

Identification of Landforms from Thoubal River Basin, Manipur

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Abstract

Thoubal River is one of the important tributaries of Imphal River, which is a part of the Chindwin River system of North East India and Myanmar. It is a rainfed river originates from Huimi in Ukhrul district of Manipur at an elevation of about 1,600 m covering an area of about 910 Km². Geomorphological Map of Thoubal River Basin is prepared on the basis of geoenvironmental parameters in which two types of landform are identified as major landform including Hills, Valley and Floodplains and minor landforms including Alluvium Fans, Scarps, Terraces, Ox-Bow lake, Point bar and Channel bar. These landforms are utilized in various purposes by nature and humans. Thus, the study of landforms and related processes scientifically and systematically is very important for the proper use of landforms.

Keywords: Geomorphological, geoenvironmental, terraces, ox –bow lake, bars

Drainage basin is one of the most fundamental and complex unit of the landscape (Chorley, 1969). Components of drainage basin are modified by a number of processes of which river is the most significant and effective. Various workers have published numerous data presented and elaborate on account of the relationship between river system and Geomorphic feature (such as Horton, 1932; Strahler, 1964; Schumn, 1956; Leopold and Wolman, 1957; Morisawa, 1958; Chorley, 1962; Thornbury, 1984, etc).

Thoubal River is one of the important tributaries of Imphal River, which is a part of the Chindwin River system of North East India and Myanmar. It is a rainfed river originates from Huimi in Ukhrul district of Manipur at an elevation of about 1,600 m covering an area of about 910 Km². The basin lies between 94°26' E-93°57' Longitude and 25°15'

N-24°36' N Latitude which falls in the survey of India Topographic Map nos. 83 K/8, K/5, K/4, L/1, L/2 and H/14 on 1:50000 scale.

A number of processes which may be from endogenic or exogenic processes had constantly modify the earth's surface at astonishing rate. As a result distinctive landforms are produced characterizing a specific process. Of all the surface processes, rivers are the most important that effectively shaping the earth's surface. Landforms are utilized by nature and human for various purposes. Thus the study of landforms and related processes scientifically and systematically is very important for the proper use of landforms.

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Geological Setup

The geological formations exposed in the study area belong to Ophiolite and Ophilitemelange, Disang and Barail groups and Alluvium. Ophiolite and Ophioliticmilange are represented by basic and ultrabasic intrusive and extrusive of peridotite, gabbro, serpentinite, shale, sandstones, conglomerate, limestone and chert associated with upper disangs, lower part of the disang is characterized by dark grey to black coloured splintery shales intercalated mudstones and minor amount of siltstone, while there is gradual increase of the arenaceous material towards upper part represented by intercalations of fine-grained greywacke type of sandstone, siltstone and shales.

clay, silt, sand, gravels, pebbles and boulders mainly present at the hill slopes, foothills and terraces. Litho-stratigraphic succession of the Thoubal river basin with a brief description of the lithounits is given in the following table (Table 1).

Methodology

In the present investigation various types of landforms and their processes of formation (Table 1) are identified and mapped from Thoubal basin on the basis of visual interpretation of Survey of India Topographic maps and Landsat Imageries on 1:50,000 scale. The information extracted from imagery is being further verified and finalized by field investigation (Fig. 2) and then analysis and evaluation are done.

RESULTS AND DISCUSSION

Howard and Spock (1940) have defined landforms as, "any element of the landscape, characterized by a distinctive surface expression, internal structures or both and sufficiently conspicuous to be included in a physiographic description". Thus, landforms are the basic element of any landscape and geomorphic analysis involves.

The geomorphic feature identified in the study area are represent in (Fig. 2).

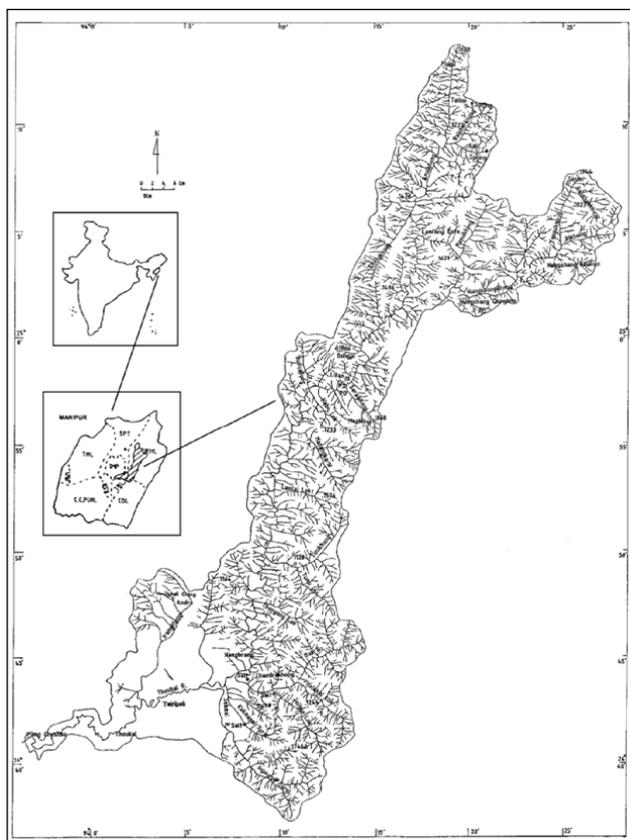


Fig. 1: Location and drainage map pf Thoubal river basin

At places these sequences show rhythmic characters. Barail Group is characterized by massive to thickly bedded sandstones with subordinate amount of siltstone and shale. Alluvium consisting of dark grey to black coloured highly carbonaceous clay, silt and fine sand of fluvio-lacustrine origin found in the plain area between Nangbrang and Irong Cheshba. Alluvium in the hilly area is consist of

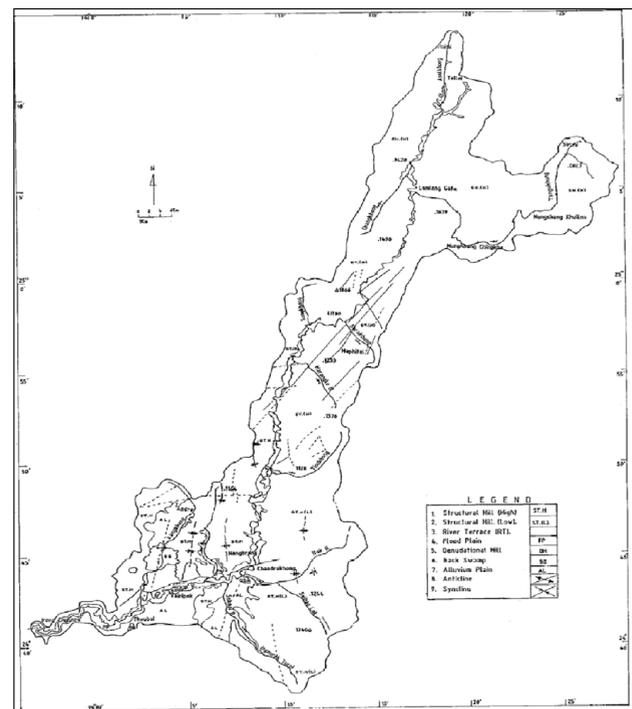


Fig. 2: Geomorphological map of Thubal river basin showing related landforms

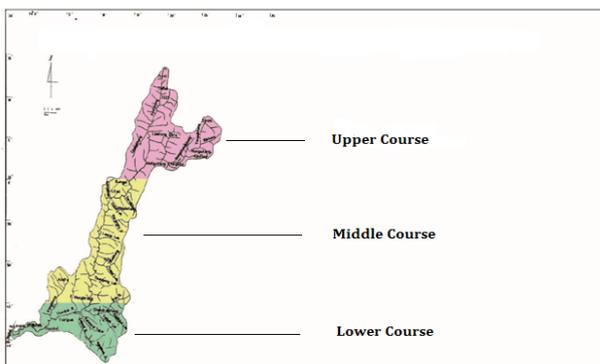
Table 1: Lithostatgraphic succession of the Thoubal river basin

Unit	Age	Lithology
Alluvium	Quaternary-Holocene to Pleistocene (?) Older	Clay, silt, sand, gravel, pebble, boulder of the foothills, hill slopes and river terraces. Dark grey to black clay, silt and sandy deposits of fluviolacustrine origin.
Stratigraphic Break		
Barail Group	Oligocene to Upper Eocene	Massive to thickly bedded sandstones. Alternations of shale and sandstone with carbonaceous matters. Rhythmic intercalation of bedded sandstones with shale at places showing turbidite character.
Gradational Contact		
Disang Group	Cretaceous to Upper Eocene	Arenaceous rocks, dark grey to black, splintery shales and interbedded with sandy-shale and siltstone and occasionally rhythmic character in the upper part. Argillaceous grey shales interbedded with mudstones and minor amount of silt in lower part.
Unconformity		
Ophiolite and Ophiolite Melange Suite	Upper Cretaceous to Mid-Eocene	Basic and ultrabasic intrusive and extrusive of peridotite, gabbro, serpentinite, shale, sandstone, conglomerate limestone, chert associated within Upper Disang shales.
Unconformity (?)		
Basement Complex ? Unseen		

Table 2: Processes and Landforms of Thoubal River Basin

Upper Course (rugged hilly terrain)	Middle Course (intervening valley)	Lower Course (alluvial plain)
Dominant Process : Diastrophic forces, Erosion, Transportation. Landforms: High structural Hills, V Shape Valley, Waterfall, Gorges	Erosion, Transportation, Deposition, Diastrophic forces. High structural and Denudational hills, Scarps, Wide and flat floodplains/ alluvium plain, Meanders, Braided river, Channel bar, Point bar, Ox bow lake, Terrace, Alluvium fans.	Depositional, Erosion, Diastrophic forces. Low structural and Denudational hill, Very wide floodplains/ alluvium plain, Terrace, Meanders, Ox bow lake, Point bar, Alluvium fans.

For detailed analysis the river Thoubal has divided into three parts on the basis of topographical variations and channel behaviors (Fig. 3).


Fig. 3: Three different parts of Thoubal river basin

Various landforms identified in the Thoubal river basin is divided into two viz. major and minor

landform with related processes are presented in (Table 2). Major Landforms identified in the study area include, high structural hills, low structural hills, denudational hills, valleys, flood plains. Many minor landforms like scarps, alluvial fans, terraces, point bars, channel bars, abundant channels, natural levees etc. are found to be associated with the major landforms.

MAJOR LANDFORMS

Major Landforms, large enough to be identified on the topographic maps and Landsat Imageries are categorized as Major landforms. It includes hills, valleys and floodplain.

1. Hills

Since major part of the Thoubal river basin is (about

90%) is hilly terrain, hills are the most striking geomorphic feature in the area. These hill ranges occurs as a series of straight or rectilinear ridges, deeply incised by river Thoubal and its tributaries. Hilly terrain is occupied by steep N – S to NNE – SSW trending structural hills with variable elevation range from 1,200 m to 2,570 m from MSL. Hills of the study area are the result of diastrophic forces like folding and faulting due to the collision of Indian plate with Myanmar. Fault and fault scarps are common in Tolloi, Choither, Ukhrul, Louphang village, near Kassom, Maphou, Koiringkoirang, Natjang, etc. From the available literature and field evidences it is evident that major hills of the Thoubalriver are structural hills.

Some of the important hills in the study area are, Sirohi (2,570 m), Kazing Malung (2,335 m) and Harbul Khayi (2,330 m) at Ukhrul, Mapithel (2,055 m), Bungpi Ching (1,866 m) near Litan and Nongmaiching (1,583 m) near Andro. Most part of the hilly terrain is covered with thick sub-tropical forest having different types of plants and trees and rich wild life such as shrubs, bushes, bamboos, pines, buffaloes, dears, leopards, bores and different varieties of reptiles. The famous Siroi Lilly blooms only on the peak of the Siruhi Hills at Ukhrul and many varieties of rare orchids also grow in the study area. On the basis of altitude and other associated features these hills are:

(i) High Structural Hills

Almost entire north-eastern part of the basin is occupied by high structural hills (800 m to 2,570 m above MSL). These hills are characterized by straight drainage courses, high relative relief, high drainage density, conical tops and trellis, rectangular, parallel to sub-parallel, barbed and radial drainage patterns. Major part of this unit is covered with thick forest.

(ii) Low Structural Hills

This geomorphic unit is restricted in south and southeastern part of the basin and constitutes relatively low hills. They are characterized by moderate to high slope, moderately high to high relative relief and sub-trellis, pinnate, sub-dendritic, dendrite, radial and sub-parallel drainage network (Fig. 1). Most of the villages are situated in the flat-topped low hills. Hillside with moderate slopes are being used for Jhuming and horticulture as a result

dissection index is higher than the high structural hills. At places both, high and low structured hills is characterized by fault scarp and vertical cliffs. A typical scarp can be seen near Sangkhai, Changamtabi, etc.

(iii) Denudational Hills

This geomorphic unit is characterized by asymmetric undulatory to sharp crested hills. Denudational hills are flanked by the foothills at the periphery of valley and also occurs as isolated hillocks in the alluvium of Imphalvalley (Plate 1). Due to extensive Jhuming they are characterized by high degree of dissection, deep gully erosion and light colour and fine texture on the lands at imageries.

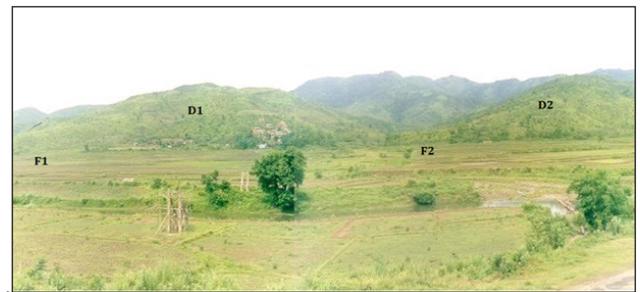


Plate 1: D1 and D2: Denudational hills; F1 and F2 Coalescence of two alluvium fans F1 and F2 near Thoubal dam

2. Valleys

After hills, valleys are the next important and conspicuous geomorphic feature in the study area. While traversing through rugged hilly terrain and alluvium, river Thoubal and its tributaries have often changed the valley nature and behavior. In the upper reaches between Tolloi to Litan such as Somdal, Phatang, Ukhrul, Nungshang, etc. valleys are narrow and deeply incised while in the middle reaches i.e. Litan, Nangbrang, Moirangpream, etc the valley courses becomes wider and characterized by the development of numerous alluvial fans. River Thoubal and its tributaries have carved their valleys along the weak zones like anticlinal and synclinal axes, fault planes, fractures, bedding planes etc. This suggests that the developments of major valleys in the study area are controlled by the structures or Diastrophic forces. Very wide valley, meanders, localized braiding's (as in Leimapokpi), terraces, etc. are the characteristic features of lower part of the valley beyond Nangbrang.

3. Food Plains

Floodplains can be defined as areas of alluvial band periodically inundated by the streams, which they fringe. The detail study of floodplains reveals that they constructed by two major processes. The first is due to the deposition of thin sheet of the sediment beyond the active channel during the periods of water spread of river. The second group of process derives from the shifting of the stream channel.

In the Thoubal Catchment the low-lying areas beyond Nangbrang viz. Leimapokpi, Chandrakhong, Sekmai etc. are characterized by dark tone on the Landsat Imagery, presence of ox-bow lakes, abandoned channels, channel fills, back swamps, natural levees, complex meanders etc. has been classified as floodplain. These features suggested that the lower course of the river is dominated by depositional processes.

MINOR LANDFORMS

Small-scale erosional and depositional features that cannot be visualized and identified on the Landsat Imageries are included in the category of minor landforms. These landforms are interpreted and identified on the contour patterns of the topographic maps and verified by field check. Minor landforms included scarps, alluvial fans, terraces, point and channel bars, abandoned channel etc.

1. Scarps

Scarps are relatively steep, straight slope that may range in height from a few meters to thousands of meters, and can be originated in many ways (Cotton, 1950). Scarps that truncate topographic features such as alternating ridges and valleys are suggestive of a fault. In the study area such features are mostly associated with the high structural hills. On the topographic maps they are identified on the basis of broken or very close contours and then verified in the field. Such scarps can be seen near Sangkhai, Nangbrang and Laimapokpi, koiringkoirang, etc.

2. Alluvial Fans

In the study area alluvial fans are mostly found in the middle and lower reaches as in Gwalamtabi, Yambem, Andro, etc. where valleys are relatively flat and wide having moderate to low gradient. Tributaries emerging from the adjacent hills and

join Thoubal river, there is sudden decrease in the velocity. As a result bulk of the sediments is deposited at the mouth of tributaries forming alluvial fans. Larger and older alluvial fans are being utilized for settlement and agriculture (Plate 1) and small and younger alluvial fans are showing barren land at the mouth of small tributaries (Plate 2).



Plate 2: Alluvium fan

3. Terraces

Terrace deposits are usually horizontal and exhibit stepped topographic benches, which forms the prominent Quaternary landscape in the study area. These benches indicate former levels of flood plains of valley floors and have been formed by the depositional and erosional processes of river Thoubal and its major tributaries. Most of these terraces are depositional rather than rock cut, which indicates the increasing rate of upliftment of the catchment's area and shortening of interval of successive rejuvenations of streams during different phase of sedimentation. The change in channel gradient, discharge or upliftment of the catchments area lead to the channel incision into its floodplain thereby original floodplain is abandoned and is left as relatively flat bench known as terraces. Terraces may occur in pairs or unpaired. Paired terraces are formed where vertical incision is more rapid than the lateral migration of river channel while unpaired terraces are formed where lateral migration of the river channel is relatively rapid. In the study area both paired and unpaired terraces have developed in the lower and middle reaches of the Thoubal river course but paired terraces are rare. Near Nangbrang village three levels of terraces T_1 , T_2 and T_3 have developed on the left side of the valley. The oldest terraces (T_1) are flat and highest on

which Nangbrang village is situated while youngest one (T_3) is the lowest and still retains the traces of flood plain morphology. On the other side of the channel only two levels of terraces (T_2 and T_3) have developed which suggests that the first terrace has developed due to the lateral migration and rest two which occurs in pairs have developed due to the vertical incision of the valley. Along the course of Thoubalriver near Litan, Sangkhai (Plate 3), Louphang, Keithalanbi, Changamdabi and Yambem only two levels of unpaired terraces have developed. Most of these terraces contain extremely poorly sorted sediment mainly composed of sub rounded to rounded boulders, cobbles, pebbles, sand, silt and clayey material. A terrace developed along the course of Thoubalriver near Khoiram shows graded (Plate 4) and the terrace near Changamdabi shows cross-bedded structures. Depending upon the suitability different level of terraces are used either for settlement, agriculture or covered with vegetation.



Plate 3: Unpaired terraces used for agriculture near Sangkhai



Plate 4: A typical terrace showing graded along Thoubal river near Khoiram

4. Back Swamp

The areas in the floodplain back of the natural levees are known as backswamp. Along the Thoubalriver course backswamps are developed after it enters in

the plain areas beyond Moirangprem, backswamp deposit is consists of extensive layer of fine silt and clay. Backswamp areas are characterized by very low relief and alluvium plain.

5. Point Bars

A stream that have cut their valleys nearly to base level or has become graded at any altitude above sea level tend to flow in broad sweeping curves due to the low velocity and deposition of alluvium which divert the stream courses. As the current is directed against the outer bank of meander it cut further in this direction and at the same time builds up a bar of sand or silt on the inner side of the meander that is known as point bar. Point bars grow by individual increments outward into the meander curve.

Along the Thoubal river course several prominent point bars have developed in the middle reaches of the Thoubalriver. These bars are dominantly consists moderately to well-rounded boulders, pebbles, cobbles and coarse sand (Plate 5).

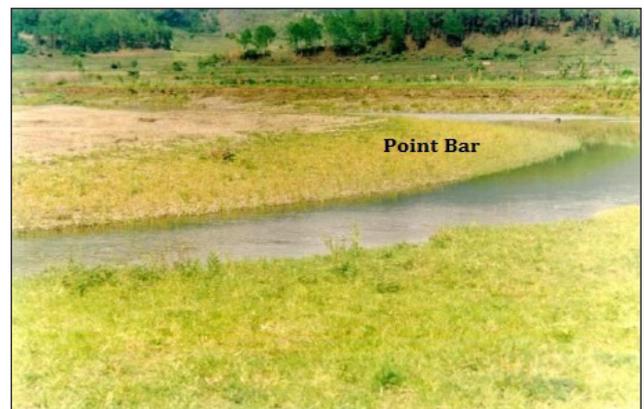


Plate 5: Point bar along Thoubal river near Island

6. Ox-Bow Lake

As the point bars grow curvature of the meander loop also grow. At the final stage of meander loop development meander neck is cutoff from the main channel. The channel abandoned during a neck cutoff is converted into an oxbow lake. In due course of time this abandoned channel is filled with silt and clayey material and converted into a marshy area. Along the course of Thoubal river ox-bow lakes are developed only near Lairongthel. But the place is filled by the nearby sediments and becomes a back swamp.

7. Channel Bar

Like ox-bow lakes, channel bars also an uncommon geomorphic feature in the study area. Channel bars are the characteristic feature of graded stream. In the study area channel bars developed at the foothill region or the places where major tributaries joins with the Thoubalriver e.g. near Sangkhai (Plate 6) and Chandrakhong.

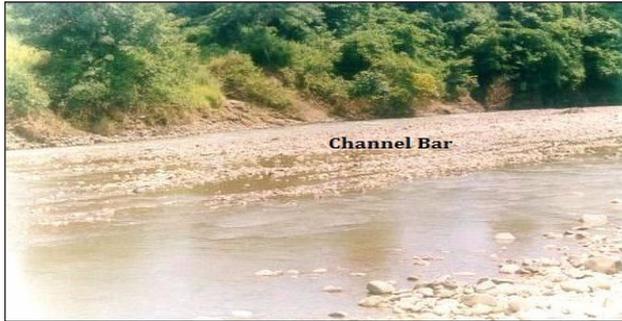


Plate 6: Channel bar deposit along Thoubal river at Sangkhai

CONCLUSION

Various landforms created by river erosion, transportation, depositional process and other diastrophic phenomenon. In Thoubal river basin landforms are identified as major such hills, valleys, and floodplains and minor landform such as alluvium fan, scarps, terraces, ox bow lake , point bar and channel bar. These landforms are utilized in various purposes by nature and human. Detailed and scientific study of landform in a scientific way is significant in land identification and management in construction sites and materials, soil conservation, river control, environmental policy and general public.

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