

The Geomorphic Regions of Ausane Basin in Rohtas Plateau: A Geographical Analysis

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ABSTRACT

This is a geomorphological study of the Ausane Basin of Rohtas, Plateau. Present has tried to study the physical geographical factors to identify the distinct geomorphic region of the Ausane Basin on the basis of the analysis of geological features-the continuation of the Vindhyan system and has establish the important of materials (lithology) along with the geohydrological aspects as shown in the Fig. 1 in particular.

Keywords: *Geomorphology, Vegetation, Valley, Basin, Tectonic*

1. Objective

The main objective the paper is to highlight the geomorphic regions of the Ausane Basin in Rohtas, Plateau. We have examined in detail the geological evolution, surface elevation, geology and structure, tectonic history, topography and morphometry of the Ausane Basin. These are the fundamental bases upon which the area may be divided into geomorphic regions.

2. Study Area

Comprising an area of 215 km², Ausane Basin lies between 24°37" to 24°45'45" North and 83°49'30" to 83°55'15" East (Fig. 1). The Basin drains into the Son from north-west. The Basin consists of number of watershed of small streams draining from west, south-west, north-east and north-west in Ausane river. The Basin slopes down, in general from north-west to south-east. The Basin shape is like an old banyan tree having larger width (18 km.) than the length (17 km.). This is somewhat an uncommon shape.

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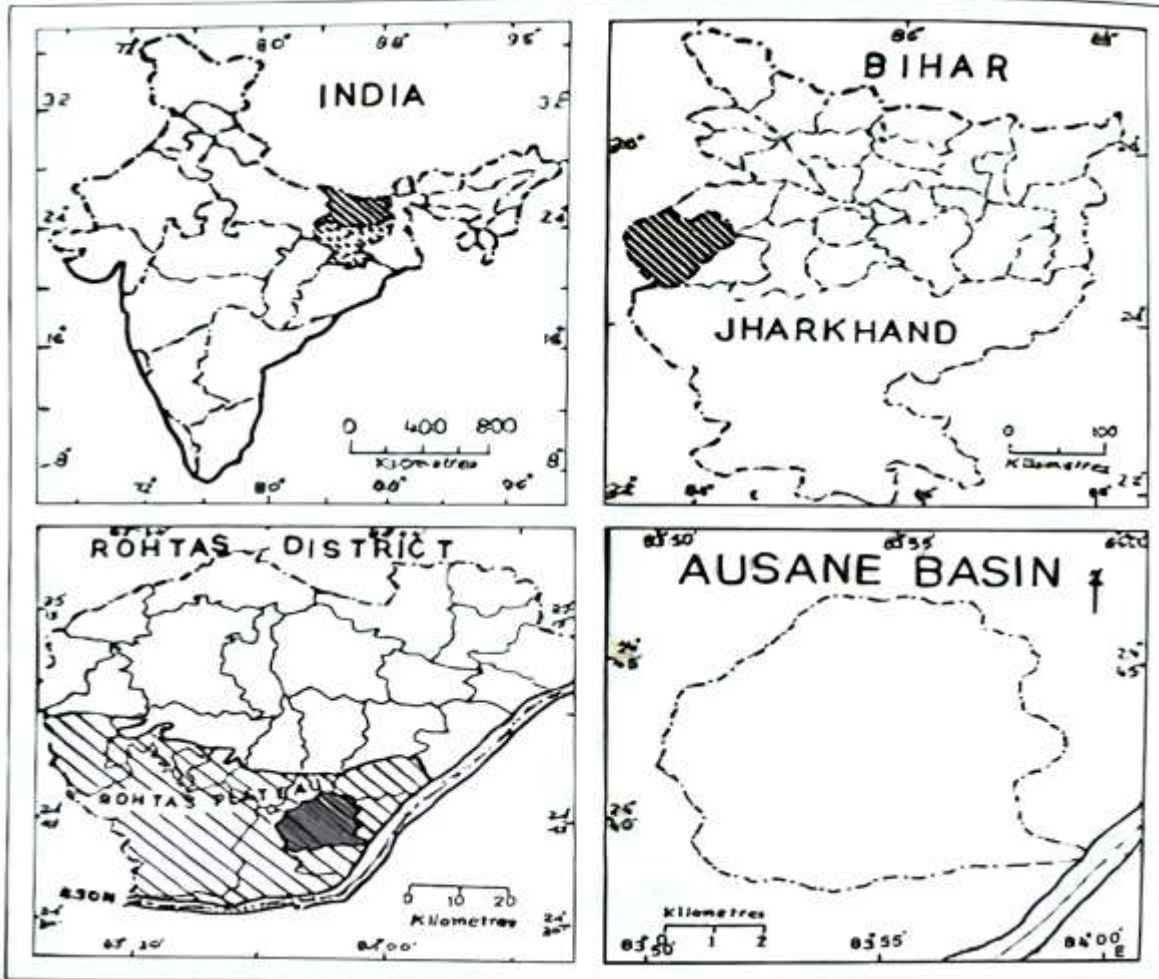


Fig. 1 Space Relation

3. Geology

Geologically the Ausane Basin is the eastern most continuation of the Vindhyan system. The study area is interesting because it consists co-nspicuously both of the Lower and Upper Vindhyan at the same site. From the point of view of lithology and structure of the constituent beds the Vindhyan system of the Ausane basin divided into (i) Lower and (ii) Upper subdivision. The Lower Vindhyan rocks are mainly calcareous and argillaceous in composition and have been subjected to folding. The Upper Vindhyan are, however, made up of undisturbed subdivision. All these geological formations help in tracing out the different geomorphic regions of the Ausane Basin.

4. Geomorphic Regions

A geomorphic region may be described as a part of the earth's surface with recognisable geomorphologic qualities which distinguish it from adjacent regions. Similar to and rather in different way from this definition, it may be termed as a region of homogeneous geomorphic unity, i.e. unity in almost all aspects of geomorphology such as geology, structure, relief, hydrology and morphometry etc. and to some extent climate also, the role of which cannot be ignored. 'It is the combined existence of these features that determines regional differentiation or the individuality of the regions in geomorphology also' (Ahmad, 1965, p. 309).

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No doubt, the Ausane Basin itself is a geomorphic region in the highlands of Rohtas Plateau. But from the foregoing paper it is apparent that within the delineation of the Plateau there are variations in materials, forms and processes. The upper portion of the basin has capping of hard old red.

Vindhyan sandstone whereas the limestone-shale beds below are peeping through the scarps. On the foot are the debris slopes which are fringed by new alluvial tracts. Both endogenetic and exogenetic processes have evolved a variety of forms ranging from a near-flat alluvial zone to the high vertical rocky escarpments. In between these are the highly and moderately high dissected region, subsided valleys, notches and khohs, karst depressions and many other large and small details of topographic feature. The morphometric variables like drainage texture, hydrographic network, relative relief, dissection index, ruggedness index, average slope and many their aspects of basin morphometry clearly depict the spatial variations within the Basin. Both erosional and depositional activities have been noted. All these variations in materials, forms and processes have been depicted on the Geomorphological Map (Fig. 2). It is noted that this geomorphic map (Fairbridge, 1968, pp. 388-403) has been prepared using the standard symbols following the recommendation of the International Geographical Union's.

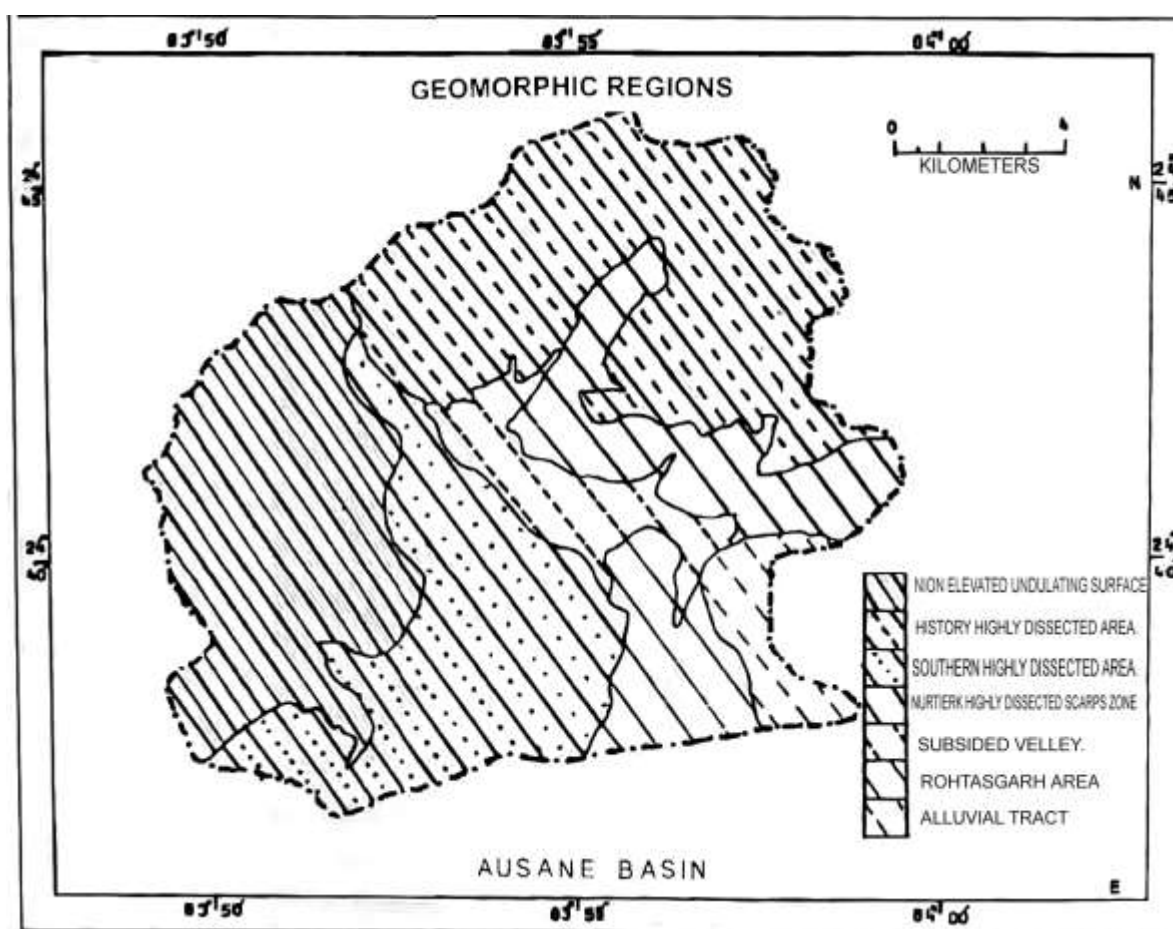


Fig 2 Geomorphologic Map

Subcommission on Geomorphological Mapping which was set up at the 1960 Stockholm meeting. This map is vich was presenting a broad outline of geomorphic regions in the Ausane Basin. But many aspects of geomorphic significance are missing, rather all the minute details cannot be represented in a map. Therefore, the authors thought it better to

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divide the study area into its geomorphic regions taking all the details into considerations. It was rather a tough task for him, but he had numerous tools, particularly drawn maps and field reports with him. He could superimpose the maps over one another to have an approximate common boundary. He could verify and alter it on the basis of field reports. In this way, the author could delineate seven major geomorphic regions in the Ausane Basin (Fig. 3 and Table- 1)

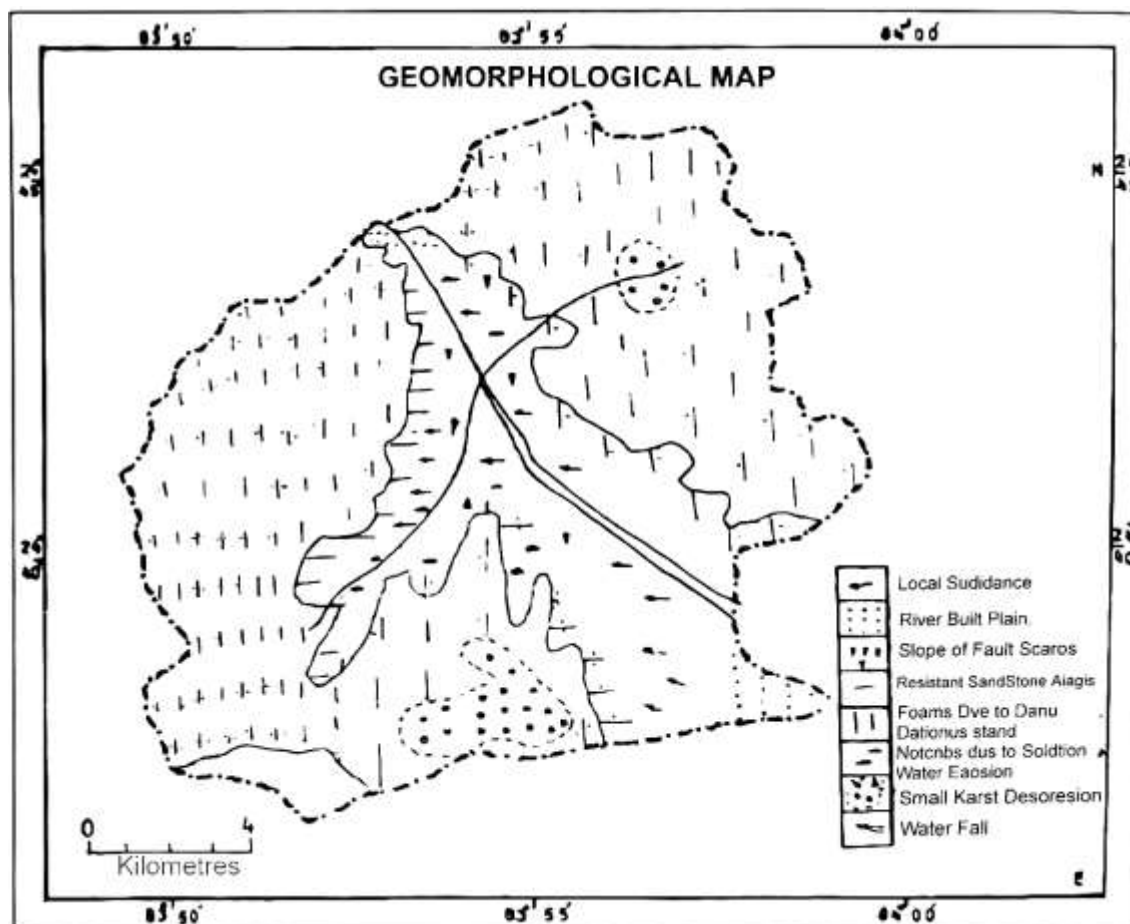


Fig 3 Geomorphologic Map

1. High elevated undulating surface with isolated depressions.
2. Northern highly dissected area.
3. Southern highly dissected area.
4. Northern highly dissected scarps zone.
5. Subsided valley.
6. Rohtasgarh area.
7. Alluvial tract.

But it is notable here that although these geomorphic regions have striking geomorphic personalities of their own, they are not demarcated as clear-cut comparatmentalized units. It is impossible and at the same time unnatural because there can be no such sharp demarcation line, on either side of which two totally different regions have developed.

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Table- 1 Geomorphic Regions

Regions	Total Area in km²	% of Total Area
Highly elevated undulating		
surface with isolated depressions	52	24.12
Northern highly dissected area	51	23.72
Southern highly dissected area	43	20.00
Northern highly dissected		
scarps zone	27	12.55
Subsided valley	17	7.90
Rohtasgarh area	15	7.00
Alluvial tract	10	4.65
Total	215	100.00

4.1 High Elevated Undulating Surface with Isolated Depressions: This geomorphic region covers an area of 52 kilometres representing 24.12 of the total area of the Basin. Situated in the western part of the Basin it is bounded on the west by the water parting lie of Kalanwa Nala and Babhandiwa Nala in west northern portion.

The maximum height of land occurs in the southern part where the height of 551 metres has been recorded. The area gently slopes down towards north and north-east from south. In the central portion of the region a little to the East of Luka a ridge type structure is found from where rivers radiate towards the north and towards the east. The height decreases towards the Gurudan Nala. Slightly eastward the height at junction of Gurudan and Gayghat Nala is 150 metres.

A series of river valleys has been carved out in a region which has a uniform and homogeneous structure throughout the area. The channels of flow have developed perhaps along joints and cracks in the body of the huge sandstone bed and dissection has been caused by the enlargements of drainage line and developments of well integrated system.

The main river flowing to the north Gurudan Nala is which receives an important tributary coming from the west known Budhua Nala, Another important river flowing towards north-east is Gayghat.

The general drainage pattern in the area is dendritic. It reveals that a well jointed bedrock is there, along which drainage lines were entrenched.

The relative relief in the Ausane area ranges from 125 metres to 203 metres. But in the water-parting area Gaighat Nala and Gurdan Nala it decreases and ranges from 80-100 metres.

The geomorphic aspects of this region have evolved due to combined processes of fluvial action and tectonics. Fluvial action is dominant in western section where rivers have produced a dense network of valleys. The valleys of the tributaries are narrow and less deep whereas the valleys along the master streams are wide, highly dissected and deep.

The area was downwarped causing a north-east flowing Gurudan Nala to take a sharp bend towards the east. This area along which the Ausane river has a east-west course is probably due to subsidence along the line.

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4.2 Northern Highly Dissected Area: The northern highly dissected area covers the northern portion of the basin area. The total surface area of this region is 51 sq. km. and covers about more than 23.72% of the Basin. This is, therefore, second largest geomorphic unit where the surface features.

Have developed entirely due to the dissection work of rivers. The western boundary of this geomorphic region is formed by Gopath river valleys. The irregularity of the boundaries in the northern, north-western and eastern parts is due to the formation of khohs, notches and subsided valleys. These boundaries are, however, in the forms of steep scarps.

The surface elevation varies moderately throughout the Basin. At the head of Barua Nala the height is 518 metres. It acts as a water-parting zone between Barua Nala and Arjuna Pahar. The height decreases towards south of this area and increases upto 525 metres in the area of the ridges which extend in south-west-northeast direction. South of this highest ridge in the west central portion of the region the tributaries of the Barua Nala have been able to dissect the Basin to some extent and the height decreases to 442 metres along the course of the Ausane river. It starts increasing again southwards and along the southern boundary of the region.

Most of the river like Barua Nala exhibit dendritic drainage pattern. In the Kauridah area we find herringbone pattern which is due to structural control. An area of radial drainage can also be spotted in the region. Tributaries of above noted rivers as well as the tributary of Khora river radiate on all sides.

In the northern portion of the geomorphic region the vegetation is of dense mixed variety where different species of plants are found. In the area north of Barua Nala the forests is of dense mixed (mainly sal) while an area of open mixed forest lies between these two vegetation belts. South of the sal belt also the forests are of open mixed variety and extend upto the southern boundary of the region.

The relative relief varies slightly from area to area. In the Barua Nala the relative relief ranges between 180 m. and 240 m., while in the central portions of the region where difference of height in small the relative relief is 20 to 40 metres. In the highly dissected north-eastern part as well as along the valleys of Kauridah area the relative relief is 60 to 80 metres. The lower reaches of Barua it is 80 to 100 metres.

The area has been evolved and shaped by fluvial action. The upper surface which is composed of hard sandstone has yielded to the channelised flow of water. This has carved the region into valleys and ridges. The inter-stream areas which withstood the attack of erosive forces are visible on the surface in the form of elongated ridges with a relatively higher elevation. Tectonic activity has added the evolution of the region of the northern, north-eastern and eastern boundaries where subsidence has produced notches, khohs. The irregular boundary of this geomorphic region towards the north, north-east and east is due to tectonic activity. The tectonic activity, however, is not the only controlling factor the evolution of the geomorphic features of this part. The fluvial activity specially its activity of limestone strata is the dominant factor. The caves were produced by the solution of limestone which due to tectonic activity of Tertiary period subsided to give an irregular shape to the northern and eastern boundary of this geomorphic region. Such large scale tectonic effect is not visible in the western part of the region, but in several places, depressions have developed.

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4.3 Southern Highly Dissected Area: This geomorphic region covers an area of 43 square kilometres (20% of the total area) in the southern middle part of the Basin. Its southern boundary is formed by the southern precipitous scarps up to the Rohtasgarh area Rakimkund fall is the only major south-east flowing river which has cut deep inside the Basin. The valley walls which are in the form of steep scarps constitute the irregular boundary of this geomorphic region in the east. The northern boundary is also in the form of low scarps representing the valley-sides of the Ausane.

The highest elevations of this geomorphic regions are formed on south-western part where the Basin is 582 metres high. The surface moderately slopes northwards and the height decreases to 522 metres on the opposite side along the boundary in the north.

On the basis of recorded height it is clear that the whole geomorphic region slopes northwards. The slope increases towards the tributaries of Ausane and Barua Nala in the north-east.

The bedrock on the surface is hard sandstone over which the rivers have not been able to carve deep valleys. All the rivers originating in the southern area flow in narrow channels northwards and form the tributaries of the Ausane flowing to the north-east. Some of the tributaries in the south-eastern parts join the Ausane river flowing to the south-east. Since none of the rivers flowing within this region are master streams, deep valleys are rarely found. This enables us to separate this part of the Basin as the southern moderately dissected Basin.

In the south-western part of the Basin we find herring- bone pattern in the tributary of Ausane river while in the other parts the pattern is clearly dendritic.

The type of vegetation varies from area to area. In the south-western higher areas open mixed vegetation is found which is not dense. Along the scarp margins dense mixed forest (mainly bamboo) is found. The type of vegetation changes in the lower eastern sections of the geomorphic region where dense mixed forest covers the area. The drainage network is somewhat fine. There are patches of open scrub vegetation interspersed in the dense mixed forest zone. These patches of open scrub vegetation are found mainly in depressed areas where settlements have developed.

The relative relief in the southern part near the scarp is below 20 m. but in the lower reaches of Ausane and in the middle reaches of Gurdan it is 60-80 metres which at some places increases to 80-100 metres. But in the deep notches of Durgawati it is more than 350 metres. The area slopes northwards from the crest of the scarps and in the upper portion the volume of water is not sufficient to encourage rapid fluvial action. The drainage lines are, therefore, narrow and their erosive power is limited. Rainwater flows gently northwards. It is incapable to cut deep-valleys due to limited volume and limited velocity of water.

4.4. Northern Highly Dissected Scarps Zone: The north middle segment of the forms a distinct geomorphic unit covering an area of 27 square kilometres representing 12.55 percent of the total surface area of the Plateau. This region may be called as northern highly dissected scarps zone its boundaries in all sides have been formed by steep scarps. The scarps to the south, south-west and northern boundary are steep and form a dividing line between the subsided valley areas in the middle part of the Basin. The boundary on the

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western part has been formed by the subsided valleys occupied by the lower part of Barua Nala. The western portion of this geomorphic region is narrower while it is wider in the east. The highest elevation in this region is found in south central part where height is 499 metres. In the north-east the height gradually decreases to 413 and 322 metres which are the lowest heights in the north-eastern corner. This zone is drained by the Barua Nala which flows towards the south-east. The scarp zones in the east and in the north-west and higher in elevation and small nalas originate in these higher areas and join the Ausane drainage system. Similar is the case in the other western half of the region. Due to the height of scarps many tributaries of Ausane river come flowing from the northern scarp area to join the Ausane in the south which forms the boundary of the region. The height along the northern scarp is 438 metres and in the south along the Ausane Basin it decreases to 321 metres. There are some of the areas scattered here and there which have heights ranging from 447 to 462 metres.

The drainage density is highest in the northern and north-western sections of this geomorphic region. There are very few rivers in a wide zone in the eastern part. The rivers coming from north to south are of varying length and size to join Ausane river. The pattern in this part is dendritic. There is a dense network of tributary joining Dhoba river which flows to the north.

In the south-central part of the area in the Banjari hill area a radial pattern of drainage is clearly visible from this highest point the tributaries of Ausane flow from north-east to south-west.

Vegetation in the north-eastern corner is of open mixed type and in the rest of the area it is of dense mixed typed. There are two depressed areas of small areal extent where the vegetation is open scrub type. In the north-western corner of the region also open mixed forest occurs.

Due to the development of a fine network of drainage lines the area has undergone high degree of dissection. Relative relief is between 60-80 metres for the area as a whole but it increases from 60-100 metres towards the Goptha basin and in the Dhoba river basin the relative relief is 220 metres due to notches and khohs.

The area has evolved on hard sandstone structure where fluvial processes have been active in carving out river valleys. Due to the high elevation of the scarp zone the rainwater flows towards the interior of the Basin and unites in the west flowing Ausane in the north flowing Barua Nala. The valleys have a roughly north-south dimension in the north-western part and northwest-southeast alignment in the north-eastern parts left of Ausane river. There has been no major tectonic activity on this geomorphic region except along the subsided valleys of Ausane.

4.5 Subsided Valley: The subsided valley zones constitute one of the most interesting and conspicuous geomorphic region of the Basin. The total area covered by these valleys comes to 17 sq. kms. representing 7.90 percent of the total Plateau surface. Subsided valleys are found in the middle eastern areas of the Basin. In the south-east there is only one region where the Ausane and its tributaries drain the subsided part. The zone of subsided valleys is found in the middle parts of the Basin where the Basin surface is drained by river. The valleys of all the rivers are inter-connected and from the finger-like extensions in the central

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body of the Basin. The subsided areas has become wider in the east where the Ausane and Amba khoh nala.

The surface elevation in the subsided section at the head of Ausane river is 250 metres. We see that subsided valleys plaintain a higher elevation in the interior of the Basin at the head of main rivers. The elevation gradually deasin at eastward which permits the river to flow from west to east. This coincides with the general slope of the Basin from the west to east. There are, however, abrupt changes of height at the head of the most of the rivers where the drainage lines leave the higher area and enter into the zone of subsided valleys. As a result most of rivers have produced waterfalls while entering into the section of subsided valleys. The intensity of fluvial erosion in lower parts has dissected the area deeper and caused them to acquire lower elevation in comparison to the upper reaches of the subsided valleys where fluvial action is not so strong.

In the eastern subsided valley occupied by the Ausane river the pattern is clearly dendritic. The drainage network has developed in a basin which is almost circular in the shape and the pattern looks like a banyan tree.

The natural vegetation in the upper portion of the Ausane valley consists of dense mixed forest (mainly bamboo) and in the lower parts the vegetation is of open mixed like. In the northern valleys the lower elevation areas contain open mixed forest while in the upper reaches of the main rivers the vegetation consists of dense mixed forest with sal as the main spices.

The relative relief in the Ausane subsided valley in the south-east ranges from 260-385 metres. In the Goptha and Durgawati river valleys it is 260-350 metres but it decreases in the Karsotha valley where it is 230 metres. Sura I and Sura II show still lower little relief ranging from 100-240 metres.

The subsided valley area is a highly dissected area due to the presence of notches, khohs and straight valley walls. Dissection index in all north flowing river valleys as well as the south-east flowing Ausane is more than 0.5.

The evolution of this geomorphic region is complex. The initial features were produced by the subsidence of the upper sandstone strata in the underground caves which were produced by solution and draining out of limestone with the movement of underground water. The caves originated perhaps before the Tertiary period and the tectonic activity of this period led to the collapse of roof materials.

Fluvial action since Tertiary has modified the original subsided valleys and processes of headward erosion have produced.

4.6. Rohtasgarh Area: The Rohtasgarh area occupies the southern part of the Ausane valley. This is the only area where the area is high. This area the 15 sq. kms. representing only 7.00 percent of the study area. The highest elevation of this zone occurs along the foot of the scarps where the height is between 519 and 511 metres. The area slopes northward. The monotony of the slope is broken here and there by a few small isolated hills which rise at places from the general level. The streams of this zone flow from south to north following the slopes of the land. The tributaries are very short and make dendritic pattern in the higher areas of the zone but the main river joining the Ausane river have formed a parallel pattern.

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The streams are young and valleys are shallow and narrow. The vegetation cover varies from west to east. In the south-west narrow patches of dense mixed forest with bamboo are found. In the wider zone in the south the cover is provided by open mixed forest. In the small patches in the east open scrub vegetation occurs. The relative relief in the higher elevation areas is between 20 and 40 metres but decreases towards the fringes.

4.7. Alluvial Tracts: An alluvial tract in between the Rohtasgarh and the river Son is a separate geomorphic region having its own regional character. It covers an area of 10 sq. kms., about 4.65 percent of the total study area. The alluvial fringe is very narrow having a width of only half kilometre in the south-western and southern parts. The elevation in the narrow tract is 140 metres. From longitude 83°50' E. the alluvial tract increases in its width and has penetrated somewhat deeper in the subsided Ausane valley. The entire tract has an elevation below 140 metres which is the maximum height of the tract along the foot of the scarp. This slope gently away from the scarps. The total variation of the height along the foot of scarp and the eastward fringe is only 22 metres.

Small streams occupy the alluvial tract flowing from north to south in the Sone. Almost all the streams originate at the foot of the scarps which forms a prominent water divide between north flowing major river and south flowing minor rivers on the alluvial tracts. The streams in their upper half have acquired dendritic shape while they form a roughly parallel pattern in the lower alluvial tract before joining the Sone. North-east of the Ausane valley there has been no development of drainage line in the alluvial tracts. The only river which cuts across the tract is Tutla river which has not been able to reach up to the Sone. The river dries up in the alluvial tract itself. The absence of integrated drainage lines in the north-eastern alluvial tract is probably due to the fact that the higher scarps do not permit water to flow towards the north-east or due to limestone structure. All the drainage lines originating from the north-east scarps flow towards the west away from the alluvial tract. There has been a development of a large number of rills in the north-eastern tract some of which are able to reach the Son. But there has not been development of clear cut river valleys. The irregularity of drainage development is probably due to the extremely porous nature of the alluvial tract in this part which leads to the rapid seepage of rain water in the underground channels.

The original vegetation cover which might have been scrub or grass has been cleared from most of the tract. The area has been developed for agricultural purposes and now it forms an important agricultural zone in the study area. The relative relief in this area is below 20 metres because of the slight variation of height in the north-eastern, south eastern boundaries of the alluvial tract.

As discussed earlier this alluvial tract has been formed by the combined processes of weathering and mass wasting of scarps and alluviation processes of the river Sone. The talus produced by the weathering and denudation of the scarp face was deposited at the foot of the scarps some of which were carried towards the fringes of the region. Over this deposit of talus and fragmented material derived from the scarp face, the river Sone has deposited finer clay materials which have buried the coarse materials below. This is a continuous process. Fragmented talus materials from the scarps have been continuously available to the tract over which the river Sone spreads a cover of finer materials specially during flood.

The area has become suitable for cultivation only due to the deposition of alluvial material by the river Son. Therefore, it can be said that the river Son has played a dominant role in the making of this geomorphic zone of economic importance.

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Conflict of Interest

The author(s) declared no conflict of interest.

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