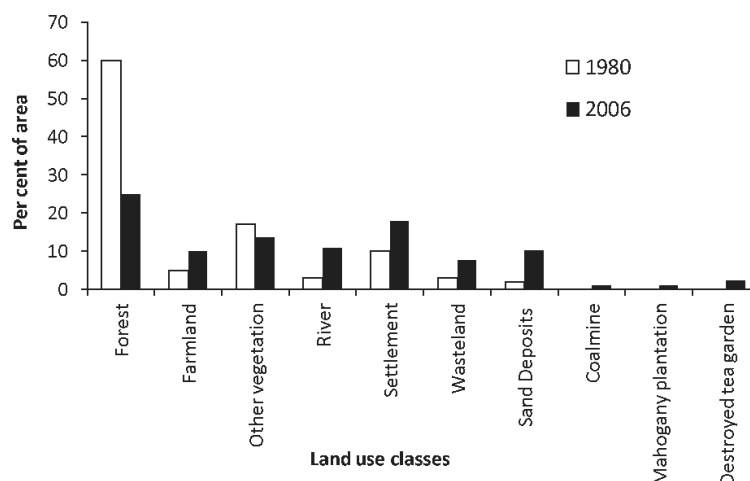


Figure 2. Change in landuse between 1980 and 2006, village Pathorjhora

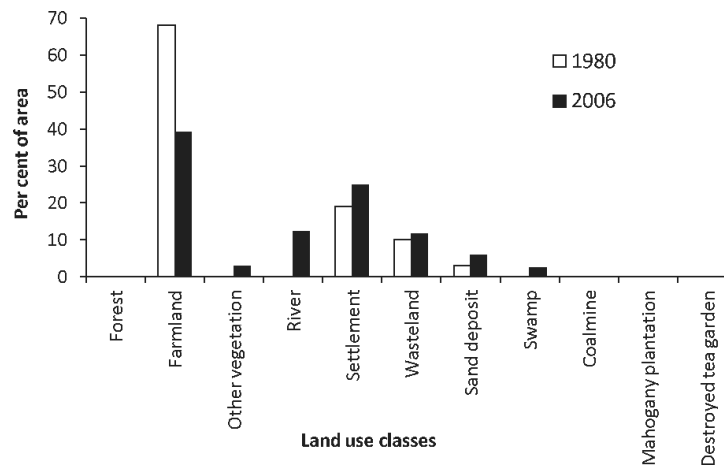


Figure 3. Change in landuse of village Domohani between 1980 and 2006

it has become easy to make a detailed classification of land utilisations. For example, ten categories have been identified viz. forest (25%), farmland (10%), other vegetation (13.7%), river (11%), settlement (18%), wasteland (7.8%), sand deposits (10.2%), coalmine (1%), Mahogany plantation (1%) and destroyed tea garden (2.3%). Comparing with the landuse pattern of 1980 it is found to have changed because of some physical and social factors. With the increasing rate of tourism, in the upper part of the rivers such as in Gorubathan and Lava. deforestation followed by landslide have increased the sediment load which have deposited due to the sudden decrease of slope in this village particularly in the confluence of Chel and Minzging. This has resulted in increase in percentage of wastelands. Because of population growth, settled areas have also increased. The vital point of this village is that, the tea garden up to 2002 was using chemical fertilizers, but with the demands in foreign markets, the tea garden authorities have decided to change it to bio-organic fertilizers and after three years i.e. in 2005 it was announced as the only bio-organic tea garden of Jalpaiguri district. Because of this change the old tea garden plots have been destroyed and though the production decreased in the past, but now it is increasing with more

suitable and healthy tea plants. From 2004 Mahogany plantation is practiced by the local people as social forestry and it will also help to increase the economic status of the local tea garden labourers after 10 to 12 years. Though it is quite far from Odlabari, but waterfalls, undulating tea garden, rivers and pristine nature surrounded by forests are suitable for tourism development.

As already mentioned, the Domohani village being located on the flood plain area of Tista, maximum area is utilised for agricultural activity. It is well connected with Jalpaiguri town and other parts of the districts by both railway and road.

From the map of 1980, only four types of landuse classifications could be identified here (Fig. 3). About 68% area is under farmland, 19% are settled area, 10% are under wasteland and sand deposits cover 3% of the area. But if the landuse map of 2006 is examined, areas under farmland (39.19%) are seen to get reduced while the area under wasteland have increased (11.7%) followed by settlement (25%). 2.52% of the area is identified as swamps (mainly in lower floodplain), 6% as sand deposits and 3.09% as other vegetation. The natural levee of Tista is used as a road. Close to the river the lower flood plain is seasonally used for agriculture.

Concluding notes

In using the land and to obtain desired results from a particular type of land utilisation, land resources should be managed in an appropriate manner in conformity to their geomorphic background. If it is not done, then it may result in land degradation. As appears from the above discussion, there is need for minimising the rate of deforestation and properly using the land by reclaiming the wastelands. In Domohani the swamps may be used for pisciculture in

monsoon, and the fertile riverbanks for seasonal vegetable cultivation. It is necessary to increase people's awareness about social forestry both along the roadside and riverbank which will help to decrease the rate of soil and bank erosion and protect the agricultural lands. Hence, land management should be made more scientifically with respect to the physical, economic and social parameters and then only it can bring overall development of the region.

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