Chapter - 4

General Geology

In this chapter the general geology of the study area is discussed. It is very important to understand this parameter as it plays important role in determining the forest type of the area.

4.1 General geology

The State of West Bengal covers an area of 87,616 sq.km. Out of this total area, 73,858 sq. km is occupied by the unconsolidated sedimentary deposits of the Quaternary period. The rest of the area is covered by hard rocks ranging in age from the Precambrian to the Tertiary periods, which are decidedly older than the sedimentary formations.

Micro-physiographic variations within West Bengal are considerable. The reason is that the formation of each one of these have been governed by many factors, such as the conditions governing the formation of the parent lithology, tectonic history and the changing geomorphological processes.

The geological formations in West Bengal are diverse in origin. It comprises the archean, metamorphic to sub recent and recent alluvium formations. About 75 percent of the land mass comprises the sub recent and recent alluvial deposits of the quarternary period while the remaining part abounds in a wide variety of rock formations, like crystallines, sedimentaries and basic flows. The metamorphic include various types of schists and gneises of Precambrian age, associated with acid and basic intrusive. The sedimentaries include essentially the Gondwana formations (Barakar formations etc) in Eastern plateau (Outliers) that belong to the Permo Carbonferous to Triassic age whereas the Siwalik formations belong to the Tertiaries in Eastern Himalayas. The basic flows belong to the upper Mesozoic age forms a conspicuous horizon setting between the two broad sedimentary groups.

4.1.1 Jalpaiguri

The present study covers Jalpaiguri district in the north. The Gondwana rocks occur in Jalpaiguri district. Lithologically the Gondwana rocks consist of pebble/boulder beds, quartzite, sandstone, slates, carbonaceous slates and coal seams. These have been situated by sills of mica-peridotide. The rocks have undergone intense deformation especially in the proximity of Main Boundary

Thrust (MBT), a fault line, with the result that the sandstone has been indurate, sheared, sheeted and bonded. The coal seams have been crushed, sheared and rendered anthracitic. The Gondwana formations erode easily.

A belt of alluvial detritus of Tertiary age occurs in the Terai region of the northern part of Jalpaiguri district. This is known as Siwalik group of rocks consisting of coarse, hard, sandstone, siltstone, slate and conglomerate. The rocks follow the fringes along the foothills and has a thrust contact with rocks of Gondwana super-group towards the north. The rocks can be grouped into two formations. The lower horizons formed of fine to medium grained sandstone with a basal red claystone and upper pebbly horizon. The sandstones are usually soft and friable; but close to the thrust it is highly indurated and sheared. The rocks of the Siwalik group also erode very easily.

The quaternary formations in the northern part of West Bengal occur just south of the Siwalik Group rocks. The formations are constituted of boulders, gravels, pebbles, sands and silts in the higher reaches forming alluvial fans and fluvial depositional terrace. In the lower reaches fluvial terraces of flood plain faces consisting mainly of sands, silts and clays are dominant. The Quaternary sediments of North Bengal have given rise to alluvial fan type of topography.

The piedmont deposits have been grouped into five units (Chattopadhyay and Das, 1982). The oldest Samsing formation consists of moderately sorted pebbles, cobbles and boulders with grey brown sandy matrix topped by chocolate brown loamy soil. The next younger formation is the Thaljora formation consisting of sub-rounded boulders with gray coarse sand matrix overlain by a reddish brown soil. The Matiali formation is the next younger fan deposit and is made up of boulders/pebbles in a coarse sand matrix. The pebbles are sometimes arranged in layers with a top yellowish brown silt. The next younger deposit is the Chalsa formation consisting of poorly sorted boulders/pebbles with greyish yellow to greyish brown top soil. Baikanthapur formation represents the youngest fan in the area. It consists of very fine white sand inter-layered with ochre yellow sticky silty clay and overlain by dark grey to thick silty loam. Shangaon formation represents the deposits of the flood plain faces of the Baikunthapur formation (Geological Survey of India, Record Volume No, 121 Pt. 2-8,PP 101-109).

The zone of piedmont fans indicates the porous nature of the soils and explains the phenomenon of quick loss of surface water through percolation. The so percolated water often appears as springs, leading to formation of rivers. The density of river channels is extremely high in this

physiographic zone. These are actively engaged in sorting out the debris and transportation of the finer materials downwards. Most of the streams have developed meanders to cause lateral erosion and consistent expansion of the channels. The river channels are yet to establish themselves as meander loops are often cut off when the magnitude of floods become exceptionally large. The contributory factors in shifts in river channel are the exceptionally high sediment loads, causing channel choking and widening of the meanders, and the mobile nature of the basement complex.

As the lithology is largely composed of unassorted materials, finer sediments often tend to choke the well-filters at uncertain periods of interval while in use. With the exception of the Tista river, water flows in all streams tend to dwindle after the monsoon rains.

4.1.2 Bankura and West Medinipur District

The areas lying to the east and north-east of Bankura are low lying alluvial plains. To the west the surface gradually rises, giving way to undulating country, interspersed with rocky hillocks.

The area consists of two different tracts. The western portion marks the gradual descent from the table land of Chota Nagpur to the delta of lower Bengal, consisting largely of spurs projecting from the western tableland and of low swelling ridges. However, there is no marked ridge of hills. In the central portion of the district there are rolling downs eventually merging with the alluvial plains. The western part of the district has poor, ferruginous soil and hard beds of laterite with scrub and *sal* (Shorea robusta) forests.

The Pre-Cambrian in the Peninsular West Bengal are exposed along the western margins of Bankura and West Medinipur districts. There are also extensive exposures of Gondwana rock formations in the districts of Bankura.

The Pre cambrians are represented by the rocks of Chotonagpur Gneissic complex and Singbhum Proterozoic folded belts. In the Singbhum Proterozoic fold belt, the two distinct litho packages are known as Dalma group and Singbhum group of rocks. The Dalma rocks are characterised by a lower unit of Komatitic basalt followed upward by iron rich tholerite. mafic and ultramafic intrusives and a few thin bands of clastic volcano clastic and chemogenic sediments occur in association with the volcanics. The Singbhum group of rocks, lying to the north of the Dalma volcanics, are represented by volcano-clastic and chemogenic sediments, felsic tuffs and volcanics

Altitudinal Zones of West Bengal

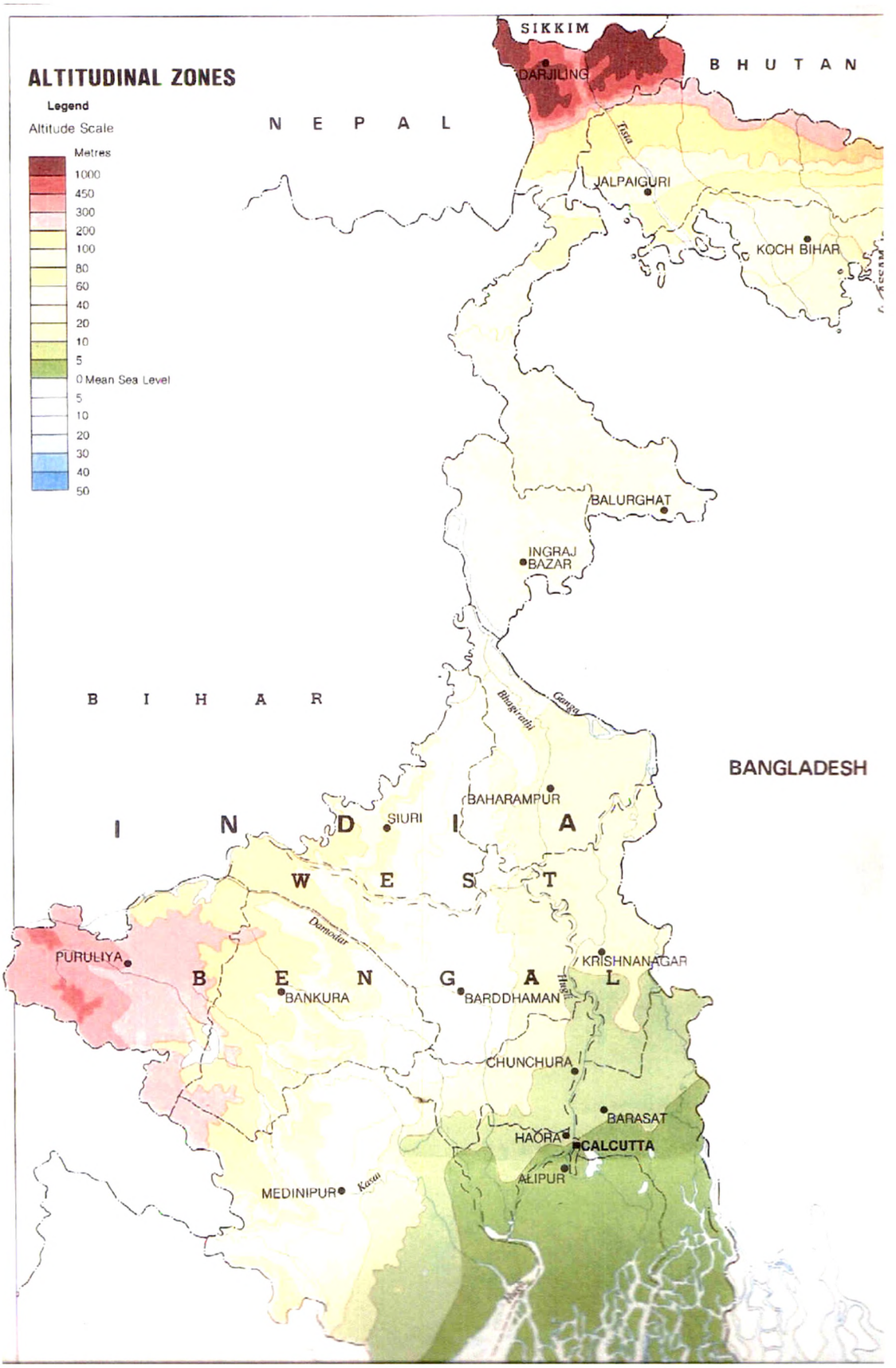

Fig. 4.1 : Altitudinal Zones

Source NBSS & LUP

and intrusives of mafic and ultra mafic types Alkaline rocks represented by carbonatite and nepheline syeite are present in the area. In Singbhum group of rocks, there are a few bodies of internal granitoids known as Kuilapal, Barrabazar and Chhendapathar granite.

Chhotanagpur Gneissic Complex has revealed the presence of a variety of rock types comprising of grey banded biotite gneiss, migmatites, hornblende gneiss, porphyritic granite gneiss, various types of granites, pegmatites, aplite and quartz veins with bands of amphibole, mica schist, calc-granilite, anorthosite and gabbro.
The Gondwana rocks are extended to Bankura adjoining Bardhaman.

The greater portion of Bankura consists of a rolling country covered by laterite and alluvium. While metamorphic or gneissic rocks are found to the extreme west, there is a wide plain of recent alluvium in the eastern part.

The most characteristic geological feature of the district is the area of laterite and associated rocks of sand and gravel. At some places one finds hard beds of laterite. At other places it is decomposed and re organised.
The Gondwana system is represented in the northern portion of the district, south of the Damodar, between Mejia and Biharinath Hill. The beds covered with alluvium contains seams of coal belonging to the Raniganj system.

It is often reported that the ferralitic soils of the region have developed in many places conspicuous incrustations. This has often been misinterpreted as signs of in situ laterite formation. Closer examination of the soil horizons show that these are formed of many types of materials bearing no relationship with the base rock. In other words, these represent materials transported by flowing water across many types of lithofacies. The incrustrations are expressions of the subsequent operating processes conditioned by fluctuating ground water table between seasons.

Fluctuating ground water table coupled with rain and dry weather conditions have led to the formation of lateritic patches in many parts of this zone. However, once brought under the plough, these lose their lateritic properties and tend to support limonitic soils because of accentuation of the leaching processes.

Sheet wash occurs during heavy rains but hardly any inundation. Although the soil is friable and

porous, run off is dominant over percolation. Hence groundwater endowment is poor. Nevertheless, the percolated water escape as non-perennial springs where the streams have cut deep channels.

4.1.3 The Fluvio Marine Delta in South 24 Parganas

In the southern part of the District of South 24-Parganas, this zone is formed of inter-lacing tidal channels. The source of sedimentation is the tidal influx, which is scouring the shallow continental shelf. On the sea face, sand dunes have formed by aeolian actions.

Under normal circumstance, the sediments get deposited between the inter-lacing river channels. But this condition has been largely altered by human action. To expand agriculture on this newly forming land mass, embankments have been created along the banks of the channels to prevent incursions of saline tidal water. These embankments enclose a tract to permit cultivation of rice with the help of rain water. As a result, features of the geomorphic processes have been altered. The district harbors, Sundarbans. The forest (including Inda and Bangladesh) consists of about 200 islands, separated by some 400 interconnected tidal rivers, creeks and canals. The area is approximately three-fifths the size of what existed 200 years ago (about 16,700 sq.km), the rest having been cleared and converted to agriculture (Hussain & Archarya, 1994). It forms an impenetrable saltwater swamp of tidal estuaries and creeks reaching 100-130 km inland, and is the largest tidal mangrove forest in the world.

The landscape is one of low-lying forested alluvial islands (56 in the Indian sector), mud banks with sandy beaches, and dunes along the coast. The forest swamp is extensively embanked and empoldered and is an essential buffer for inland areas against the ravages of frequent cyclones from the Bay of Bengal. The nutrient-rich waters also provide the most important nursery for shrimps and spawning grounds for crustaceans and fish along the whole coast of eastern India.

The land is constantly being moulded and altered by tidal action, with erosion along estuaries, and deposition along the banks of inner estuarine waterways augmented by the discharge of silt from seawater (Sanyal & Bal, 1986).

In the first instance, sedimentation has been confined within the river channels. This is raising the levels of the river beds, requiring periodic strengthening of the enclosing embankments. Once the embankment collapses, tidal incursions extend into the protected agricultural land and expand the

area under sediment accumulation. Until such disasters happen, the agricultural fields lose their nutrients. The accumulated rain water enhances leaching process. When the water is drained out during low tide, loss of nutrients also happens.

Rains constitute the major source of potable water. The non-saline aquifers occur at great depth, which is expensive to tap for the generally poor farmers. Shallow tube-wells accelerate the penetration of saline prisms into the so exploited sweet water aquifers.

Most parts of this zone have been brought under agriculture by destroying the mangrove vegetation. In the south-eastern part of this zone, some of the mangroves have been preserved, which has been declared as a Bio-sphere Reserve and is used for preserving tigers.

The major streams passing through this zone contain many river terraces and, thereby, reveal the mobile nature of the basement complex.

4.2 Influence of structure and lithology on forest

Landscapes provide the niche for plants and animals. The structure and lithology influence the landforms and soil conditions of the area. This in turn affects the natural vegetation. As has been evident that the forest types in the study area varies from North India Moist Deciduous forest in Jalpaiguri to Northern Tropical Dry Deciduous Forests in Bankura and Medinipur to Littoral, Swamp Mangrove forests in South 24 Parganas.

The mangrove vegetation itself assists in the formation of new landmass and the intertidal vegetation plays an important role in swamp morphology. The activities of mangrove fauna in the intertidal mudflats develop micro morphological features that trap and hold sediments to create a substratum for mangrove seeds. The morphology and evolution of the eolian dunes is controlled by an abundance of xerophytic and halophytic plants. Creepers and grasses and sedges stabilizes sand dunes and uncompacted sediments. The Sunderbans mudflats (Banerjee, 1998) are found at the estuary and on the deltaic islands where low velocity of river and tidal current occurs. The flats are exposed in low tides and submerged in high tides, thus being changed morphologically even in one tidal cycle. The interior parts of the mudflats are magnificent home of luxuriant mangroves.

Jalpaiguri district on the other hand was once completely covered with natural forests with grasses in the river channels. But from the middle of the last century, the forests are getting

cleared to make room for the development of tea gardens and for expansion of agricultural land in tune with population growth. Terraced agricultural farms are gradually invading the steeper slopes of the valleys and altering the orientation of surface run off. The natural forests have been largely replaced by single stand Teak forests for commercial purposes by the State Forest Department. Hence the earlier richness of bio-diversity has decreased in the Reserved Forests.

The forests in the districts of Bankura and West MedInipur had degraded during the past 50 years. The blanks in the forests were susceptible to erosion.

The lateritic zones in Bankra and West Medinipur, the tidal processes in Sundarbans and shifting river course in Jalpaiguri poses problems for agriculture in the area. In the agrarian economy the natural geological processes play important role in shaping the landform and soil condition that in turn creates the base for agriculture. The general geology of these areas favors growth of unique natural vegetation types like Shorea Robusta (Sal) with associates like Kendu, Mahua in South West Bengal, Mangrove in Sundarbans and Sal with associates like Chap, Chilauni etc in the North Bengal that are being used by the people for meeting their daily needs as wll as for earning livelihood.

In this chapter the general geology of the study area is discussed. It also reveals how the landform of the area is influenced by structure. The relationship between structure and lithology with forest is also discussed.