CHAPTER VI

ROLE OF GEOMORPHOLOGY IN RESOURCE PROSPECTING
AND UTILISATION:

In the preceding chapters attempt has been made to describe
the geomorphological processes and forms in the Mayurakshi basin.
In this chapter effort will be concentrated on showing how these
factors influence the development of this region.

"The applied role of geomorphology relates mainly to the
problem of environmental resource management. The role has greatly
enhanced recently by emphasis on the quantitative study of process-
form relations through the application of various forms of process-
response model ... Geomorphic surfaces usually embrace influences
that extend well beyond the traditional confines of the subject and
so have a way of surfacing in virtually any development project".¹

The present study of geomorphology having emphasis on detailed
scientific study of forms, materials and processes can provide
much needed information for the planning and development of
Mayurakshi river basin. Here a little attempt is done to explain
the geomorphic importance in resource utilisation.

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¹ Faniran, A. and Jeje, L.K. (1983) - 'Humid Tropical
(1) The impact of Geomorphology on water utilisation:

The Mayurakshi river valley project got some advantage of the Geomorphology of the basin area. The Mayurakshi river which flows through Santhal Parganas, Birbhum and Murshidabad carries very little water during the rainy season (41%). The basin suffers from drought due to the irregularity of the monsoon rainfall (fig. 1). But as the river is a rainfed one the farmers have to rely on the monsoon rainfall. The ground water condition is not favourable throughout the basin area. During the dry season the depth of ground water varies from 152.4 m. in the west to 4.57 m. in the east and in the rainy season the ground water table is at a depth of 6.1 m. in the west to 1.52 m. in the east (fig. 2, Pl. 22). The Archaean rocks of the western part is impermeable and in this zone the ground water table is low. Therefore the farming practice was retarded during the winter season and was affected during the rest of the year by occasional drought or flood. Therefore during the predam period agricultural production was low. To meet the need of water the river valley project was undertaken. The project consists of (1) a reservoir and a dam across the Mayurakshi at Massanjor on the Archaean terrain of the Dumka hills, (2) a main barrage across the same river about 37 km below Massanjor and (3) two canal systems - the 'North Bank canals' and 'South Banka Canals' (Ch. II).
The dam site selection demands the knowledge of geomorphology, lithology and geological structure of the terrain. "As Bryan (1929) has pointed out, there are at least five requirements of a good reservoir site that depends upon geological conditions: (1) a water-tight basin of adequate size; (2) a narrow outlet of the basin with a foundation that will permit economical construction of a dam, (3) opportunity to build an adequate and safe spillway to carry surplus waters, (4) availability of materials needed for dam construction, (5) assurance that the life of reservoir will not be too short as a result of excessive deposition of mud and silt".1

As for the construction of the Massanjor dam, the geoporphological conditions were suitable for the reservoir and dam site. The dam has been constructed between two hills - Satbor hills and Panjahari. These two hills stand as natural walls of the reservoir (fig.3). The Mayurakshi river flows over the Archaean granite-gneissic terrain in this area. On either side of the river the rocks are charnochites while to the south the rock is hornblende gneiss. These metamorphic rocks are not well jointed and uniformly massive, so unloading is not common.2

The impermeability of the rock provides a water-tight basin for reservoir and the position of the hills caused the construction of the dam economically.

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2. Ollier (1974) - op. cit., p.82.
As the tributaries of the Mayurakshi formed a dense network over the Archaean terrain, a large number of them meet before the river reaches the Dumka hills. Therefore by constructing the dam at Massanjor most of the rivers of the catchment is controlled (fig.1,2).

Another locational advantage for the construction of the dam and the barrage is the availability of the building stones. Large quantities of hard, compact and resistant materials like granite and granite-gneisses are widely distributed in the Archaean tract. In the Birbhum district granitic rocks are quarried near Panchra (23°46'N: 87°20'E), Dubrajpur (23°43'N: 87°22'E) and are also available near Ranibahal (24°06'N: 87°22'E) and Adarpur (24°01'N: 87°31'E) Trap rocks are also used as building materials. Large quantities of trap rocks from Rajmahal hills were used for dam construction. "The quarries are located to the West of Rampurhat, Nalhati, Muraro and Rajgram railway stations within the Birbhum district and to the west of the Pakur and Rajmahal".

From the above paragraphs we can conclude that the geomorphological conditions have provided adequate favourable conditions for the execution of a water management project in the Mayurakshi basin. But the siltation index of the catchment of the post-dam period affects the life of the reservoir.

1. Hunday and Banerjee (1967) - op. cit., p.35.
2. Ibid, p.38.
The reservoir has been designed for a life of 100 years on the basis of a siltation of the reservoir at the rate of 0.75 acre feet per square mile of the catchment area. But the siltation index as per survey of 1972-73 is 4.21 acre feet per square mile of the catchment area per year.

(II) Mining and Quarrying:

The role of geomorphology in the exploration of some minerals, cannot be ignored as firstly some minerals have direct topographic expressions, secondly the topography is an indicator of the geological structure favouring accumulation of some minerals and from the geomorphic history the physical conditions are appreciated under which minerals are accumulated.

The previous chapters on Geology of the area provides some knowledge of the mining and quarrying of the basin area. In the Mauruakshi basin a large part is underlain by Archaean granite-gneissie rocks. These rocks are used as building materials. The quarries are near Panchra, Dubrajpur, Rajmahal and Adarpur. Trap rocks from Rajmahal hills are used as building materials and are available from the quarries located to the west of Rampurhat, Nalhati, Muraroi and Rajgram railway stations. Laterite is cheap building material which can be quarried and dressed.

Large deposits of Tertiary clays have been reported from many parts of the Birbhum district.

1. Supplementary report to the Comptroller and Auditor General of India (for 1975-76).
2. Ibid.
In Mahammad Bazar (23°59'N: 87°34'E) extensive deposits of clay occur which is regarded as Lithomerge type of lateritic clay formed from weathering of rocks under tropical conditions. The clay is suitable for use in the potteries and refractories.2

The clay deposit of Kumarpur (23°59'N: 87°35'E), though high in oron and titania can be used in the manufacturing white coloured earthwares, low and medium tension insulators and medium heat duty refractories.1

In Kharia (23°59'N: 87°36'E) the clay deposit is economic to work and is suitable for use in pottery and refractories.2

The clay deposit of Rajudharpur, Anargore (about 1.6 km. south of Mahammad Bazar) is ferruginous and besides being used in ceramics may also be utilised in rubber, paint, textiles and chemical industries.3

In Dewanganj (24°04'N: 87°36'E) and Chak Nuria (24°12'N: 87°44'E), clay occurs in Kaolinised Gondwana sandstones and is suitable for whiteware and refractories.4

In the Mayurakshi basin some marginal sections of Gondwana formations occur one to the south-west of the basin (23°50': 87°03' - 23°45': 87°19') on the interflue of the Ajay and the Mayurakshi (Trans-Ajay coalfield) and the other in the Rajmahal hilly region.

1. Ibid.
2. Ibid.
3. Ibid.
4. Ibid.
In the peninsula, Gondwana deposit is synonymous with the coal deposit. During the Damuda of Gondwana period a warm climate prevailed over the region resulting into the abundance of terrestrial vegetation which ultimately developed coalseams.

A small outlier of Barakar rocks consisting of pebbly sandstones, grits, sandstones and carbonaceous shales with thin stringers of coal is exposed over an area of about five square kilometres lying between the Brahman and Ajay rivers and on the northwest of Suri (23°55′: 87°32′) and north of the Tangsuli village (23°58′: 87°29′) in the Birbhum district.1 The Barakar series containing thick kasta and Paharpur seams is exposed in the Trans-Ajay coal field extending from Pariharpur (23°50′: 87°03′) eastwards to Pajara (23°45′: 87°19′).2 These coal fields are the extensions of the Raniganj coalfield.3 The dykes and sills of the Rajmahal region have burnt the coal seams of these fields.

Birbhum district has a role in the ancient history of iron and steel industry of India.4 Here different formations specially the profiles of laterites have deposits of iron ore because of their characteristic development, i.e./the process of laterisation final weathering products are hydrous oxides of aluminium and iron ore.

1. Hunday and Banerjee (1967) - op.cit., p.43.
Pisolitic iron ore and thin beds of limonite and haematite are collected from the laterite covering the Rajmahal trap. As laterite is found capping a large part of the Archaeans, Gondwanas & Trap Pisolitic iron ore is available in many parts of the basin. The ores in this region are derived from different formations: magnetite from the metamorphics near Namgulia, veins of limonite from the sandstones of the Damuda and Mahadeva series of the Gondwana system; layers of Pisolitic iron ore and packets of thin bed of limonite and haematite from the laterite within flows of the Rajmahal trap to the north of the Birbhum district. There are two or three seams of limonite ore in the laterite. Analysis of limonite ore shows that they contain 28-59% iron.

Gold in association with other minerals like monasite ilmenite, rutile, zircon, magnetite etc. has been found in the Tertiary deposits of West Bengal, Bihar and Orissa. Tertiary deposits about 45.7 m to 76.2 m in thickness occur in Birbhum, Burdwan, Bankura and Midnapur districts. Early Tertiary streams flowing down the crystalline Chotanagpur plateau were able to deposit such important placers on the plateau fringe area. The drainage pattern of the Mayurakshi shows that it flows through the faults which might localise gold lodes. As gold placers are likely to be richest where stream velocity is low, therefore the understanding of varying gradients, shape and size of the buried channel is

necessary. As the plateau fringe area (in Birbhum district) lies on the shore of the ancient Tertiary bay (ch.II), it is expedient that Tertiary rivers must have retarded their velocity in this region at their outfall. Therefore the zone may contain gold in the placers.

Besides the occurrence of the minerals described above, sands and gravels occurring in the basin area are of some economic importance. Inferior type of sand is used for making green-glass. In this region as glass-sands are rare most of the sands are obtained from vein quartz, a pure quartzite and pure friable sandstones. There is a good reserve of sandstone around Tangsuli basin near Suri. There are two deposits of Quartz and feldspar near Raspur Kadirganj in Muhammad Bazar P.S. of Birbhum district which were quarried in the past for supplying glaze material to patelnagar Firebricks and Potteries Ltd.

Soil erosion and conservation -

In the Mayurakshi river basin, soil erosion is a major problem. It causes heavy siltation in the river beds and removal of the top soil thereby depleting the soil fertility of the agricultural fields. Although biotic factors, already discussed account for major cause of the considerable soil erosion, besides it, the geomorphic factors act as important catalyst of soil erosion.

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In the Mayurakshi basin, soil erosion is in the form of rills and gully erosion and sheet wash which depend upon several geomorphic factors of which (1) the character of the terrain, (2) the soil and (3) the lithology and structure are the most important.

The Mayurakshi basin has been divided into two main geomorphic units - (1) Erosional plateau and (2) Depositional plain, the former being further divided into (I) Erosional plateau, (II) Plateau fringe and (III) Residual hillocks.

The relative relief of the erosional plateau is low (15.25 mt. - 30.48 mt.), plateau fringe is moderate (30.49 mt. - 60.96 mt.) and along the residual hillocks moderately high (60.97 mt. to 121.92 mt.) and high (121.92 mt. to 243.84 mt.) (fig.61). The average slope of the undulating plateau is below 2° and of the plateau fringe is 2°-4°, while in the piedmont zone of the hills it is 4° to 12° (fig.63). Slope is steep and nearly vertical on the banks of the rivers, roadsides and canal banks.

The soil over the Archean terrain and Rajmahal trap is liable to rill and gully erosion because of their physical and chemical character (plate 8, 12). The zone of older alluvium is also prone to gully erosion. The soils over sandstone, micaschist, quartzites and grits are light and non-cohesive and are liable to wind erosion (ch.II).
AVERAGE YIELD OF CROPS
IN DT. BIRBHUM

FIG. 82
With the above conditions of terrain, soil and geology, soil erosion is widespread over the erosional ~hotanagpur plateau, at the foothill zones and in the plateau fringe area. In this region sheet and gully erosion in unterraced fields, wastelands and denuded forests is taking a heavy toll of land and water resources. The rapid soil erosion causes the rising of siltation index in the reservoir of the Massanjor dam (ch.III).

The adverse effect of soil erosion is evident from an analysis of the figures of land-use and crop yield for a few years. The following table shows the change of landuse pattern of the Birbhum district.

<table>
<thead>
<tr>
<th>Total cultivated land</th>
<th>Cultivable land including fallow (acres)</th>
<th>Land not available for cultivation (acres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1924-32</td>
<td>768900</td>
<td>105194</td>
</tr>
<tr>
<td>1946-47</td>
<td>726900</td>
<td>109100</td>
</tr>
</tbody>
</table>

These figures lead to the conclusion that during that period there was much more fallowing which indicates that the land is progressively losing fertility.

Fig. 33

RELATIVE RELIEF INDEX OF DT. BIRBHUM

RELATIVE RELIEF INDEX

- 100
- 80
- 60
- 40
- 20
- 0

Source: G.R.I. Vol. 40 No-1
The picture is more clear if we compare the production of crops for several years. The production of paddy (chariff and Boro) and wheat increased from 1954-55 to 1970-71 (an effect of irrigation) which again decreased during the later years (table, fig. 9).

Recently soil and water conservation works and aforestation work has been taken by the Forest Department. Soil conservation measures have been taken up since 1961-62 in derelict forest areas by digging contour trenches to facilitate absorption of water by the soil and to stimulate growth of the plant. The increasing soil moisture also promotes heavier undergrowths which in turn check soil erosion.

The impact of geomorphology on agriculture -

The dependence on agricultural activities on geomorphic forms primarily to topography can best be seen in the central part of the Mayurakshi basin (Birbhum district) where three predominant type of landform units are met with (fig. 7). The physiographic determination of agriculture was more clear during the pre-dam period. The correlation co-efficient between the net cropped area with the relative relief indices is .90 in 1944-45 which was decreased to 0.69 during 1970-71. 

PERCENTAGE OF CULTIVATED AREA TO TOTAL AREA - DISTRICT BIRBHUM

WINTER

RABI

FIG. 9
high correlation co-efficient of 1944-45 which implies the close conformity of the amount of cultivated land with the physiography has decreased lower owing to the implementation of the Mayurakshi river valley project.

During 1980-81, the area under cultivation was very little dependent upon the physiography. The irrigation water from the Mayurakshi and her tributaries have solved the problem of scarcity of water in winter and occasional draughts. The summer and Rabi cultivation follows the surface configuration to some extent while the effect on the winter and Bhadoi crops are negligible (table 47, fig.73,81).

Other than those described above there are the effects of flooding and related drainage problems, chemical weathering, eluviation and mass easting on the resource utilisation of the Mayurakshi drainage basin which on the one hand renders help to the development of the area while hinders on the other hand. Much of the processes, forms and materials that have been covered in the preceding chapters yet to be studied in detail in the application of geomorphic research to resource utilisation.

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