CHAPTER ~ V

CLASSIFICATION AND MORPHOMETRIC EVALUATION OF MORPHO - UNITS

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5.0.0 Introduction:

The preceding chapter has crystallised the fact that every individual landform element has some definite relationship with the other. The discussion so far intended to explain the qualitative as well as quantitative nature and areal distributional pattern of major morphometric attributes, namely, the absolute and relative reliefs, the dissection index, slope and drainage texture conditioned by diverse agencies. Assemblage of these attributes and the consequential dismantling of the area into more or less homogeneous units, is known as morpho-units or 'morphological units'. The term 'morpho-units' means the unit having average similarity in form and character, but Lueder, D.R., (1959) named them 'unit landform' of different orders. As far as the order is concerned, it is to be restricted to a certain stage, Sing, K.N., (1980). Savigear, R.A.G., (1955) explains that a morphological unit is either a facet, a micro-facet, a segment, or micro-segment. The smallest unit of a terrain, i.e. the facet can hardly be attempted for an area of considerable extent as the one in hand, covering over 5,354 sq.km.
The morphological subdivisions of almost all orders have been devised by the exponents but with different nomenclatures according to scale, and have been termed 'Natural Region'. Linton, D.L., (1951) in his broader sense has distinguished them as physiographic regions. Bourn, R., (1931) in his regional delineations of Britain has suggested the "Characteristic Site Assemblage" as the basis. This site concept provides, on the one hand, the flats and slopes, the two visible expressions of erosional and depositional process and, on the other hand, offers units of relatively uniform environment for the development of soils, natural vegetation, etc. Thus, the site provides distinction in the landscape. More recently, Strahler and others have been responsible for extending geomorphic thought beyond the restrictions of a qualitative system by not basing on the sequential development or any preconceived ordered framework, but treating or considering the "land surface form as the last Geographical Stratum" (Robinson, G., 1963).

The complexity of the physical forces and their behavioural attitude towards the creation of numerous forms, leads to the complications in the classifications of land surface forms in the area under study. As far as land form is concerned, if explicitly demarcated, it should be
altogether different from its surroundings. But this rather ideal delineation is too difficult, if not impossible, to achieve as there are only the five attributes, i.e. Absolute relief, relative relief, the dissection index, the drainage texture and the slope with their 6, 6, 4, 4 and 6 categories respectively. They can be combined to guide as many independent units as possible. If considered at the level of a facet, the smallest unit of terrain becomes strenuous and can be more comprehensively delineated with the aid of the stereopairs. Therefore, with these available source materials, one has to restrict the form allocations to a certain order and has to depend on generalisations as well. The first three broad or meso units, though easily discernible on the map as well as in the field, do not present their reductive characters. Still lower orders are to be looked upon, basing on the aforesaid morphometric attributes, individually or in combination. In dismantling the total coverage into morpho-units of different orders, an effort has been made to put the most alike areas of a locality together. And hence the study, though a patchwork, can form an integral part of the country's morpho-units at their respective positions. The Varada basin as a whole the Karnataka plateau in the broad physiographic divisions (South Deccan) of India (Fig. 1).
5.1.0 First Order Morpho Units:

The Tarada river basin extends over diverse topographic area, i.e. Malnad in the south with undulated thick vegetative cover and towards east rolling plains with scrub and sparse vegetative cover (Fig. 2). On these lines three first order groups have been divided into:

1. The Maidan Region,
2. Transitional Belt, and
3. Malnad Belt.

These three divisions are different in topography and more diversified in rainfall occurrence. This leads to a difference in vegetative cover and land use of the area. In between Malnad and Maidan, the transition belt lies between the main physical boundary of Malnad and National Highway No. 4. This dividing line is observed in the north also, where rainfall varies.

5.1.1 The Maidan Region:

The Maidan region, covering 25.69% of the total area is (1,375 sq.kms.) is characterised by vast plain with broad river valley. The height ranges from 515 - 656 meters,
with the geologic formation of shale, schist and extensive
distribution of black soil. The rainfall distribution
ranges between 550 - 750 mm. with very poor vegetation,
scrub and grass cover.

The morphometric characteristics of the area depict
of the extremely low to moderate absolute relief and relative relief. This can
be visualised (Table - 1) from the fact that the categories
of A E L and A M L, cover 86% of the region. R E L, R M L,
share 77 and 21 per cent, of the region respectively and
thus account for 98% of the total area. Dissection indices
show the same trend of low and moderate groups. These two
attributes and indices show low to moderate distribution of
categories. Since this area is low lying and flood plain, these dominant characteristics are observed. In plain and low lying area drainage density is distributed
more harmoniously into moderate texture and very coarse texture,
which cover 94% and 6% of the area respectively. Small gullies
and rills join the main stream. These are concentrated
in the north and south of this region. The slope categories
are unevenly distributed. The distribution of slope
categories is similar to that of drainage texture. These
two attributes are very significant because of the confluence
point and the from three sides. This
Maidan region covers the southern tip of north Maidan of Karnataka plateau.
5.1.2 **Transitional Belt**

This region, which lies between the Malnad and Maidan regions is a narrow belt covering 19.96% (1,069 sq.km.) of the total area, height ranging from 530 m. to 681 m. The region extends from south of Byadgi to north-east of Shiggaon. Transition of climate (rainfall) is observed and rolling plain topography exists. The whole region consists of graywacke, schist, bands of ferruginous quartz. Dolerite dykes are distributed in the west and north of Haveri. In the old rock formation, intrusives are prominent with hard bare remanents. Another important characteristic of this region is that mixed soil (red and black) is found in the area. In general, the area is flat with some intrusives. Hillocks (height of 621 to 651 m.) are seen in the north-west and south-east of the basin.

The total picture evaluated (Table - 1, Fig. 1) shows the moderate to extremely low. Absolute and relative reliefs are distributed in four categories. Below 530 metres, has been reduced to 5.70 percent of the total region. Two higher groups of absolute and relative reliefs (A M, and R M) cover nearly 2% of the region. Dissection index has followed almost the same trend of relative relief. Noted factor is that coarse drainage
texture is not widely distributed in this area. Even though two rivers are flowing (Varada and Dharma) with very few tributaries, more irrigated area is found in between the Varada valley and Dharma valley. The small hillocks (606 m.) are situated in the south of Hangal. Relative relief group coincides with the moderate slope group. The drainage texture is coarse to moderate and covers 48% of the region. It is more in high lands than in the low lying areas. Because of this reason small catchment areas of these streams are found in the uplands.

5.1.3 Malnad Region:

Malnad is a hilly country covering about 54.35% of the total basin area. The region is situated at the edge of Sahyadri hill covering thick evergreen and deciduous forests. Malnad region is lying in the south of the basin and forms the precipitous edge of the Western Ghats. The geologic formation of this region is granitic greiss, one of the oldest rock formations called Archaean system. The chlorite schist, banded ferruginous quartz and graywackes are the groups of Dharwad schist. Red loamy and lateritic soils are extensively distributed in the region. Whole region comes in the height range group between 545 - 901 metres.
In this gentle undulating topography the morphometric attributes are widely distributed in different categories. Absolute and relative relief slightly differ in coverage. Moderately low and low absolute relief cover 95% of the area. The relative relief consists of REL and REM and covers 86% of the area and the same percentage of low and moderate dissection index. The high lands, which exist in south and south east of the region, cover about 1.40 and 0.68% respectively of the area under the categories of moderately high and high groups. Another noted factor is that the gradual decrease of drainage texture varies from coarse to fine texture. Eighty per cent of the region is included in the moderate to gentle slope group. In the east more undulation is observed. Small isolated flat topped hills and valley slopes are covered with thick vegetation. High rainfall with thick vegetation and undulation topography is the unique character of the region. Hard gneiss remanents of erosion resistant rocks occur in this region.

5.2.0 Second Order Morpho Units:

The three first order regions have further been subdivided into as many as six second order regions (Fig. 3 and 4). Criteria like topography and relative location
SECOND ORDER MORPHO-UNITS
CATEGORIES OF MORPHOMETRIC ATTRIBUTES IN PERCENT

Fig 3
have been taken into account. The Malnad region consists of dissimilarities in the granitic gneiss, graywackes and chlorite schist groups. The Maidan region with distinctive sites a plain topography. Following are the second order morpho-units, namely:

1. Dandavati valley 4. Chandraghatti Hill Area
2. Sagar Mountain Strip 5. Flood Plain

The above six morpho-units even though small, differ significantly in their appearances, which has also been established by the morphometry of the region (Table - 2).

1. Dandavati Valley lying between the 545 to 621 m. has 90% of its area under moderately low absolute relief (AML) and 95% under extremely low to moderately low (RELI, RML) relative relief. Categories of dissection index are distributed low to high with same variation. This shows the undulation and dissection in the region. Since this river has less tributaries, the drainage texture is coarse in character. Variation in the slope is observed from the table moderate to gentle slope covering 88% of the area (Table - 2).

2. Sagar mountain strip is situated in the south of the basin, where of the Varada river basin.
lies. Rest of the area comes under catchment area of the Sharavati river. The distribution of absolute and relative relief clearly shows that this is more undulated and dissected. Absolute and relative relief categories are distributed from low to high (Table - 2).

The marked similarities, observed in this region, that categories of relative relief and dissection index are widely distributed. This is a clear indication of more undulated topography. This region is characterised by high rainfall and thick vegetation cover. Drainage texture covers nearly 51% of the region and consists of coarse to fine texture. The Varada river takes its birth in this region near the spur. Small streams are originate from these high lands.

(3) Siddapur Plain area is covered with small remnants of rocks. The region is surrounded by highlands in the west (outside the basin). It is covered with geological formation of graywacke, migmite and associated granitoids. Absolute relief is moderately low (AML) in the whole area and relative relief is extremely low to low (REL and RML) 92% of the area. The drainage texture in this region is uniformly distributed and covers 51% of the region. It moderate to fine texture. Distribution of slopes includes the group of low to gentle slope.
(4) Chandragutti Hill is located in the south-west of the basin. The prominence of this region is the rounded hill formed of granitic gneiss. This structure is surrounded by plain with low height group (759 - 834 m.). As a result, relative relief of RMH and RH categories are occurring. Seventy four per cent of the area is covered by very coarse (TVC) and coarse texture (TC). There is more uniform distribution of dissection index categories in the study area.

(5) Flood Plain area is situated in the north-east of the basin near the confluence point of the Varada and the Tungabhadra. Even though this region comes under the height group of 515 - 540 m. it is more planation in its form, with a broad river valley associated with more lateral erosion. Groups of absolute and relative relief are concentrated only at lower levels and depict clearly the low relief. The same trend is observed in dissection index and slope categories. The region, coming under 515 m., can be classified as a newer surface. This can be compared with newer surface area of the Krishna basin ranging from 370 - 515 m. On this basin the surface is reduced to 515 m. forming lower part of the Varada river valley. This region is covered with black soil and rainfall infiltration capacity. Ninety two per cent comes under very low, coarse to moderate texture group.
(6) Sirsi Piedmont region is surrounded by uplands and hills in the west of this region which is outside the boundary of the basin. Because of this locational factor this region has similar features to piedmont.

Absolute relief group is located in AML and AL, whereas relative relief is in REL and RML. Dissection index of the region is 83.83% and depicts only a moderate index (DM). The region is clearly different and unique from the surrounding regions.

The above micro or second order morpho-units showing different morphometric attributes and distinctive arrangement of topography. This type of classification on the basis of above attributes will be helpful for micro-level physical planning for maximum utilization of resources.

The third order morpho-units can be classified into two broad groups, these are the Dharma river basin and Byadgi Hill and scrubby area. The Dharma river has an elongated shape and height ranges from 530 - 621 mtrs. It flows in two regions with narrow valley in Malnad and Maidan. Dharma canal provides irrigation in the Hangal taluk between the Dharma and Varada rivers. This leads to an irrigated landscape. Byadgi highlands, with scrub and grassy...
distinctively dry character. It is characterised by low rainfall, very sparse drainage and bare rock outcrops.

5.3.0 Morphogenetic Evolution:

The broad morphological unit of the Varada river basin covering Karnataka plateau is included in second order relief on the surface of the earth by geomorphologists. But the height and relative location vary in different parts of the world. The study area rises from about 515 - 787 m. (1700 - 2600 ft.) except in few spots of 909 m. (3000 ft.).

It is the ancient block of peninsula and is dominated by an open senile topography. The varied landforms and physiographic peculiarities are considered to be the result of circumdenudation of an old tableland (Radhakrishna, 1966). Peninsula is a shield area composed of some of the oldest rocks of the earth's crust which have undergone much crushing and metamorphism. The peninsula has been exposed from ancient times to the agents of erosion and is at present an extensive plateau approaching peneplanation (Pitchumuthy, 1967). This stage of development is clearly observed in this study area.

The area under study covers under the Archaean, Dharwar and post-Dharwar system of Pre-Cambrian rock
formation. Geomorphologists are largely aware of the various factors that contribute towards the evolution of some small part or other parts of the earth. Rock forming is a major part of the basin amongst the oldest known formations in India. The gneisses and associated schists have of nearly 2.5 to 3 thousand million years the events that had happened at an early period of the earth's history. Both the Dharwar schists and the peninsular gneisses are believed to be the result of intense diastrophism. As a result of it they are interbedded and interfolded. The sedimentary strata appear to rest over the gneisses at some places with an unconformity, while at others they are largely interbedded with them (Wadia, D.N., 1966). Sometimes it indicates older age than some of the gneisses, hence it is difficult to identify with any certainty. Dharwar system is often metamorphosed into schists and gneisses. They are indistinguishable from the primitive gneisses and schists. In the study area east of Sorab taluk chlorite schist is formed which is adjacent to granitic gneiss formation (Fig. 6, Chapter - I).

The evolution of this area may be studied in the following stages: sedimentation and uplift in purana times. A vast interval of time must have elapsed before this upraised surface was reduced to base level. The basin comes
under the plateau and it is not subjected to any comprehensive mountain building forces after the close of the late Pre-Cambrian times. Later movements were only of an epeirogenic character, elevating the denuded surfaces into a plateau and subjecting them to fresh cycles of erosion.

The end of the Jurassic period witnessed the first breaking up of the Gondwana Continent. The disintegration and removal of the upraised Gondwana surface has contributed to the sediment formation in Cretaceous and Eocene. In the mid-Cretaceous and mid-Eocene period around 25 million years ago, the laterization took place. These forms are observed in the form of graywackes and schists in the study area. The easterly drainage of the Varada drainage in the peninsula is admittedly ancient and was responsible for the reduction of the original Gondwana surface to a peneplane. Radhakrishna (1966) opines that rivers of the peninsula are not guided by the underlying rock structure, as the drainage of an earlier cycle, which had run its course, has been superimposed on the newer surface. Laterite, which had formed a crust over the peneplaned surface, came to occupy elevations of 909 m. (3000 ft.) over the plateau.

Reduction of the old plateau to a new plateau surface in the study area (515 - 606 m. 1700 - 2000 ft.).
A vast part of the basin. By reconstructing the present contours it may be considered that 606 - 635 m. (2000 - 2100 ft.) group area is erosional surface. Most of the catchment area of streams originate above 606 m. height in the study area. This is confirmed from the view of Vaidyanadhan. He opines that erosional surfaces over the Pre-Cambrian rocks at successive lower elevations exist across Karnataka plateau.

The probable morphological evolution of the basin is explained here. It is not an end in itself, still detailed work and investigation of structural activity are going on. On the whole the endogenic force in the upliftment of plateau leads to process of exogenic rejuvenation of drainage. Climatic factors help denudation, resulting the surface configuration. Fluvial erosion is the main activity along with chemical weathering, viz., laterites. Are the agents in the erosional cycle of this surface of the earth?
REFERENCES


**Index of Morphometric attributes**

### Absolute Relief (AL)

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<th>Level</th>
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<td>AM</td>
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### Relative Relief (RR)

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<td>Moderately low</td>
<td>RML</td>
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<tr>
<td>Low</td>
<td>RL</td>
<td>31 - 60</td>
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<tr>
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### Drainage Texture (DT)

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### Dissection Index (DI)

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<td>Moderately high</td>
<td>DMH</td>
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