Introduction:

Geomorphology (Greek: Ge- 'Earth; Marpho-from, Loges-discourse) is the scientific study of the geometric features of the earth's surface. It incorporates all aspects of the interface between the solid earth's hydrosphere and atmosphere. It is an interdisciplinary science, it also studies the morphology of the sea floor and a close look at the moon, marks and other planets provided by space crafts has created on extra terrestrial aspects of geomorphology.

Geomorphology has very recently come up as a very important branch of earth sciences. It is closely related to geophysics and geology particularly for obtaining diastrophic and structured characteristics of the earth. It however falls mainly in the realm of geography, because of the need for obtaining the surficial characteristics of its various relief forms.

1.B Review of the Previous work

1.B.1 Contribution of Foreign Scholars

Geomorphologits like Russel (1949) Kesseli (1954) and Hammond (1985) have contributed significantly to the
development of the quantitative approach to the study of landforms. They have laid emphasis particularly on the suficial expression of landscape rather than on their genetic aspects Davis (1924) and wooldridge (1946) considered that land forms were the best reflects of the history of the earth in many parts of the earth's surface. It is also indicates the Geomorphological studies conducted in the past have been very helpful to geological. Interpretation. Traditionally, the subject is confine the origin and evolution of landforms reflect in the inter between erosional and weathering processes operating structure and lithology under varied condition.

1.B.2 Contribution of Indian Geologists and Geomorphologist

In India, geomorphological studies began only after 1930 with the work of wadia (1936) geologists and geographers both paid munch attention in this regard and their contribution are great importance particularly in the field of physical geography geologists like Auden (1933) Wadia (1936) Chatterjee (1946) Chhibbar (1948) Krishnan (1957) Chaubey (1964) Sharma (1974) and other had contributed significantly in the field of geology as well as geomorphology geographers like Singh R.P(1956) Ahmad(1958) Bagchi (1960) Mukhopadhaya (1980) Singh

1.B.3 Development of applied geomorphology

With the development of applied geomorphology it has become easier to evaluate and solve the problems pertaining to the earth's surface both physical as the socio-economic aspects of mankind for a long time geomorphology was considered just a subject comprising mainly studies of the types and origin of landforms. Only relatively, recently it has found many applications in different fields of resource and environment surveys. The development of the subject got new momentum as its scope was progressively enlarged with advances in its methods of research which day by day become more scientific. Thus applied geomorphology has emerged as a branch of
Geomorphology for development purposes. Brundan (1978) consider. Applied geomorphology as the application of geomorphological techniques in analysis and pollution of problems relating to development planning, environmental management, engineering, construction, etc.

1.C. Application of Geomorphology in Various Spheres –

Verstappen (1983) has demarcated the various field of geomorphology as follows (i) Static geomorphology, concerned with actual landforms (ii) Dynamic geomorphology concerned with processes and short term, (iii) Genetic geomorphology concerned with long term development of relief and (iv) Environmental geomorphology concerned with land use ecological links between geomorphology and neighbouring disciplines or elements of the land. Application of geomorphology in different fields like earth science (Geology, Soil science, Hydrology) Environmental studies, development and planning, field of urbanization in the field of engineering are useful for mankind.


It is rather surprising that applied geomorphology has developed Lately (Tricart 1978) inspite of the fact that mankind has survived through the ages only successfully
applying his knowledge of the world around him. (Marsh 1965) This branch has recently attracted increasing interest of geomorphologists (Thornbury 1954, Fels 1965, Jennings, 1966, Doughlas 1967; Chorley 1969, Brawn 1970, Cooks and Droonkamp 1974; Gregory and walling 1979, Goudi 1981, Graig and crapts 1982) discussed the application of geomorphology to hydrology, economic geology engineering projects, military geology, soil exploration etc. The topography according to him provides valuable dues to mineral exploration and prospecting. During the last four decades a great advancement in geomorphological studies have been made in developed countries like U.K., U.S.A., France, Germany, USSR, Hungary, Poland, Nether land, Australia, Canada and New Zealand and British Geomorphological research group have contributed significantly on various aspect of applied geomorphology.

1.C.2. Contribution of Indian Geographers in Applied Geomorphology –

In India applied geomorphology is still a factory, though its importance is realized in many quarters of developmental activities. Some Indian geomorphologists have been working on research projects, mostly concerned with discharge-yield study, rate of erosion, sediment yield
bank erosion, land use, settlement and applied aspects founded either by the development of science and technology or department of environment Government of India. Besides, various universities, control and state government organization such as the geological survey of India, the national atlas and thematic mapping organization (NTMO) the soil and land use surveys, the central and state groundwater departments. The Indian space application research organization (ISRO), Ahmedabad; the national remote sensing agency (NRSA), Hyderabad have initiated serious geomorphological research according to their needs and requirements.

Knowledge of geomorphology has been applied to different types of Human activities in the past. It is being done to even in the Present. This is the second aspects. Its applications of geomorphology such as geomorphology and agriculture, slope and terracing Geomorphology and soils field patterns and ground moisture.

To conduct relevant studies a commission an applied geomorphology was formed under I.G.U. This commission has under its preview, irrigation, Pedology, agronomy, rural engineering, city planning conservation of resources, transport photo interpretation, geomorphic mapping etc. the commission meets once in a year and discusses problems and subjects related to applied geomorphology.

1.D. Recent Trends and techniques in applied Geomorphology –

Development of unique techniques of study in geomorphology is a feature of present country. There are in fact, seven significant trends in geomorphological studies (i) Geological geomorphology (ii) Regional geomorphology (iii) Applied geomorphology (iv) Quantitative geomorphology (v) Palaeo geomorphology (vi) climatic geomorphology accompanied with morphogenetic
approaches and (vii) Stratigraphic geomorphology (Singh 1977)

Latest applied geomorphology has been divided into three separate themes (i) environment management (ii) Research evaluation and (iii) Environment Hazards. Trends and technique of analysis have changed from time to time. In the starting the discipline was studied mostly using the Qualitative techniques based on the concepts of Davis and Penck. But lately geomorphologists like Russell, Kesseli and Hammond have contributed to the development of Quantitative techniques, which have been found very useful in the analysis of landform.

The traditional techniques of geographers have been supplemented by application of Remote sensing Techniques. Particularly areal remote sensing and satellite remote sensing. With the help of visual and computer associated techniques. Images are interpreted and the required data are gathered according to necessary. Finally maps are prepared. Though aireal Photograph were use even in the late fifties and early sixties, their scale and range of resolution have been widened considerably improved the techniques. Quantitative analysis of slopes, drainage density and other land form element can be
carried out most correctly and rapidly with the help of aerial photographs. These photographs can also be used as an aid to the study of Dynamic have been proved an excellent tool after the second world war. Now a days this technique has been widely applied in identifying morphological characteristics of land forms wasteland mapping, Preparation of resource inventory and evaluation of terrain.

The whole field of data storage data retrieval, data analysis and data display is expanding rapidly and we soon find geography as special type of regional data storage system based on electronic technology (Hagget and Chorley 1969) A few techniques can be used in some areas to study the slower processes of drainage network rejuvenation and extension valleys filling and pattern of stream capture as well as hill slope dissection and mass feature.

The measurement of slope appraisal of weathered zone mechanism of erosion, with high level accuracy has become possible due to multistage concept of Remote sensing. Here it become necessary to mention the experimental stations installed at machakas and Nanyuki in the tropical Kenya such station helps in studying various aspects of geomorphology now a days geomorphic mapping models and systems are used to express and delineate geomorphological
information. Geomorphic mapping is very useful in land use planning. It has an advantage over the topographic maps as it brings into focus relief and its facets more directly.

Environmental geomorphology has received much attention as most of the contribution have been successful in identifying major geoenvironment problems of their respective areas. Man, through his interference with the natural system has been adjudged as the most potent factor in affecting the geomorphological processes. Similarly deforestation has been taken as the major cause for accelerated rate of soil erosion, siltation of river beds and reservation and recurrent floods. A common concern has been raised for the conservation of natural resources and maintenance of ecological balance. The arid landscape has been considered as suitable for investigating, such problems of increasing magnitude.

1.E. Objectives

The present study lays emphasis on the morphometric analysis of land form in addition, attention has been given to applied aspects of geomorphology, particularly distribution of geological structure, soil management and
availability of water resources the main objectives of the present study are –

(i) To evaluate the morphometric aspects of terrain both qualitatively and quantitatively.

(ii) To delineate the study-area into morphometric units of different orders. Application of remote sensing techniques has been made to verify terrain categorisation based on various morphometric attributes glanced from topographical maps.

(iii) Identification of geomorphic units using landsat imagery.

(iv) To correlate geomorphic attributes and geological structure in the study area. An attempt has been also made to bring out relationship between availability of water resources.

To identify areas of severe soil erosion and suggest measures for its control, including afforestation, slope and ecosystem management and use of scientific agriculture practices.

1.F. Methodology –

Geomorphological analysis requires a correct interpretation of the area under study has not been
properly surveyed geologically and geographically. Therefore a detailed account of the area is not available at one place. However literature on the stratigraphic and dystrophic history of the area is available in memoirs and records of geological survey of India. Besides, investigation made by the geologists of the oil and Natural gas commission, Govt. of India regarding the stratigraphy and structure of the Bokaro basin is also available.

To study area intensively relevant literature and data available on the area have been consulted. Each morphometric attributes i.e. absolute relief, relative relief, dissection index, drainage density, drainage frequency and slopes has been analysed. For this purpose topographical sheets No. 72L 2,3,4 72P 2,3,4,7,8,12,16 73M 1,5,9,13 issued by survey of India have been used. The contours map at feets interval, drawn from 1:150000 topographical sheets have been used for analysis of morphometric attributed. The drainage analysis has been also undertaken by using the above mentioned topographical sheets for a detailed investigation, all the measurements were computed into metric system. Numerous types of data and maps regarding the climatic characteristics (Rainfall, temperature) etc. have
been collected from NRSA, Hyderabad, NATMO Kolkata and Survey of India, Dehradun.

The study area measuring 4454.40Km$^2$ has been divided into 10.24 Km$^2$ units. All the morphometric attributes have been rechecked by toposheets. The above assumption techniques (Quantitative) has been further tested in the height of geology and structure of the area.

All the morphometric attributes are enumerated, classified and represented by suitable cartographic techniques. Their categories have been also depicted on the maps. Karl Pearson's coefficient of correlation for suitable pairs of attributes has been computed and interpreted so as to throw light on both physical and cultural landscape of the area.

1.G. Organization of the Present Study –

The present study has been organized into eight chapters.

Chapter I introduction and general survey of the physiographic elements which from the basis of landform studies. The distribution of major relief features, latitudinal zones and drainage along with the elements of climate, soil
and natural vegetation are dealt to aquatint the reader with the general topographic character of the area.

Chapter II deals with the geological base and evolution of landscape of the study area.

Chapter III seeks to fluvial landscape both absolute and relative and established the quantitative relationship between the two. The dissection index a more scientific expression of relief analysis and erosional potential is also computed. The areal distribution of dissection index and their correlation with absolute relief have been also calculated. The area height relationship has been evaluated by applying the techniques of hypsographic clinographic and altimetric frequency curves.

Chapter IV describes relief under the heads of absolute relief relative relief dissection index, area height relations and landscape profiles. An attempt has been made here in to identify the erosion surface of the area.

Chapter V is devoted to morphometric characteristics of same selected tributaries of drainage basin including bifurcation ratio, weighted mean of bifurcation ratio, mean channel gradients streams density and frequency hypsometric integards etc.,
Chapter VI deals with the analysis and distribution of average slope including identification of major slope categories and evolution of slope. The coefficient of correlation between slope and absolute relief has been compared. The magnitude of slope has been also portrayed by using trigonometric functions and sine.

Chapter VII analysis the relationship between geological structure and morphometric attributes, classification and morphometric evaluation of morpho units.

1.H. Location and Extent –

The Mor basin (86° 50' East to 87° 58' East longitude and 23° 51' North to 24° 35' North latitude) lying in the districts of Dumka and Godda in Jharkhand and Birbhum in West Bengal embraces an area of about 4454.40Km² (Fig. 2.1) It is limited by the Mor river in the South western part of Rajmahal highland. Damodar river in the South west far from the study area. The basin is elongated from Northwest to South east. The main rages of the basin are namely Trikoot (753m), Masanjor (474m) Nawadeeh (286m) Nakti (276m) Pahar's is the North west valley Siddheshwar (245m) and Matihari (289m) in NW-SE direction. It is bounded by the administrative units of
Ranchi District in South west Dumka district in North and Deoghar in west.

1.H.1. Previous Studies –

The Mor basin forming a part of the metamorphic terrain of Rajmahal Highlands had enticed eminent earth scientists, specially geologist to explore both academic and economic interests. They have give more stress on geological aspects of the area and a few of them had studied the area from geomorphological point of view. Their studies were not fully concentrated in his basin, but their explanations on Hazaribagh plateau and surroundings area are helpful for further detailed study of this basin.

Williams (1947-48) is regarded as the pioneer worker of the Bokaro coalfield, i.e. Nothern portion of the Bokaro Basin. He had give name of this field after the Bokaro River. Due to his sudden death in November 1948, his report on this field was not completed and Hughes examined this field geologically in 1866-1867. He was favour of giving the name of lofty Luguhill (1976) desinatethe field. The Bokaro Coalified, after it had been geologically explored by Hughes in (1866-1867) had not been entirely resurveyed systematically for a long time.
Chattergee (1946) the pioneer worker is the field of geomorphology, described the physiographic evolution of Chhotanagpur Singh R.P. (1957) documented the stages of structural growth of Chhotanagpur, He (1966) had shown the effect of physical landscape on cultural landscape of Chhotanagpur. Singh's (1969) contribution is explaining the geomorphic features of Chhotanagpur Highlands in work mentioning.

Ahmad (1958) made a study of Hazaribagh plateau while explaining the geomorphic outline of Chhotanagpur. Chhotanagpur scarps. Moreover Ahmad (1966) traced post Gondwana faulting in Peninsular India and its bearing on the tectonics of the sub continent.

1.H.2 Major Relief Feature

Structurally Mor basin forms a part of the stable Deccans shield which has generally remained unaffected by mountain building movement since practically the close of the Precambrian and Gondwana formations, the landscape of Mor basin expresses itself in different surface forms, which range from granite, gneiss, domes, projected over peneplained surface to peaks, hills plateaus, spurs and scarps, highly dissected and diversified by Mor streams.

Major through faulting in Permian times that brought into being the Mor valleys when the Gondwana rocks were laid down in fresh water lakes; uplift in the Hot conditions of Triassic days. When some five thousands feet of unprotected Gondwana sediments were stripped away and massive sandstone of Middle Gondwana were formed a volcanic outburst in the Triassic and minor faulting and tearing during tertiary earth movements. The Mor basin is deeply dissected with a vast stretch of land with relative relief, comprising about all the total area which is drained by tributaries of Mor basin. The whole area can be subdivided into two major and five relief regions (Fig. 1.3B).
1.H.3. Mor Basin Upland

1.H.3.A. North eastern Mor basin upland

1.H.3.B. The Southern Mor basin upland

1.I. The Valley Region

1.I.c. The Upper Mor trough

1.I.d. The Middle Mor trough

1.I.e The Lower Mor trough

1.H.3 Mor Basin Upladn

1.H.3.A. North eastern Mor basin upland –

The north eastern Mor basin upland is situated is the North east part of study area. This terrain consists of a highly undulating dissected surfaces with hills and ridges projecting over it. More than 21.60% of the area of this regions are namely as Mohanpur scarp (400m) Hansdiha (392m) Nawadih (320m) Karbind (320m) Asanbari (220m) Makhdoom Nagar (180m) upland, Sanakpur (108m) Mohammad nagar (82m) Peneplain in Northeastern part of study area. It is composed by Gneissic and granitic landscape in the shadow of which are many seduded valleys of peaceful beauty.

1.H.3.B The South western Mor Basin upland –

The south western Mor basin upland is situated in the southern part of the study area. It has confined to the area
of western upland 1587.20 Km² percentage of total area 35.6% of area. It is confined to the Trikut (735m) Raghuwadih (476m) Amba (420m) Gora (427m) Katri (265m) Pahars, Taljhari (438m) Mahapur (470m) Scarp, Polajori Gorge (320m) Suga Pahari tableland (220m) Haripur revine area (380m) Mayurakshi Nagar Peneplain (120m) are southeastern part of the study area.

1.I. The Valley Regions:

1.I.c. The Upper Mor trough –

The upper Mor trough occupies the North western part of the study area and its gently slopping towards the southeast. Its sources in the higher plateau 488.48m Nonia upland. This area is limited in 788.48Km². The area is open cultivation fairly extensive.

1.I.d. The Middle Mor trough –

The middle Mor trough is composed of the older alluvium rocks and near masanjor, the river turn to the northwest and then to the southeast. This area is limited in 552.96Km². The Mayurakshi Reservair (300m) found in this area. Quite a big area of this region is flooded by the river almost every now layer of alluvium is deposited.
1.I.e. The Lower Mor trough –

The lower Mor trough is a evelled peneplain surfaces. It is the lower part of Mor basin. It has height f about 203m. It formes a beautiful steep-sided valley, when its passed through the gap between the imposing hills of

1.J. Climate –

Davis postulation, landscape is a function of structure, processes and stages, not only envisages the importance of geology in landscape evalution but gives due consideration also to processes both endogenetic and exogentic and stages. These entrants interact upon each other while shapping form. Exogenic processes conditioned chilfy by climate with its varied nature and forms produce different feature. A rock may be resistant to a particular climate, while it will be sensitive to a different climate. So due to the variation of climate the same type of rock produces different landscape features. It is known, "that tropographic facies from the hall marks that climate."
In research on the evaluation of topographical form one must without doubt according increasing importance to those hypothesis proposing that past erosion conditions were different from those of the present due to climatic conditions being different. (Darbyshire, 1973)

1.K. Temperature –

In general distribution of temperature is affected by inclination duration and intensity of sun's rays, cloud cover, humidity conditions and attitudes variations.

For a proper discussion of the distribution of temperature in a highly dissected upland region. It is necessary to record temperature at different altitudes. This is possible only with a fairly close network of observatories in the area. But their absence does not permit a factual statement, yet some general characteristics about the temperature may be given a follows.
Table 1.1
Mean Monthly Temperature at Dumka 2006-2007

<table>
<thead>
<tr>
<th>Months</th>
<th>Maximum ($^\circ$C)</th>
<th>Minimum ($^\circ$C)</th>
<th>Mean ($^\circ$C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>22.7</td>
<td>10.5</td>
<td>16.6</td>
</tr>
<tr>
<td>February</td>
<td>25.9</td>
<td>12.4</td>
<td>19.1</td>
</tr>
<tr>
<td>March</td>
<td>31.5</td>
<td>17.5</td>
<td>24.5</td>
</tr>
<tr>
<td>April</td>
<td>36.1</td>
<td>22.4</td>
<td>29.2</td>
</tr>
<tr>
<td>May</td>
<td>37.5</td>
<td>24.2</td>
<td>30.0</td>
</tr>
<tr>
<td>June</td>
<td>36.6</td>
<td>24.5</td>
<td>30.5</td>
</tr>
<tr>
<td>July</td>
<td>31.7</td>
<td>23.3</td>
<td>27.5</td>
</tr>
<tr>
<td>August</td>
<td>28.8</td>
<td>22.9</td>
<td>25.8</td>
</tr>
<tr>
<td>September</td>
<td>29.2</td>
<td>22.4</td>
<td>25.8</td>
</tr>
<tr>
<td>October</td>
<td>28.6</td>
<td>14.3</td>
<td>23.9</td>
</tr>
<tr>
<td>November</td>
<td>23.6</td>
<td>14.3</td>
<td>18.9</td>
</tr>
<tr>
<td>December</td>
<td>22.3</td>
<td>10.2</td>
<td>16.2</td>
</tr>
</tbody>
</table>

Source-Dy Director Genera of observatory Poona 5 (2006)

In highland area there is a regular decrease of temperature as one moves up at the rate of $1^\circ$C Per 180m. This decrease in temperature is due to the regular loss of heat is expansion of the air mass as it leaves the heated ground after being warmed.
Table 2.1 shows the mean monthly maximum and minimum temperature in °C at Dumka during 2006-2007. May and June with mean temperature of 30.8°C and 30.5°C respectively are the hottest months while December and January, with mean temperature of 16.2°C and 16.6°C respectively, are coldest months.

1.K.1. Atmospheric and Wind Conditions

Pressure generally follows the temperature. When the temperature increases to a maximum of 37.5°C in the month of May, the pressure in June decreases to a maximum of 930.7 mbs at 17 hrs. IST. It is a very remarkable phenomenon which is clear from table 2.2.

There can be little doubt that both the daily and the yearly inequalities of pressure grow as we ascend to higher elevations. But since the barometric variation depend upon the range of temperature.
### Table 1.2

**Correlation between Pressure and Temperature variations at Dumka**

<table>
<thead>
<tr>
<th>Months</th>
<th>Pressure (mbs) at 8.0 hrs ISI</th>
<th>Pressure (mbs) at 17.0 hrs ISI</th>
<th>Mean Daily Min Temp (°C)</th>
<th>Mean Daily Max Temp (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>947.4</td>
<td>944.9</td>
<td>10.1</td>
<td>22.6</td>
</tr>
<tr>
<td>February</td>
<td>945.3</td>
<td>942.8</td>
<td>12.4</td>
<td>25.5</td>
</tr>
<tr>
<td>March</td>
<td>943.2</td>
<td>940.1</td>
<td>17.2</td>
<td>30.9</td>
</tr>
<tr>
<td>April</td>
<td>940.9</td>
<td>937.3</td>
<td>22.1</td>
<td>36.2</td>
</tr>
<tr>
<td>May</td>
<td>936.8</td>
<td>933.4</td>
<td>23.5</td>
<td>37.4</td>
</tr>
<tr>
<td>June</td>
<td>933.5</td>
<td>930.7</td>
<td>24.5</td>
<td>33.9</td>
</tr>
<tr>
<td>July</td>
<td>932.5</td>
<td>930.1</td>
<td>23.3</td>
<td>29.5</td>
</tr>
<tr>
<td>August</td>
<td>934.6</td>
<td>931.7</td>
<td>22.9</td>
<td>28.8</td>
</tr>
<tr>
<td>September</td>
<td>938.0</td>
<td>935.5</td>
<td>22.9</td>
<td>30.5</td>
</tr>
<tr>
<td>October</td>
<td>943.9</td>
<td>941.2</td>
<td>19.1</td>
<td>28.6</td>
</tr>
<tr>
<td>November</td>
<td>946.3</td>
<td>943.8</td>
<td>14.8</td>
<td>25.3</td>
</tr>
<tr>
<td>December</td>
<td>947.8</td>
<td>945.3</td>
<td>10.0</td>
<td>22.4</td>
</tr>
<tr>
<td>Annual</td>
<td>940.9</td>
<td>938.1</td>
<td>18.5</td>
<td>29.2</td>
</tr>
</tbody>
</table>

Table 2.3 gives the mean monthly wind velocity and the dominant wind direction at Dumka. The speed wind varies from 6.8Km/hrs both in the months of October and November to 11.3Km/Hrs and 11.8Km/Hrs is the month of May and June respectively.
Table 1.3

Mean wind velocity at Dumka

<table>
<thead>
<tr>
<th>Months</th>
<th>Mean wind velocity km/hrs</th>
<th>Mean wind direction at 8.0 hrs/IST</th>
<th>Mean wind direction at 17 hrs ISI</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>8.3</td>
<td>W/NW</td>
<td>NW</td>
</tr>
<tr>
<td>February</td>
<td>8.8</td>
<td>W/NW</td>
<td>NW</td>
</tr>
<tr>
<td>March</td>
<td>10.2</td>
<td>W</td>
<td>NW</td>
</tr>
<tr>
<td>April</td>
<td>10.4</td>
<td>SW</td>
<td>NW</td>
</tr>
<tr>
<td>May</td>
<td>11.3</td>
<td>SW</td>
<td>NW</td>
</tr>
<tr>
<td>June</td>
<td>11.8</td>
<td>S</td>
<td>NW</td>
</tr>
<tr>
<td>July</td>
<td>9.7</td>
<td>W</td>
<td>SE</td>
</tr>
<tr>
<td>August</td>
<td>9.4</td>
<td>S</td>
<td>SE</td>
</tr>
<tr>
<td>September</td>
<td>8.4</td>
<td>S</td>
<td>NW</td>
</tr>
<tr>
<td>October</td>
<td>6.8</td>
<td>W</td>
<td>NW</td>
</tr>
<tr>
<td>November</td>
<td>6.8</td>
<td>W</td>
<td>NW</td>
</tr>
<tr>
<td>December</td>
<td>7.2</td>
<td>W</td>
<td>NW</td>
</tr>
<tr>
<td>Mean</td>
<td>9.1</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

This shows that the wind blows with greater velocity in summer than winter. The direction of wind is also variable. At 17.0 hours, it blows the North west in all months.
1.K.2 Relative Humidity –

The relative humidity expressed as percentage of the total possible amount of vapour percent in the air, is the highest an Mor basin during the months on July and August at 8.0hrs. it is generally high during the rainy season. (June-October) beet is reduced to 2% to 4% only during the winter season.

Table 1.4
Mean Relative Humidity and Highest Maximum and Lowest Minimum Temperature at Dumka

<table>
<thead>
<tr>
<th>Months</th>
<th>Highest Max Temp. ($^\circ$C)</th>
<th>Lowest Min Temp. ($^\circ$C)</th>
<th>Rel.Hum. (at 8 hrs)</th>
<th>Rel. Hum. At 17$^\circ$C hrs/IST %</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>30.5</td>
<td>2.2</td>
<td>63</td>
<td>44</td>
</tr>
<tr>
<td>February</td>
<td>33.3</td>
<td>3.3</td>
<td>63</td>
<td>45</td>
</tr>
<tr>
<td>March</td>
<td>38.8</td>
<td>6.6</td>
<td>39</td>
<td>28</td>
</tr>
<tr>
<td>April</td>
<td>41.6</td>
<td>13.8</td>
<td>31</td>
<td>20</td>
</tr>
<tr>
<td>May</td>
<td>43.8</td>
<td>16.1</td>
<td>48</td>
<td>38</td>
</tr>
<tr>
<td>June</td>
<td>42.7</td>
<td>20.1</td>
<td>69</td>
<td>64</td>
</tr>
<tr>
<td>July</td>
<td>38.8</td>
<td>20.0</td>
<td>88</td>
<td>85</td>
</tr>
<tr>
<td>August</td>
<td>32.7</td>
<td>20.0</td>
<td>87</td>
<td>85</td>
</tr>
<tr>
<td>September</td>
<td>33.3</td>
<td>18.3</td>
<td>89</td>
<td>82</td>
</tr>
<tr>
<td>October</td>
<td>33.3</td>
<td>11.1</td>
<td>68</td>
<td>71</td>
</tr>
<tr>
<td>November</td>
<td>30.5</td>
<td>4.40</td>
<td>66</td>
<td>55</td>
</tr>
<tr>
<td>December</td>
<td>27.2</td>
<td>3.8</td>
<td>64</td>
<td>53</td>
</tr>
<tr>
<td>Annual</td>
<td>43.8</td>
<td>2.2</td>
<td>64</td>
<td>56</td>
</tr>
</tbody>
</table>
1.K.3 Rainfall –

The area enjoys monsoon type of climate with rainfall mostly concentrated in the month of July, August and September. Rainfall which does November and February-increases to about 7.23 cm. in March owing to the influence of occasional cyclonic storms in that monthly. In July of the rainfall is 28.25 cm., and August heaviest fall of 33.75 cm rainfall highest point of the year.

Table 1.5
Monthly and Monsoon-wise Rainfall (cm) at Dumka 2006

<table>
<thead>
<tr>
<th>Months</th>
<th>Rainfall</th>
<th>Months</th>
<th>Rainfall</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>2.50</td>
<td>July</td>
<td>28.25</td>
</tr>
<tr>
<td>February</td>
<td>1.25</td>
<td>August</td>
<td>33.75</td>
</tr>
<tr>
<td>March</td>
<td>8.50</td>
<td>September</td>
<td>24.50</td>
</tr>
<tr>
<td>April</td>
<td>7.50</td>
<td>October</td>
<td>14.00</td>
</tr>
<tr>
<td>May</td>
<td>5.75</td>
<td>November</td>
<td>1.75</td>
</tr>
<tr>
<td>June</td>
<td>22.75</td>
<td>December</td>
<td>2.00</td>
</tr>
</tbody>
</table>

2.L. Drainage –

Broadly speaking the limitation and subsequently evolution of any drainage system are determined by two main factors i.e. firstly the nature of the surface on which
the stream begin to flow and secondly, the geological structure in the widest sense of that terms i.e. undulation folds, faults, joints, angle of dip and lithology.

The means of Drainage is the geography that to the manner in which precipitation falling within an area or brought from outside is drained such water generally takes two forms i.e. it may flow through river of accumulate in lakes or natural ponds etc. The whole drainage network of the study-area are belongs only Mor river system.

2.L.1. Mor River System –

The Mor river flows towards northwest to southwest direction. Many subsequent tributaries streams are join to the Mor river. In the earlier part if its course, it has a rapid flow and bring down large quantity of soil. In the river catchment area, the dry season starts from October to May. The volume of water in the river windless to trickle. It source in the higher plateau of 488.

1.L.1. Tributary Streams of Mor River –

The following tributary streams are found is Mor basin.

1.L.1.a. The Siddheshwari River

1.L.1.b. The Matihari River
1.1.1.c. The Tepra River

1.1.1.d. The Bhurkhar River

1.1.1.e. Others

1.1.1.a. Siddheshwari River –

The Siddheshwari drainage system covers only 921.60Km² or 20.68% of the basin area. This system occurs in the extreme North western part. Where the Siddeshwari river the western boundary of study area. It receives the water of Nalas. It is divided into three parts (i) Upper Siddheshwari (474m) (ii) Middle Siddheshwari (435m) (iii) Lower Siddheshwari (120m) There are naubil (512km²) and Chandan (112.64km²) situated in this area.

1.1.1.b. Matihari River –

The Matihari river covers an area of about 337.92km² or 7.58% of the study area. The Higher parts of the river are (753m) and Lowest part of the river is (288m). the assisted flow system is this area Bansjora (92.16m) and others in (254.76m).

1.1.1.c. Tepra River –

The Tepra river has covered the 368.64km² or 8.06% of the study area. It is situated in the western part of the
study area. There are main fluvial system Godhana 61.44 km\(^2\) and upper part of area is (470m) and lower part of study area is (288m).

1.L.1.d. Bhurkhar River –

The Bhurkhar river covers an area of about 317.20 km\(^2\) or 7.14% of study area. It is linked with Mor River in the North western part. Its upper part is (494m) and lower part is (270m).

1.M. Soil –

Soil study of any landscape leads to the understanding of the processes that operated, the environmental in which it formed, the slope drainage conditions etc. since soil is the function of climate, slope drainage parent material and biotic environment. The thickness of the soil is not only determined by the slope but also by the time of its formation. So form the quality of soil, the time may be as certained. Texture of soil also various depending on the nature slope.

Soil is the surface layer of the earth on which land plants grow. The mineral constituents of soil development in situ, due to the decomposition of the parent rock material vary directly according to the character of the underlying rocks. Hence, it has been considered necessary that the
preparation of soil map should be based on geological map of the area. But recently it has been recognised that climate plays no less significant role than geologic structure in determining the character of the surface soil. In several tropical countries, it is almost impossible to distinguish lateritic that has been formed from underlying granite and the laterite that has developed on shales. On the other hand, moisture, which is a factor of climate, plays a cardinal role in bringing out soil differentiation both laterally and vertically under the influence of run off flow and percolating rain water. Broadly speaking the soil of Mor basin can be classified into three broad groups (Fig. 2.6)

1. M.A. Sandy Soil  
1. M.B. Red Soil  
1. M.C. Leterite Soil

1. M.A. Sandy Soil –

The sandy soil locally known as Dumka District in Negra and Rehra is the most interior kind of soil which can be improved by aeration or manuring. It is poor in Nitrogen, Phosphoric acid and Humus, but has moderate amounts of Potash and time. The soil varies from reddish yellow to greyish yellow in colour and is often moderately deep; its fertility status and cropping patterns are similar to those of red soil.
This soil is mostly found in areas lying close to stream channels in valleys of Mor trough (288m) in South east Rameshwar (200m) Dhaba (180m) Muhammad Bazar (152m) Kamardiha (100m) Sanakpur (180m) Palosi (89m) Maureshwar (28m) Santi (100m) Man Bazar (94m) Barkata (80m) Muyurakshi Nagar (120m) Chandra (108m) Brahma Bariya (180m) Peneplain of Mohanpur (130m) Chandan Nagar (200m) Makhdum Nagar (180m) Shekhpur (120m). in lower mor valley (180m) Ardhuni (140m) Nalhati (100m) Parsi (80m) in tableland Middle Mor (275m) Lower Naubil (300m) Kalahar tableland (200m) Pahar Siuri upland (260m) Laberia peneplain (120m) is the south western part of study area.

1.M.B. Red Soil –

The red soil is another important group of soil which is widely distributed over Mor basin. It is derived from the ancient crystalline and metamorphic rocks, namely granites, Geinssses and schists, with subordinant rocks rich in ferromagnesium minerals. In comparison with the black cotton soil, it is poores in line, Potash and ferric oxide and is also low in phosphorous content.

The red soil covers valleys of Middle Mor trough and North west of study area Noniya (398m) Raja Pathar
(440m) Nawadih (340m) Sahara (320m) Rajadih (240m) upland of Nunihar (440m) Nakti (274m) Sadhudi (278m) Pahar, Bhcckhar (400m) upper Mor (488m) Pasora (300m) Bhamri (250m) Matihara (388m) valley, Agola (120m) Asansol (130m) peneplain of Mohanpur scrap (400m). In the south eastern part of study area Hingia (320m) Batihar (240m) Gorge and Asanbari upland (220m) situated. Hatia (280m) Kusumhata (474m) Kendhata upland (320m) and Siuri upland (260m) in the south western part of the study area.

**Tabal 1.7**

**Analysis of Red soil**

<table>
<thead>
<tr>
<th>Red Soil contents</th>
<th>Figers in %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insoluble matter</td>
<td>90.47</td>
</tr>
<tr>
<td>Alumina</td>
<td>2.92</td>
</tr>
<tr>
<td>Ferric oxide</td>
<td>3.51</td>
</tr>
<tr>
<td>Lime</td>
<td>0.56</td>
</tr>
<tr>
<td>Magnesia</td>
<td>0.70</td>
</tr>
<tr>
<td>Soda</td>
<td>0.12</td>
</tr>
<tr>
<td>Potash</td>
<td>0.24</td>
</tr>
<tr>
<td>Phasphoric Acid</td>
<td>0.09</td>
</tr>
<tr>
<td>Carbon dioxide</td>
<td>0.38</td>
</tr>
<tr>
<td>Water and organic matter</td>
<td>1.01</td>
</tr>
</tbody>
</table>
1. M. C. Laterite Soil

Normally laterite soils are argillaceous material impregnated with iron peroxide and are mettled with various tints of brown, red and yellow while a considerable proportion some times simply consists of white clay. They usually harden when exposed to air laterites are also occur in a large number of forms containing a considerable quantity of Hydrates of alumina.

Table 1.8
Analysis of Laterite soil

<table>
<thead>
<tr>
<th>Laterite Contents</th>
<th>Figures in %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insoluble matter</td>
<td>86.46</td>
</tr>
<tr>
<td>Soluble Silica</td>
<td>0.50</td>
</tr>
<tr>
<td>Potash</td>
<td>0.38</td>
</tr>
<tr>
<td>Soda</td>
<td>0.32</td>
</tr>
<tr>
<td>Zinc</td>
<td>1.72</td>
</tr>
<tr>
<td>Magnesia</td>
<td>0.38</td>
</tr>
<tr>
<td>Ferric oxide</td>
<td>6.12</td>
</tr>
<tr>
<td>Alumina</td>
<td>7.19</td>
</tr>
<tr>
<td>Phospheric Acid</td>
<td>Trace</td>
</tr>
<tr>
<td>Carbonic Acid</td>
<td>0.12</td>
</tr>
<tr>
<td>Water organic matter</td>
<td>2.81</td>
</tr>
<tr>
<td>Sulphuric Acid</td>
<td>Trace</td>
</tr>
</tbody>
</table>
This type of soil is observed on Kakm Pathar (420m) Hansdiha (392m) Palajori (320m) is Northwest Gorge Karbind (320m) Kanto (400m) upland of Kathijuria (254m) Mohanpur (400m) scrap, Trikoot (753m) Kharar tableland (196m) upper Naubil (240m) Chandan (200m) valley, Gara (427m) Katri (265m) Naubil Siddheswari water dividing area (235m) Patanpur Gorge (300m) Sugapahari Tableland (220m) is in the south western part of the study area.

1.N. Natural Vegetation –

The study of Natural vegetation of any region incorporate a part of the distribution of various types a analysis of differentiation of plant kingdom in relation to topography, rock types, climate is the most important. Natural vegetation is often the product of the physical environment in which it courses. It is noted that atmospheric edophic and biotic conditions govern the broid features of vegetation of an area. Impact of altitudinal variations on vegetation has been testified by various workers, including strahler A.N. (1952) and Pearson G.A. (1931) Champion H.G. (1936) describes the vegetation of the Chhotanagpur per region as tropical moist deciduous in contrast to the vegetation of Ganga plain which he calls Tropical dry deciduous. (Fig 2.7)
1.N.1 Tropical Dry Deciduous Vegetation

The tropical dry deciduous type of vegetation is a combination of two distinct types. The first is the some-xerophytic type corresponding to driver areas. It includes trees and scrubs, vary often stuned and now mostly deputed. The second is the damp, tropical natural vegetation confined to the water tracts. The forest at present are mostly confined to the undulating area drained by Dhanadigh Ravine area (300m) Agola (120m) Dumka (288m) peneplain of upper Mor (488m) Motihara (388m) Bhamri (250m) valley of Kharsuri (488m) in north west. In south east Rameshwar (200m) Dhaba (180m) Muhammad Bazar (152m) Kamardiha (100m) Palasi (89m) Sanakpur (108m) Santi (150m) Bharpata (80m) Mayureshwar (108m) Maurakshi Nagar (120m) Brahmabaria (180m) Chandra (108m) Peneplain of Mohanpur (130m) Chandan Nagar (200m) Sekhpur (120m) Makhdum Nagar (180m) upland Ardbuni (140m) Nawadih (100m) Table land of lower Mor valley (180m) Hingia (320m) Gorge of Sanakpur (108m) and Lower Naubil (300m) Middle Mor (275m) Masanjor (400m)) Kusum hata Pahar (474m) Loberia peneplain (120m) Siuri upland (260m) upper Naubil valley (240m) in the south western part of study area.
1.N.2. The Tropical Damp Deciduous vegetation –

The damp tropical deciduous forests are confined to higher elevations of the Noniya (398m) Raja Pahar (440m) Nawadih (340m) Rajadigh (240m) Sahara (320m) Karbind (320m) Karto (400m) Kurawa (490m) Amba (400m) Bahadurpur (400m) upland, Nakti (274m) Naunihar (440m) Trikut (753m) Raghuadigh Pahar (476m) Bhamri (250m) valley of Agola (120m) Asansol (130m) Lakhni (300m) peneplain of Mohanpur (400m) Taljhari (438m) Hahapur (470m) and scarp of Kurua (100m) Tepra valley (362m) in the North west in area. In south east Batihar (240m) Gorge, Asanbari upland (220m) Kendhata (320m) Kujuhata (300m) Bagdaha (280m) upland of lower Naubil (300m) Chandra (200m) valley of Naubil (427m) Kunjora (300m) Kairabani peneplain (220m) Siddheswari water divideded area (235m) Sugapahari Tableland (220m) and Karmantr scrap (224m) are found in the south west part of study area.

1.0. Summary and Conclusion

The study area measures about 4454.40Km$^2$ and varies in elevation from 289m. to over 735m. It has been divided into two major and five secondary physiographic regions namely. (1) Mor Basin Upland (A) The Northern Mor basin
upland (B) The South Mor basin upland (2) The Mor Basin Trough (C) The upper trough of Mor Basin (D) The Middle Trough of Mor basin (E) The lower trough of Mor basin. The Mor basin has largely a tropical location the highest temperature at Dumka are recovered in the month of May and June these month have mean temperature of 30.8°C and 30.5°C respectively. The relative humidity is generally high during the raining season. August is the rainiest month with average rainfall of 33.8Cm. The basin experiences 4 seasons namely (I) The cold weather season (November to February) and (II) The Hot weather season (March to May) (III) The rainy season (June to August) and (IV) The season of retreating monsoon (September to October).

Mor basin is main Drainage system of the Study area. The main tributaries of Mor basin are (i) Siddheswari (2) Matihara (3) Tepra (4) Bhurkhar (5) Others rivers. Although many subsequent tributaries streams are join to the main Mor river season starts. In the river catchment area from October to May. The volume of water in the river dwindles to trickle.

Three main groups of soil namely Laterite Relief and Sandy soils occur in the area. Laterite soil has been noted in parts of the higher basin and on summits of tills such as
Dumka (288m) Rameshwar (200m) Siddheshwari (474m) scarp of Trikut (753m) Gorge of Kar bind (320m) Naubil Pahar (235m) but the most typical soil of the area is red soil which occurs quite extensively. The sany soil zone associated with riverin plains and valleys accounts for half of the population of the area.

The vegetation is primarily of the monsoon sub humid of tropical moist deciduous type with "Sal" (Shorearobasta) the most important tree species. In toruetropical moist deciduous forests, "Sal" account for about 60% to 80% the canopy cover.

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