INTRODUCTION

Geomorphology is the study of landforms, their description and interpretation. It is an important branch of Geography which deals with the evolution of landforms including the sequential developments that might have taken place in shaping them since their initial appearance above the base level. The study of landforms provides information useful to human as well as physical geographers. Now such studies are not only of academic interest but also have occupied an important place in applied fields viz. civil engineering, geology and geophysical exploration, hydrology, rural and urban planning. For the development of agricultural resources, the terrain assumes special significance. Geomorphology, which is concerned with landforms, materials and their related processes is pertinent to all aspects of environmental management involving these physical phenomena (Cooke, R.U. and Dornkamp, J.C. 1974).

Despite the close interrelationship between the cultural and the natural landscapes on the earth that have been long occupied by man, the forms of the land undergo evolutionary processes beyond man's control. Therefore, despite human interference with their evolution, landforms remain the basic unit of study in reference to the physical
landscape, but their study must include man's role as an evolutionary factor (Varma, J.H., 1971).

The seed of physical geography was sown as early as 4th century B.C. at the time of Herodotus who made a statement, "Egypt is the gift of the Nile". Amongst other ancient pioneers Aristotle (384-322 B.C.), Strabo (54 B.C. - A.D. 25), Seneca (1st B.C. - A.D. 65) postulated some of the basic concepts of physical geography. The dawn of modern geomorphic ideas, after Hutton and his followers who gave the deterministic approach to physical geography, the development of this branch was more or less confined to the geological circles.

Later Plyfair (1748-1819), mathematician, and Charles Lell (1797 to 1875) Powell, L.W. (1834-1902), Gilbert (1843-1918) and Datton, C.E. (1841-1912) the geologists, prepared the ground work for Davis to build up the concept of geomorphic cycle. Davis, W.M. from American school has been acclaimed as a great definer, analyst and the father of geomorphology. He gave the conception of explanatory description of landforms and prepared his doctrine of "Structure, process and Stage" (1904). He also recognised the stage of growth, maturity and old age in the development of landforms. He had to face the challenges from Walther.
and others in 1920. The geographical concept in landform study was advocated as early as 1935 by Smith, L.H., who observed, whatever agencies and processes may have caused the sculpturing and configuration, that is the principle consideration of the topographer and geographer. Russell (1949) remarked that the geologists are mainly interested in vertical cross-section while geographers focus on horizontal cross-section on which the human landscape evolves.

Kessali, J.E. (1946) formulates three concepts regarding the study of landforms (1) concept of descriptive landform analysis (2) concept of landform types and (3) concept of landform type regions. Kessali, J.E. (1954) crystallised his outlines and suggestions as under: (a) the desired geomorphology need not concern itself with the origin of the landform (b) Geomorphology should divorce itself from explanatory terminology (c) It should be developed by recognising and defined landform types (d) Landforms themselves should be mapped by the use of appropriate symbols (e) The physical as well as human geographers should contribute to the development of geographic geomorphology. Hammand, following the ideals of Kessali, devised a method for quantitative empirical description of landform regions and also coined a new
terminology "Land surface forms". Hammond, E.H. (1965) envisaged geography of landforms which encompasses empirical and descriptive analysis of landform in relation to other physical and cultural phenomena.

Weaver, G.D. (1965) has divided the study of landforms into following types (1) Formulating the basic criteria to analyse quantitatively the surface features rather than studying the genetic implications of various morphometric techniques (2) changing the scale of observation under which we may consider characteristics of the area from macro to micro scale. (3) Dismantling the landforms (4) Reassembling the landforms.

Further the study of landforms should be oriented towards the analysis and spatial distribution of geomorphic qualities of the land surface features. The genetic explanation of landforms should follow afterwards as complement. The landform categories should correlate with the cultural factors in respect of individual geomorphic elements of the landforms.

Among the notable scholars in this field Lueder, D.R. is worthy of special study and his concept of 'unit landform' and component classes of the drainage pattern can
hardly be ignored. In addition, Lester King, Choi, R.J., Arthur Holmes, Longwell, C.R., Knoff, A., Flint, R.F., Schumm etc. have made significant contributions in landform studies. King's position as a tropical geomorphologist is unique.

Studies up to the fifties of the present century were more of qualitative nature, generally confined to a definite beaten track which had its base in the concepts of Davis and Penck. Horton, Strahler, Leopold, Lehman, Le Heux, Schumm, Clark and others may be credited to have extended the geomorphic studies beyond the restrictions of a qualitative system. Horton's postulations regarding the drainage basin parameters provided a skeleton for Strahler to develop his quantitative geomorphology of drainage basins. Similar is the case with Smith's relative relief, Dov Nir and Ervin Raiz's work on the slope etc. Morphometric analysis of landforms has followed in its wake.

Descriptive (preferably quantitative) landform analysis should be the first step in any type of landform study, especially, in geography, where the facts of the earth surface always are in focus. In the field of descriptive geomorphology two current tendencies may be observed; one is search for as precise descriptive system
that can be used in the analysis of areal relationships between landforms and the occupancy of land by man. The other is the search for a broader frame of reference into which a system of explanatory description based on genetic principles can be fitted (Zakrzewska, B. 1967).

After having formulated the basic concepts of landform analysis, it will be worthwhile to discuss in brief the morphometric analysis employed in the present endeavour. Morphometry is part of Morphology. It adds to the verbal description of form, and the corresponding numerical expression makes the morphological observation and description even deeper and clearer, but it can not be substituted for them (Zekerzewska, B. 1967). Clarke, J.I. (1966) defines the term quite elaborately as follows: "Morphometry may be defined as the measurement and mathematical analysis of the configuration of the earth's surface and of the shape and dimensions of the landforms. The main aspects examined here are the area, altitude, volume, slope, profile and texture of the land as well as the varied characteristics of the drainage basins". The exponents of morphometric analysis are Baulig, Birat, Strahler, Horton, Dury etc. The study of terrain undertaken by Singh, R.L. (1967) in the line of morphometric approach is followed.
Geomorphological studies have proved to be valuable to geographers, because they take an increasing account of man's part in modifying natural processes and landforms. In short, geomorphological studies are coming of age and in future will make increasingly important contributions to man's use of his living space (Bradshaw, M.J. Abott, A.J. and Gelsthorpe, A.P., 1979).

Present Study:

The study of landforms or terrain is basic necessity both for planning and defence purposes. The present study precisely defines almost homogeneous terrain type or landform type which can serve as better guide to the planners (Economic and Regional). Roads, dams, canals etc. can be laid over such a well studied area. The need of the study of drainage basins is important because of their existence in the physical landscape and their significance for producing fluvial landforms and its significance for human use (Gregory, K.J. and Walling, D.E., 1976). The idea of the drainage basin as a suitable framework for the study and organisation of the facts of physical and human geography has a long tradition in the history of the subject" (Smith, C.T., 1969).
In the present study of this physiographic and cultural complex emphasis has been laid on the morphometric analysis of landforms and on the correlation of morphometric attributes with settlements and then the validity of geological details is checked. An attempt has been made to analyse the landuse pattern in relation to landforms. In the present thesis researcher has used quantitative techniques to define and to describe the nature of landforms and their spatial pattern.

Objectives:

The present study covers the following objectives:

1. To analyse the terrain study of area-height relationship.

2. To study the physiographic and cultural complex of the region.

3. To study the relationship between the different elements of the drainage-net along with the slope analysis.

4. To study the geomorphological processes of fluvial dominated landscapes.

5. To study the ground water potential of the region in correlation with drainage and rainfall.
6. The integrated unit of landform has been traced and the attempt is made to provide a hierarchical order of landform units designated as morpho-units recognized in the area.

7. To study the landforms with its correlation with soil and surface landuse.

8. To study the areal relationship between landforms and the occupancy of land by man.

9. To study the settlement pattern, physical setting, distribution and evolution, population growth pattern and its relationship with topographic features.

10. To study the effect of geomorphology on the human life of the region.

Study Area:

The location of the Varada river basin itself is of considerable geomorphic significance. The whole area comprises (5,354 sq.km.) two main physiographic divisions, Malnad and the Maidan regions. Geographically it is extended from 74° 45' to 75° 45' E Longitude and 14° 5' to 15° 5' N Latitude. The Varada river is the tributary of the Tungabhadra and rises at Varadamula near Ikkeri in Sagar taluk of Shimoga district in Karnataka State. The
area covering Malnad region has rich forest resources with hilly country bordering on the Western Ghats with high rainfall. Maidan is gentle rolling and flat topography with scattered forest of scrubs associated with a senile topography and low rainfall distribution. The basin has varied geological characteristics under the Archaean complex or Crystalline complex consisting of the Dharwad System and gneissic complex. Dharwar occurs, as N N W and N W trend and forms the oldest formation of the Pre-Cambrian period. Agriculture is the main landuse of this basin and forest comes second. The region has varied types of settlement distribution with different cultures.

**Methodology:**

The present work is based on primary and secondary data. The data and information were collected from various government publications, memoirs and records, mainly from Geological survey of India. Talukwise and villagewise data were collected from taluk offices. Groundwater resources of the taluk level are supplied by the District Mines and Geology Department. Most of the observations in this thesis, however, are based upon field work in the area under study. One inch to one mile scale toposheets of Survey of India have been selected for the quantitative enumerations of the Morphometric attributes.
The study of the essential elements of terrain of the Varada river basin has been undertaken through measurement and analysis of surface morphological features employing standard geomorphic techniques including various quantitative analyses such as study of (1) topographic expression, e.g. relief, slope, altitude, etc. (2) Drainage characteristics, e.g. river terraces, patterns, meandering and flood plain drainage density and frequency. Field study has been carried out to identify the major erosional depositional landforms in relation to their order of evolution in the Varada river basin. The field photos have been presented. In this piece of geomorphological research, geomorphic mapping is also made with the help of Landsat Imagery and aerial photographs. The study has been analysed with the help of maps, diagrams and field photos. The researcher is aware of limitations due to non-availability of physical data (viz. erosional and depositional rates) and lack of micro-level information. This attempt demonstrates that with the available material one can present a useful work.

Chapterization:

The study has thus accomplished systematically in eight chapters.

*Researcher has used the aerial photographs to study the landform features and spatial distribution of streams (consultation in Survey of India, Southern Circle, Bangalore, 1983).
The first chapter is devoted to the study of the physical elements of the environment of the region. The distribution of major relief features, altitudinal zones and drainage, along with elements of climate, soil and vegetation are dealt with, general topographic character of the area.

The second chapter analyses both absolute and relative reliefs and establishes a quantitative relationship between the two. The dissection index, a more scientific expression of relief analysis and erosional potentials, is also computed. The area/height relationship has been evaluated and the technique of altimetric frequency curve has been applied.

The third chapter deals with slope analysis to study the distribution of slope categories with the help of Wentworth's method. The interdependence of slope and relief is also shown. Some light is also thrown on the probable development of slope in the area under study.

The fourth chapter deals with the drainage analysis, covering drainage texture, frequency, run-off and pattern. The basin parameters have been evaluated and analysed quantitatively. Hydraulic and topographic sinuosity indexes have been worked out. Anomalies in the application of the conventional genetic classification to the streams
and their evolutoinal sequences have been given due consideration. Over and above, the relations of drainage density relative absolute reliefs are also established.

The **fifth** chapter aims at dismantling the area into morphological units of first, second and third order based on the morphometric attributes. Probable fourth order division along with the bases is also suggested. The details of the morphometric characteristics have been supplemented upto the third order.

The **sixth** chapter Section 'A' deals with the applied aspects of landform studies by way of analysing the distributional patterns of settlements and population through spatial analysis. It also includes the study of correlation of morphometric attributes such as absolute relief, relative relief and drainage density with distribution of settlements.

The Section 'B' deals with the impact of geomorphology on the human life of the region.
REFERENCES


