CHAPTER- 1
INTRODUCTION

1.1 INTRODUCTION:

The present study deals with Geomorphic analysis of Arunavati river basin. Development of landforms climate and the processes operating in a particular area is associated with Geology. The Arunavati river basin is located in the transitional zone of Satpuda region. The Arunavati river basin, which is situated close to Deccan plateau, a place in North Maharashtra region, has been analyzed for their landforms.

Geomorphic analysis of the Arunavati river basin has characteristic landforms in semi arid and dry areas. It is well accepted that the processes of landforms formation is the cause of all topographic forms under normal erosion. The processes of denudation are numerous and varied but their effects on relief development are small as compared with the stream erosion. So it becomes necessary to study the erosional processes in relation to the various landform developments.

Erosional processes take place on the surface when the force provided to the erosional agent exceeds the resistant of the surface. The degree of erosion depends on a number of factors viz. amount, intensity, duration of rainfall, the infiltration capacity of land, thickness of soil, the chemical and physical properties of the material, the vegetation cover and slope of the ground. Erosional work done by any agent depends upon the two factors: (i) The forces applied and (ii) The resistant offered by the material. The interaction of these two results in varying amount of the displacement of material giving rise to relative relief (Patil, 1987).

The main agents of erosion such as river, (moving water) glaciers (moving ice) and wind (moving air) can be considered as to be in the, liquid, solids, and gaseous states, respectively. These variations are related to the properties of matter. Their erosional abilities are well reflected in the types of landforms developed by them. The wind seldom develops valleys as it is rarely applied along a definite line, whereas two can be considered to prefer linear pattern of erosion.

As the ice is solid material, it is very closely packed and the atoms and molecules are closely spaced. The intermolecular forces of attraction are stronger and do not allow the molecules to wander anywhere. Due to these properties in the ice, it
has a tendency to resist the flow. Hence the velocity of glacier is too low as compared to other two agents. However, due to the solid mass of moving ice, the glaciers have tremendous competence to pluck pieces of rocks and carry them onwards. This result in development of ‘U’ shaped valleys.

Water being in liquid state, the atoms and molecules are more widely spaced than in the solid state. (i.e. ice). The intermolecular forces are weaker and allow a molecule to wander anywhere within the mass of water. It has a tendency to concentrate along a linear path only and, therefore, the energy gets concentrated along a linear path. As a result of such concentration one finds ‘V’ shaped valley getting developed.

The air is in gaseous state of matter. The air molecules have the freedom of motion because of the force of attraction between the air molecules is negligible so the air does not have definite shape or definite volume. Due to this property the air molecules can move freely anywhere, with the mass. The energy is not concentrated along a particular path. So the wind erosion may be called as the aerial erosion and hence no particular valley forms may be developed by wind.

Apart from the variation in the agent of erosion, which is largely controlled by climatic condition the valley forms produced by the same agent of erosion show considerable variation. These variations are basically by other factor such as – (1) Lithology, (2) Tectonic history of the area, (3) Variations in climates in the past.

It is long since ancient times the valleys have attracted attention of Geologists. The development of valley has been one of the major areas of debate centered on work of running water or effect of drainage. The concept of uniformitaniaism by Hutton as against the then existing doctrine of Davinianism and the debate following Huttonian concept speak for the importance of the landform in question.

The valleys are essentially the function of the concentrated flow of water which occupies only a small portion of the large trough. The valley forms are directly or indirectly controlled by the activities of stream at the base of the trough. The stream lowering its bed or relatively stable forms the base levels for valley sides slopes and hence can be considered to exert influence on these slopes though indirectly.
A variety of shapes may be seen in the profile curves of the valley forms. Essentially these shapes are functions of two major aspects (i) Incision by streams at the base and (ii) Denudation of sloes caused by a number of processes.

The Arunavati rises in the slope of inner Satpuda ranges and flows in a general south westerly direction and after passing by Shirpur it joins the Tapi. The Arunavati is a north bank tributary of river Tapi and seven Sub-basins of Arunavati river rises in the rugged hills of Satpuda ranges at height 650 m. from sea level near Jhirpan village in Madhya Pradesh. It flows south westerly direction and covers area 738 sq.kms. which lies between 21°18'N to 21°37'N latitude and 74°49'E to 75°13'E longitude. It travels about 69.5 kms. From its source to mouth. It begins at SendhavaTahasil in Madhya Pradesh and meets the river Tapi at village Vanaval in Shirpur Tahasil of Maharashtra. The survey of India toposheet no. 46\textsuperscript{0}/2, 46\textsuperscript{0}/3, 46\textsuperscript{b}/14, 46\textsuperscript{b}/15 are used for present study. The Dhule district is traversed by a good network of Tapi River and its important tributaries are Arunavati, Amarawati, Panzara and Burai.

The study region is located in the North Maharashtra. The northern part is the hilly strips of Satpuda ranges and the middle part is formed by Tapi alluvial plain. An attempt has been made in this research work to present some general considerations governing the application of geomorphic analysis of Arunavati basin. The study is purely based on extensive field observations of different parts of the river basin.

Geologically the Arunavati basin has strong foundation of horizontally bedded basaltic lava flows, commonly referred as Deccan trap, exhibits the differential rate of weathering and erosion. Red boles occur with thickness of 0.5 to 1.5 m. Red boles are observed along the foot hills of Bijasanghat, near Lauki village, Hadakhed and Sangavi village. Alluvium with thickness ranging from 2 to 30 m. is observed along the mainstreams.

1.2 SELECTION OF STUDY AREA:

The Arunavati rises in the slopes of inner Satpuda ranges. Dhule district forming its boundary for about 2 kilometers enters in Dhule district and flows in a general south westerly direction. Further making its way through the outer ranges of the satpuda and after passing by Shirpur it joins the Tapi. The Jhirbavi formed by the union of the Titwa and another stream is an important left bank tributaries of the Arunavati.
The study area falls in the rain shadow region of Western Ghat. The seasonal rainfall and alternate wetting drying of the land promotes soil erosion, soil creep, landslides and gully erosion. Such various types of geomorphic processes are operating in the study area.

1.3 IMPORTANCE OF THE PRESENT STUDY:

The present study comprises two major aspects (1) Fluvial processes, (2) Tectonic adjustments and landforms development of Arunavati river which provides evidences of erosional, structural fossils, erosional surface, active erosion,surface rejuvenated river valley, residual hills, pediment slope, river terraces, flood plains, waterfalls and all other associated topographic expression developed in a multicyclic landscape though valuable contribution have been made by empirical observation was considered, necessary to present a complete picture of the evolution of the landscape spectacle of the Arunavati river.

The major objective has been to provide interpretative information regarding regional geomorphology of the Arunavati River. Where fluvial interruption specially in and around the shear zone have brought about not able ravine features for this purpose the work of definition of the different geomorphic sub-divisions has been performed with a complete represent action of the relief, taking the drainage basin as a geomorphic unit he has referred to the nature of geomorphological problems of the area concerned and also suggested ways and means to tackle them. Spate and Lear month (1967) observed ‘The peninsular India has much more geomorphological variety than is often credited to it’ also forms this point of view to the study the geomorphological variety of the Arunavati River.

The themes include weathering processes slope retreat and forms of slope associations river traces relating to cycles of erosion and quantitative analysis which illustrate the area. The present important finding and results in the morphometric analysis of color maps with interpretation of the effect of various available standard techniques adopted to enhance the study on geomorphological problem of Arunavati basin. The nature and origin of the weathering forms of this part of Precambrian metamorphic terrain, particularly with respect to the crystalline out crops of the Satpuda ranges area with the relationship of the Arunavati drainage system are specified.
1.4 **AIMS AND OBJECTIVES:**

The aim of the present study is to study the various geomorphic processes operating in the study area and development of the landforms within limits of the study. The aims are:

- To study the various geomorphic processes operating within the study area.
- To study the morphometric characteristics of the study area.
- To establish development of landforms and their relationship with the geomorphic processes operating in the study area.
- To study the textural and morphometric characteristics and chemical characteristics of soil in the study area.
- To study the relationship between geomorphic processes and availability of water resources.
- To study tectonic activities impact of faulting on river basin morphometry.

1.5 **HYPOTHESIS:**

1. The development of erosional, depositional landforms depends on the various processes operating in the river basin.

2. The nature of climate, lithology, geology influence greatly on the intensity of processes operating in river basin.

1.6 **METHODOLOGY:**

In order to attain the desired aims and objectives of the research, following methods are adopted:

1.6.1 **Literature Survey:**

It is necessary to take an overview of the research work related to the topic. The researcher visited Jaykar Library University of Pune, Central Library of North Maharashtra University Jalgaon, Library of Z. B. Patil College Dhule, Library of Agriculture College, Dhule. Library of S P D M College, Shirpur. Library R C Patel College, Shirpur. Library of Kisan Arts, Commerce and Science College, Parola. The researcher has also gone through research journals, books, magazines, newspapers and websites for the research work. It also proves useful to know as the recent
developments in the concerned topic. While scanning the literature, the researcher has collected various kinds of secondary data regarding rainfall, climate, humidity. Researcher observed various geomorphic processes such as erosion, transportation and deposition of the study region in the light of the available literature.

The review of literature has been done at two stages viz., pre-field stage and post field stage. To have better understanding of the subject, collection and reading of the articles related to the topic of research were carried out in pre-field stage. On the basis of this experience, the pilot field survey, regular field investigations, field visits to the study area were carried out. Thereafter, post field literature review was also carried out to get acquainted with the basic principles, methodologies adopted by the various scholars world over.

In recent years, geomorphology has developed its various subfields. There are Genetic Geomorphology, Regional Geomorphology, Structural Geomorphology, Applied Geomorphology, Tropical Geomorphology, Coastal Geomorphology, Aeolian Geomorphology, Glacial Geomorphology and Fluvial Geomorphology. The current review primarily deals with research work done in the peninsular India, but some references available on the Ganga Plain were also referred. The present work is based on the analysis of the collected information. The literature reviewed is listed below:

1) Journals of reputed research institutions
2) Standard reference books
3) Websites concerned with the research topic
4) Dhule District gazetteer
5) Climate Data Collected From Agriculture College Dhule
6) Survey of India toposheets
7) Seminars, Workshops, Conferences attended at National and State level.
8) Internet websites related to the research topic.

1.6.2 Field Work:

The pilot survey of the study area was undertaken in the month of October 2006 by the researcher. The available literatures in the study area are gazetteers and
the historical information and historical evidences. The literature for the subject matter and the literature related to study area are studied in detail. The valuable oral information provided by the local people is given a due weightage. The information available on the internet has been judiciously used for the present study.

Researcher and research guide have visited number of times to the source and mouth point regions of Arunavati. The places which were visited are: Kanjya fall, Solvan, Malvan (M.P.), Palasaner, Sangavi, Sule, Lakdya Hanuman, Chilare, Umrade, Vakwad, Budki, Boradi, New Boradi, Kodid, Gadaddev, Malkatar, Wadi, Samrya Pada, Nimzari, Lauki, Karvand, Shirpur, Shingave, Kharde, Untavad, Kalamsare, Amode, Sak vad, Borgaon, Jatode, Balade and Vanaval village (Maharashtra) where Arunavati joins the Tapi river.

In addition to observations of the study area, the field work included identification of various landforms, processes, origin, structure deposition, weathering, soil and sedimentary profiles, the hill slopes, their mature elements, drainage network, the channel forms, gradient types of flow channel, cross section parameters, erosional and depositional features like waterfall, small rapids, gorge, valley forms, river terraced, interlocking spurs.

The collection of primary and field work data like field measurements, observations using toposheets were carried out in the presence of research guide. The linear, areal, relief aspects, slope, soil erosion, sedimentary data also have been measured during the field work and interview of the several local people in dialects.

1.6.3 Laboratory Work:

The data generalized from the field work has been processed and the charts, maps, graphs, diagrams and models are prepared in the laboratory. The present study is based mainly on various geomorphic as well as morphometric techniques developed by a number of scholars like Horton (1945), Strahler (1952), Schumm (1956), Kirkby (1971).

Laboratory work involves preparation of various maps. Various base maps are prepared with the help of the Survey of India Topographic maps such as location, Physiography, geology.
The work essentially passed through three stages. The first stage was collection of data for morphometric analysis from field. Second stage was that of processing data and analysis of the same using various techniques.

The morphometric data has been generated from the topographic maps. Entire network of the Arunavati basin has been organized into hierarchical order as per the Horton’s (1945) method. Ambad nala, Chondi nala, and Jhirbavi nala tributaries account nearly 50% area occupied of the total Arunavati basin.

The cross profiles, relief, slope and drainage maps have been drawn from the topographic maps. The processes like gully development accumulation of material contact zones in the form of debris slope and micro relief were closely observed in several visits to the present study region. The erosion surfaces have been identified based on altimetry analysis. The quantitative and computerized techniques have been used for data processing, construction, testing of hypothesis. Lastly drainage maps of Arunavati basin have been prepared on the overall geomorphic study. The last stage of analytical work is representation of data by using cartographic techniques.

1.7 ARRANGEMENT OF THE TEXT:

The work carried out is organized into six chapters. The text includes geomorphic characteristics, understanding the factors of the processes responsible for the shape, size and pattern. The attempt has also been made to relate geomorphic structure of Arunavati basin to human life.

The work carried out can be organized as follows:

- The first introductory chapter, attempts to introduce the subject highlight aims and objectives of the study. It also includes methodology as well as review of research work.
- The second chapter deals with the physical setting of study area. It includes physiography, structure and lithology, vegetation, climate, soil and drainage of the region.
- In the third chapter drainage characteristics are studied in detail. It includes analysis of drainage composition, morphometric analysis, drainage density, texture, shape index, bifurcation ratio, stream frequency, ruggedness index, and relief ratio of the Arunavati river.
• The fourth chapter refers to relief analysis of this study area. It includes relative relief, absolute altitude, dissection index, average slope, amplitude of relief, index of recession, super imposed profile, cross profile, a longitudinal profile of the major river and their tributaries.

• Fifth Chapter includes analysis of valley forms, processes operating in the study region, valley width, valley side, slopes, valley asymmetry, and index of recession of the study region.

• The last chapter is associated with discussion and conclusions. This chapter includes major findings of the present research work as well as some suggestions. Bibliography, photographs and published research papers are appended at the end.

1.8 LITERATURE REVIEW:

Literature review carried out by the researcher is arranged under following sub-headings:

18.1 Morphometric Analysis:

Kharkwal (1970) analyzed a morphometric study of Himalayan Basin. These basins, more or less, represent regions of varied nature in respect to relief range and underground structure or lithology; hence they show different dimensional measurement. Jamkar and Bhamare (1983) carried out morphometric analysis of river Panzara and its important tributaries. The co-relation between stages of landforms development and various morphometric attributes show as there is significant impact on total basin relief, average and drainage density on stages of landforms development. Suresh (1995) made a study of morphometric analysis of Yogachi river basin Karnataka. Basin shows varied type of drainage patterns, which are characteristic of hard rock terrain. Low drainage density indicates the area is underlined by resistant rocks. Sharma and Amin (1996) analysed a morphometric study of the Dikhou river basin, Assam. The values of basin elongation. (E) for the 7th order hilly basins are within 0.6-0.8, which is similar to finding of Schumm (1956). Basu and Sen (1997) Studied the recent changes (1975-1992) in the morphology of the Hugali. These measures if considered and implemented would help to resuscitate the river Bhagirathi-Hugali and thus enliven the port and metropolis of Calcutta upon which the economy of entire Eastern India is dependent. Nagrale and Kale (1997)
Indicate lithological on the channel morphology of the upper Tapi River Madhya Pradesh. This study, therefore, has been able to establish that even in areas of the uniform lithology, secondary difference in bedrock can produce a variety of forms and features other things being the same. Jawahar and others (1998) deal with Morphometric analysis of the upper Noyil Basin, Tamil Nadu. The bifurcation ratio values obtained reveal that the basin has not been affected by structural disturbances and the drainage network in the study area is in well-developed stage. Srinivasan and Subramaniam (1999) indicates ground water targeting through morphometric analysis in Mamundiyar river basin, Tamil Nadu. The morphometric characteristics of the basin have been projected as a model to infer the dominant parameters typical of any part of the brain. Umak and others (2000), deal with Morphometric slope analysis of part of gawilgarh hills around chikaldara gavilgarh region of Amravati district, Maharashtra. The plains are pediments surfaces of undulating nature. The plains are pediment surfaces of undulating nature. These are usually extensive drained by gullies and streams.

Agnihotri et al. (2000) spatio temporal variation in channel morphology bed and bank erosion of Umeh river in Truns-Yamuna surface of Ganga basin while the different ombrothermic conditions and dynamic nature of gulling process along with uniformity in land use in riparian zones are found more responsible for temporal variations regarding the bed bank and bank erosion. Balaselva and others (2000) has studied morphometric characteristics of Arujuna river basin in Tamil Nadu. The quantitative analysis has helped to understand some useful hydrological characteristics. Gurjar (2001) analyzed relief morphometry of the Sahibi river basin. Rajasthan. The whole basin from the Shahapura plain to Masani barrage site is a continuum of a single featureless pediplain of recent origin with a marked level slope trending from the south to the north. This pediplain surface has recently witnessed neotectonic movements which are evidenced in from of gullies and ravines. Joji and others (2001) analysed rainfall discharge relationship analysis of Vammanapuram river basin, South Kerala, India. The detailed study of rainfall and the relationship between discharge and rainfall discharge to infiltration and slope of the terrain of this basin are examined. Buvaneswari (2001) studied morphometric analysis for water resources management. The significance of the morphometric characteristics of the fourteen micro basins and for the basin as a whole are helpful to understand the flood
possibilities and propose strategies for water resources management. Ganesh (2001) observed by hydro-meteorological characteristics and water balance of Periyar basin Kerala. The characteristics of hydro-meteorological parameters such as distribution of potential evapotranspiration actual evapotranspiration, soil, moisture, storage capacity, water, loss, water deflect and water surplus. Singh and others (2003) observed morphological analysis of hill slope in Jabalpur and its adjoining area. It may be concluded that the residual convey-concave hill standing over all most flat basaltic structure are undergoing the procedure of slope decline and slope flattering due to active down vesting. Mansoor and others (2006) observed morphometric analysis of Raysan Valley basin. The types of dendritic river drainage represent the most part of the basin because of the rocky volcanic formation. Konwar and others (2007) analyzed morphometric analysis of Bogdoi river basin, Assam.

From the above study it can be concluded that the morphometric variables of seventh order drainage basin of the area are influenced by lithology and structure. Rose Suja and Krishnan (2006 and 2007) studied a comparative morphometric analysis of subwatersheds in Kanyakumari and Nambiyar river basins of Tamil Nadu, India. The need for precise description of the geometry of landforms particularly for river basin which from the logical areal unit for hydrological studies is one of the most important aspects. Anirudhan and Raghunath (2007) indicate hydromorphometry of Ayiroor river basin Kerala. This study reveals that the morphometric attributes of drainage basin are basically controlled by nature of surface geology that the surface formations. Thakuriah and Saikia (2010) analyzed micro morphometric landforms analysis of Buriganga basin, Assam. On the other hand zone with low component score are passive zones as the potential and kinetic energy is minimum with almost absence of active denudation.

1.8.2 Geomorphic Analysis:

Singh and Kumar (1969) studied sedimentary geomorphological evolution of stream order of the Topa and Silphi basin in Ranchi. The geomorphological evolution of stream orders of the Topa and Silphi basin delineates some of the basic phases of denudation chronology in harmony with epeirogenesis recording of the tertiary period. Taher (1974) analyzed fluvial process and geomorphology of the Brahmaputra plain. Along the piedmont zone there are patches of older alluvium extending along the interfluves up to the Brahmaputra flood plain. It is, therefore, chiefly a
gradational plain. Through-out the length of the valley the Brahmaputra has a very low gradient which is only 14 cm per km. Chandrashekar and Naganna (1983) indicates geomorphic study of the Chikkahagari basin in Karnataka. The morphogeny shows as dominant action of the running water followed by a moderate action of mechanical-chemical and mass wasting with minimum of wind action. Prasad and others (1984) observed study of precipitation trends in Shimsha river basin in Karnataka. Both fourier analysis and auto co-relation analysis indicate the absence of any periodicity in the precipitation pattern. Magar and Kale (1996) analysed geomorphological characteristics of piedmont stream in Achalpur area, Maharashtra. This is to say that the nature of hydraulic geometry upstream as well as downstream of the junction is remarkably different. Kumar and Verma (1996) observed relief-studies on Panchamarhi M.P. The geomorphic evolution of Satpuda ranges was completely stopped by Deccan Volcanism (65- million Years) which enveloped the area. Cessation of Deccan volcanism (40 million years) marks the beginning of post trap erosion cycle which is responsible for present day topography. Due to uncapping of Deccan trap overburden, the area underwent upliftment and intensified the erosional processes.

Sharma and Bora (1996) analyzed a study on some flow characteristics of the Manas River, Assam. The flow characteristics of the river, techniques like stage, discharge, hydrographs-discharge, frequency curves and flow probability curves have been used and necessary interpretations are made for reveling the flow characteristics of the river. Joshi and Rawat (1998) studied geomorphic analysis of the eastern outer Himalaya a case study in between Dikrong and Ranga river Arunachal Pradesh. Outer Himalaya is a youngest geomorphological unit where geological structure plays a dominant role in the development of landforms. Richarya and others (1998) analyses hydrogeomorphic studies of Tones basin around Maihar, Satana district M.P. The ground-water potential of the study area is intimately related with various geomorphic parameters. Babar and Kaplay (1998) studied geomorphometric analysis of Purna river basin in Parbhani district, Maharashtra. The higher drainage density in hilly terrain indicates that the karpara sub-basin is more suitable site for rainwater harvesting and conservation.

Singh and Dubey (1998) observed spatio temporal variations in the reliefs on man impact gully basin in sub humid tropical raverine environment of Deoghat area.
Allahabad district, U.P. The process of gullying and ravianation has been accelerated due to anthropogenic factors mainly cultivation and grazing. Rana and Goswami (2001) studied fluvial geomorphology and basin ecology of the Jia Dhanshri river basin, Assam. The fluvial environment with the existing geoenvironmental and agro economic scenarios of the basin for evolving a suitable strategy for environment planning and resource management. Sultan (2001) indicates geomorphological characteristics of Wadi Zabid Basin, Yemen. The morphological features of Wadi Zabid basin are largely formed as a results of the tectonic movement. Volcanic activities during the tertiary and quaternary periods. Anbalgaon (2001) observed geomorphic evidences of neotectonic activities in Gavla river valley, Kumavhimalaya. The course of Kalsa and Gaula river in Himalaya show sudden and abnormal changes indicating the influence of neotectonic activities on the ongoing erosional and depositional processes. Diwan and Gupta (2002) indicate geomorphometric characteristics of Kurang river basin in Chattisgarh State, water conservation structure and recharge structure are suitable in metamorphic and sedimentary respectively. Mukhopadhyaya (2002) analyzed geomorphology and natural Hazards in the lower Brahmaputra basin with special reference to floods. The impact of adverse human interference in the watershed regime need to be studied and analyzed appropriate scale model micro mess and microscale with an integrated approach for obtaining meaningful results.

Kumaraswamy (2003) studied geomophological characteristics and water management strategies for semi and river basin of south India. The distribution and development of water resources are space and time specific, especially in semi and river basin. Adil and others (2004) analyzed geomorphological studies in the eastern part of Gwalior area, M.P. on the basin of the observation it can be inferred, that the cycle of erosion started from the Precambrian period just after the rock formation. Nagaraja and Suresh (2004) observed geomorphological studies of Chinnahagari basin, Karnataka. Further the hypsometric analysis for the basin also substantiates the mature stage of landform also substantiates the mature stage of landform development. Magar and others (2005) studied piedmont plain a geomorphic overview of Satpuda piedmont in western Vidharbha, Maharashtra. In the present study an attempt has been made to identify geomorphic and geologic characters of piedmont plain at Satpuda foot hills.
Patil and Shinde (2005) analyzed ground on south western flank of Balaghat range from southern Deccan traps. It is concluded that although the direct signs of ground tilt are either poor or absent. The AF and T Vectors reveal that the northern basin are of Bori river tilt towards that the northern basin area of Bori river tilt towards North west direction which is responsible for the development of asymmetric drainage. Hire and Kale (2006) studied geomorphic effectiveness of high magnitude floods on the Tapi river; Evolution based on floods hydrographs and steam power graphs. The results of the analysis presented in this paper clearly indicate that large magnitude floods are the most geomorphologically effective fluvial events in monsoonal rivers. Nural (2006 and 2007) analyzed changes in fluvial geomorphology of the Kalang river basin of Assam, India. The study of morphometric parameters of the Kalang shows that the river is gradually reducing its dimension.

Patil and others (2008) observed geomorphic controls of ground water in Amaravati basin. The various geomorphic factors considered in the present investigation are absolute relief, relative relief, dissection index, slope, weathering depth and drainage frequency. Deswal and Pani (2009) analyzed a geomorphic investigation of alluvial terraces and related neo-tectonic activities along Bata river Sirmour district Himachal Pradesh, India. The main objectives of the study was to investigate the study was to investigate the Terrance morphology, terrace stratigraphy and to interpret the geomorphic history of the area. Kavita and Ganesh (2009) indicate geomorphology and drainage basin characteristics of Amaravati river basin Tamil Nadu, India. The morphometric characters show that the drainage is trill is influenced dendritic trending to be parallel. Mukhopadhyaya and others (2010) analyzed emerging hydrogeomorphic and ecological problems in barul wetland and within Ajay river basin west Bengal, geomorphological problems like thick sand deposition in the wetland bed and connecting canal etc. are gradually cumulating in mounting fashion.

1.8.3 Drainage Analysis:

Singh (1979) analyzed quantitative analysis of selected drainage basin of Simla hill region. The salient attributes of each drainage basin have been derived with the help of morphometric analysis by applying quantitative techniques. Singh and others (1990) studied drainage analysis of a few river basin in Bilaspur region (H.P.) India. The region is constituted by various rock types which range in age from Pre Cambrian to Pleistocene. Ganesh (1993) observed a trend surface analysis of
rainfall distribution a case of upper Vaigai basin Tamil Nadu, India. The upper Vaigai basin is analyzed linear trend surface and associated residuals are defined for the distribution of rainfall. Vaidhyanathan (1999) analysed quantitative analysis of selected drainage basin of Simla hill region. The salient attributes of each drainage basin have been derived with the help of morphometric analysis by applying quantitative techniques. Sreedevi and others (2000) analyze drainage characteristics of Dagery river basin. Andhra Pradesh, India. The streams of lower orders mostly dominate the basin. The development of stream segments in the basin area is affected by rainfall. Joshi and others (2002) observed a study of channel runoff and groundwater level fluctuation of ranga river basin, eastern Himalaya, India. While comparing the increasing and decreasing trend of the hydrograph a positive impact was found on rise and fall of the ground water level. Singh (2002) analyzed drainage analysis in a part of the Deccan trap in central India. M.P. The thalweg study present breaks of slope in a few rivers revealing rejuvenation, intension of valleys, predominance of ephemeral hills and a number of small steams indicate toward the multi-cyclic landforms development in the area.

Ramani and Rajamnickam (2005) studied drainage morphometry of The Vankarai river. The drainage morphometric parameters are useful to study the terrain configuration and the effect of the drainage morphometry on stability of the study area. The drainage network also serves as on index of the magnitude of fluvial process and resultant soil erosion. Singh (2007) analysed A study of drainage characteristics of Dun pun river basin, a tributary of Gunga River. In between the two areas some transitional zone emerges especially in the southwest with moderate drainage frequency and southwest with moderate drainage frequency and moderate course drainage frequency partly formed over older alluvium. De (2010) studied A quantitative study of the longitudinal and cross-profiles (1989-1994) of the river Balasan in the Darjeeling district of West Bengal. The Himalaya interrupting the smooth running of a cycle of erosion and thereby, produced a number of sub cycles or epic-cycles along the long profile of the river Balasan, demarcated by definite breaks of slope.

1.8.4 Quantitative Analysis:

Padmaja (1994) observed a few salient characters of the rejuvenated snature of mej and its tributaries along the left bank of Chambal (Rajasthan) The erosional
process of Mej have much in common with those of Chambal river and geomorphic evidences of suggest that Mej was in existence during Mesozoic period. Singh and Dubey (1996) indicate loss of soil nutrients from man impacted gully basin in sub humid tropical environment of Deoghat area. Amal (1997) analysis size characteristics of nearsurface sediments in the shore zone of Kachchh as possible indicators of geomorphic process. Among the several statistical procedures adopted to derive information’s from the grain size statistics, cluster analysis was successful in linking landforms according to the processes acting on them. Manik and Goswami (1997) studied evaluating alternative techniques for flood frequency a case study on the Kopili river, Assam. In this study an evaluation of some of the existing techniques of flood frequency analysis is carried out as a case study on the Kopili River, Assam. Singh and Dubey Others (1998) observed rate of erosion in the hierarchical orders of natural and cultivated gully basin of Deoghat area, Allahabad district. Most of the gullies are cultivated and have been modified with the result of the rate of rill and gully erosion has been accelerated many times due to anthropogenic factors. Bassirani (1999) analyzed environmental aspects of wet land ecosystem of Seistan basin, SE, Iran. The adverse factors these wetlands and conservation measures for human use are also discussed.

Chattopadhyay and others (2000) studied application of remote sensing and geomorphic information system in the generation and synthesis of environmental statistics a case study from Manar basin South Kerala. The analysis of Manar basin has appeared to be a handy tool for environmental management planning. Rana (2003) observed downstream changes in channel form and grain size in the Jia Dhanasri river, Assam, India. This study suggests adopting appropriate structural and non-structural measures for protection of banks from erosion. It is also structural measures will be an effective plan for channel stability and higher productivity of the agricultural stability and higher productivity of the agricultural lands. Ahmed and others (2005) analyzed deforestation effects on sedimentation of Krishnai river, South bank of Brahmaputra river basin in north eastern India. Krishnai basin is a southern part tributary of the main river Brahmaputra, characterized by exceeding high rate of erosion.

Rana (2006 and 2007) analyzed Jia Dhansiri River, Assam, India. A study of channel shifting and channel pattern. The degree of braiding is increasing
progressively while sinuosity index is decreasing. The major causes of braiding are low surface gradient, flood, high sediment discharge and severe bank erosion. Agnihotri (2006 and 2007) studied identification of erosion surfaces of Mohan river basin at the regional scale. Methods and techniques involved in identification clearly point out that functional life of the erosion surfaces must be fitted into the ‘geological time scale’. The timing, rate and amount of crustal plate motion and sea-floor spreading may be key elements to our understanding of erosion surface. Ahmad and Kanth (2007) analyzed Soil erosion intensity zones in Liddar basin, Kashmir. The Liddar basin which diverse physio-climate condition and farming systems is highly vulnerable to soil erosion hazards. Dongare (2008) studied Rational Derivation of river-bed profile. The purpose of in this paper is to review certain principles which afford a rational derivation of the profile of river-bed and test the result on Denawa river tributary of Tawa River of central India. Pande (2009) observed structural control and evolution of landform in upper Saryu basin, Uttarkhand state. The above mentioned observations as well as discussions conclude that the litho logical and structural traits of the area are significant aspects which reflect the control of inner composition upon surface relief features. Joshi (2009) analyzed scour depth estimation based on the physical properties of soils along the tributaries of river Pravara, Maharashtra. The soil physical properties as well as credibility index suggest that these soil are fairly to moderately and the estimated scour depth is between 3 to 4 meter.

Rana and others (2009) analysis Nature of channel shifting of a foot hills Fed river in the alluvial setting- a case study of river Rapty, India. The study further revealed that the river is more dynamic in its entire course and shifted towards east in response to neo tectonic activity. Bhattacharjee and others (2009) studied floods and their hazards impact on flood plain dwellers in Mangaldai sub-division, Assam. In recent years Foods have posed as serious problems in the geomorphic, environmental, ecologic and economic spheres. All over the river plains of the world, especially over the river plains of the world, especially over the ravines areas of the third world countries where population pressure on land, water and resources has tremendously increased. Mukhopadhyay and Pal (2010) have analyzed emerging hydro-geomorphic and ecological problems in rural wet land within Ajay river basin West Bengal. Wetland is one of the important limbs of the nature comprising with large number of
usability. Barul wetland is a very small unit of wetland found in Ajay river basin near Illambazar. This small wetland unit is now infested by different types of hydro-ecological and geomorphological problems.

Krishnaih (2011) observed land capability of the Papagni river basin, Andhra Pradesh using remote sensing technique. The erosion intensity is high in central and northern parts of the Papagni basin. Hydro geomorphically, the basin is divided into six categories of the ground water potential zones.

1.9 PREVIOUS WORK: