CONCLUSION

The present area under research, the Shahdol region, is a sub-part of Vindhyanchal-Baghelkhand region and is bounded between, 23^0 3' 14" N to 23^0 38' 39" N latitudes and 81^0 8' 20" E to 82^0 1' 15" E longitudes and covers a territorial span of 3670 Km^2. It is spread over Sohagpur, Burhar, Jaitpur Tehsils of Shahdol and Anuppur Districts. The Study area is 132 Kms. long in east-west direction and 106.4 Kms. wide in north-south direction. The water divide of Son and its eastern trubutaries make the eastern boundary of the region while the northern limit is demarcated by the northern water divide of Gorna river whereas the water sheds of Sarpha and Johilla rivers work as the southern boundary of the study area. The south-western and western boundary is delineated by water divide of Son-Johilla and their tributaries, whereas the water divide of Son and Johilla rivers acts as the north-werstern boundary of the region.

The geology of the study region is a part of ancient Gondwanaland whose basement is formed by the crystalline granites and gneisses of the Archaean formations intruded in Dharwar formations and overlain by the upper and lower Gondwana formations consisting mainly shale and sandstone rocks. Geomorphologically the region presents basin and hill topography where the mariginal parts are represented by denuded hills, plateau and monadnocks of different sizes and periods and the core area is formed by a larger basin which is saucer shaped.

The granites and gneisses of Basal complex, sandstones, limestons, Shales, mudstones, Coal seems of upper, middle and lower Gondwanas, lava cover of cretaceus and laterites and alluvium of Tertiary pleistocene and present time are the main rock features of the region.

Various rock cycles, tectonic cycles, mineral cycles, hydrological cycles and geomorphic cycles were primarily responsible for the creation, destruction and maintenance of geomaterials through different phases of physical, chemical and biochemical processes. Due to the effect of environmental processes the parent rocks are disintegrated, decomposed and fragmented and mineral components of these rocks are converted into clay, silt and loam over the basal or parent rocks through the process of Kaolinization and montmorillonisation. In the intermittent period of the big cycle, sub cycles worked independently within their own system but their relation is with the processes of transformation and exchange of different geomaterials into the irreversible and reversible direction to complete the geocycle of the region. The rock forming elements are affected by sub-aerial denudational processes in different ways. The intensity of carbonation and oxidationis determined by the presence of Ca and fe_2 O_3 elements. Moderate presence of iron oxides in other rocks like quartzite and granite produce moderate oxidation in these rocks. Higher concentration of Silica in the rocks of the region are least affected by chemical weathering process except haematite quartzites.

The region falls into the tropical monsoon type climate with hot summer, cold winter and rainy periods which may be distictly placed into three seasons. The distinguished features of the climate of the region are that it experiences highest temperature in May and early June while it is mild and moist during outburst of monsoons in rainy seasons and severely cold in winter season.

In the summer season the temperature rises upto 48^0 C during the period of sunshine and drops to 20^0 C in the nights which is ideal for physical weathering processes resulting into block disintegration, shattering and exfoliation of rocks. In the mid June the temperature begins to drop appreciably due to moist conditions and rains. The rainy months of the July, August and September are characterised by heavy rains, moderately high temperatures and high relative humidity conditions which are uncomfortable for human activities but are conducive for chemical weathering and fluvial erosion. The winter months of November, December, January and February are ideal for human activities due to low temperatures, moderate to low humidity and absence of rains which causes minimum river action, moderate wind action and moderate weathering conditions.

The development and composition of the natural vegetation of the study region is mainly controlled by climatic, edaphic, biotic and physiographic factors. Sal is the dominant forest variety of the region which is influenced by the depth of the soil and soil moisture conditions. The authoress has classified the forests of the region into trap Sal forests, Mixed Deciduous forests and hilly Sal forests which provides a good pastureland for the domestic animals whereas tribal population gets fuel from these forests. Different types of gums and wild fruits are being collected from these areas whereas heavy fellings and unrestricted grazing is common.

Soils of the region are all zonal in character derived from the parent rocks but their physical and chemical properties differ from place to place depending on the nature of parent rocks, and nature of denudation and the processes which worked during the period of their formation. The soils of the Shahdol region have been classified into (i) Black Soils, (ii) Mixed Red-Black Soils, (iii) Grey and Brown Soils, (iv) Laterite Soils and (v) Alluvial Soils.

The region has been divided into three physiographic regions. The northern hilly tract region is characterised by hilly topogrophy, whereas

Shahdol basin is vast erosional surface whereas isolated hills break the monotony of the region. The Maikal region is formed by hill ranges and scarps of various sizes and shapes.

The study region is drained by single river system Son which is a subsystem of the Ganges catchment. There are drainage devides of three categories i.e. primary, secondary and tertiary, in the region. The primary water divide is not present in the region because the region is drained by the tributaries of Son only. The chief tributaries of Son are Sarpha, Kunuk, Gorna, Katna, Kaser etc. The main drainage pattern is dendritic whereas trellis, parallel and radial patterns are found over hills, hill ranges and scarps of Maikal and northern hilly tract regions.

An attempt has been made to study the spatial patterns and variations of drainage density in different regions, through 10 sample basins. The study of drainage density indicates that low drainage density accounts for maximum frequencies in the region because 50.41% of the total frequencies are concentrated in this category whereas high drainage density category represents 15.47% of the total frequencies and moderate drainage density category is relegated to 34.04% of the total frequencies only. Mean drainage density for the entire region (2.03 Km/Km^2) also falls in moderate drainage density category. The standard deviation of 0.98 falling well below the mean drainage density also indicates maximum concentration of frequencies in a few classes and there is no reasonable variation. The coefficient of variation for the whole region (48%) also reveals moderate variation from mean drainage density.

The stream frequency for the entire region shows that maximum frequencies are concetrated in poor and very poor frequency classes. The central tableland region account for maximum areal coverage of low and very low stream frequency classes. A close perusal indicates that there is well marked gradation of stream frequency category from the bank of Son to the escarpment of Maikal highland region. The domain of very poor stream frequency classes bagins from the banks of Son grades into poor and moderate upto crest. The scarp faces of nothern hilly tract and Maikal highlands are dominanted by high and very high stream frequency classes which is the result of steep slopes, weak formations, high dissection and high relative relief. The central tableland is a peneplained surface which is dominated by poor and very poor categories. The statistical analysis of stream frequency classes indicates that the mean value of sample basins ranges between 4.03 to 6.63. The mean value of all the sample basins except Nagbandh falls into poor stream frequency category. Nagbandh is the only stream whose mean value denotes moderate category. The S.D. values of the sample basins range from 1.71 to 3.51 indicating moderate variation of frequency classes in the basins.

The drainage texture is defined as spacing of streams. The overall picture of frequency distribution of drainage texture in sample basins is almost symmetrical to the regional pattern where course and very course categories combined together account for 60.98% of total frequencies. The frequency polygons of Gorna, Baghari, Kaser and Katna denote highly negatively skewed distribution where 45% to 50% of the total frequencies are concentrated in very course Dt. categories while course Dt. classes account for 23% to 28% frequencies in Gorna (23.22), Bhaisan (28.57), Nagbandh (25.42), Kaser (24.84) and Katna (23.12) basins. The frequency distribution of moderate Dt. is more than 40% of the total frequencies in Bhaisan (40.71) and Nagbandh (42.38). Very fine and fine Dt. classes account for below 17 percent of the total frequencies. None of the sample basins account for more than 20% of the total frequencies in fine Dt. category whereas very fine class is meagrely represented by below 12% frequencies. In the light of the above statement it may be concluded that the entire region and sample basins show the characteristics of late mature to old stage of erosional cycles because of dominance of coarse to very coarse texture classes. The patches of moderate, fine and very fine texture areas are marked by early to late mature stage of the cycle where hills and hill ranges having steep-slopes, high dissection and moderately high relative relief have generated more drainage lines and comparatively dense drainage net. Only the scarp faces of Maikal highland regions are characterised by fine and very fine texture classes due to very steep slopes, high dissection and high relative relief. The drainage network of the region is mainly affected and controlled by the structural factors and terrain characteristics. The southern Maikal highland region is composed of basaltic cover which is highly denuded by the Son and its tributaries resulting into a very dense net of drainage lines and high Dd, SF and fine Dt.

The authoress has selected 10 sample basins of different physiographic regions for the detailed study, interpretation, verification and analysis of various laws of stream network. The 10 sample basins have been ordered according to Strahler's scheme of ordinal scale.

Out of 10 sample basins Murna (3), Nargara (9) and Sarpha (10) are the sixth order streams while Gorna (1), Baghari (2), Jhiria (3), Bhaisan (5), Nagbandh (6), Kaser (7) and Katna (8) are the fifth order streams. It is apparent that there is direct relationship between the area of the basin and number of stream segments but prominent exceptions are also present in such rivers which are greater in area and smaller in relation to stream segments. The area and the number of stream segments is largely controlled by a number of topographic and hydraulic factors. The rivers which have developed their basins over Maikal highlands have smaller basinal coverage in relation to stream segements because high relative relief, high dissection, steep slopes and mature stage of basin development have aided in more branching of streams in relation to basinal areas wherein the rivers located over level surface of Shahdol tableland are characterised by large basinal areas and lesser numbers of stream segments which are due to low relief, gentle slope and old stage of development.

Murna Nadi covering an area of 609.54 Sq.Km. is pioneer in stream segments having maximum number of stream segments (1506). River Gorna occupies the lowest size by having only 54.05 Sq.Km. area which also has higher number of stream segments (447) Sarpha, Kaser and Katna rivers also present the same trend which have drainage areas of 382.44, 302.89 and 290.30 Sq.Kms. and number of stream segments of 776, 652 and 636 respectively.

Basalt covered Maikal highland region has been responsible for the high dissection of the region, high relative relief, steep slope, hill ridges where scarps have issued much feeders which are reflected in the larger number of stream segments of this region.

The behavioural pattern of bifurcation ratio of 10 selected basins of the present study region has been calculated and a comparative analysis has been attempted on the basis of data of mean bifurcation ratio $(\overline{Rb})$. It is apparent that average bifurcation ratio of 10 sample basins ranges between 3.09 and 5.58 which totally validates observations of other geomorphologists. There is negative relationship between order and bifurcation ratio being higher in lower orders and decreasing in higher orders.

It is evident from the regression lines that the law of stream numbers holds good in the basins of Jhiria, Baghari, Nagbandh basisn as the points nearly fall on the regression lines but some departures from the ideal condition are noted in the basins of Bhaisan, Gorna, Kaser, Katna, Murna, Sarpha and Nargara, where pronounced departures are found in different orders of those basins which flow over two contrasting terrains. There is definite deviation of stream numbers within the small basins from the ideal theoretical conditions and some times streams become "excess" in that some streams terminated by joining a higher order stream.

The law of stream length holds good in the present study because the total stream length continues to decrease from the first order to the last order. A definite relationship exists between the stream length viz total, mean and cumulative and order of the basin. The order and cumulative main length of sample basins follow positive exponential function model as propounded by Horton. In the present study all the streams of the 5th and 6th order follow above general rule. The mean length $(\bar{Lu})$ and order present a direct relationship where mean length of streams increases with increasing order which is again validated in the present study. This law is again tested by the co-efficient of correlation between stream order and cumulative mean length which lies between +0.85 to +0.97. These values clearly indicate that this model is applicable in its tolality in some basins only while marked departures are presented by a few basins.

It is clear that there is variation of area ratios within the orders of the basins yet there is increase or decrease of area ratios with increasing or decreasing order. It is also apparent that area ratios does not follow any definite rule of decrease or increase with order within the basin. The mean area ratio of 10 sample basins ranges between 1.11 (Murna and Nargara) to 1.21 (Kaser). The co-efficiant of correlation (R) between mean basin areas and order ranges between +0.87 to +0.95. The co-efficient of correlation clearly depicts that the model of basin area v.s. stream order is not validated in its totality and marked departures are noticed in certain orders.

It is clear that Jhiria, Katna, Baghari, Kaser, Sarpha, Gorna, Nagbandh and Nargara basins completely validate the law of allometric growth where all the points fall on the regression lines while departures in a few orders are marked in some basins.

The authoress came to conclusion that in general steeper slopes are destroyed more faster than destruction of gentle slopes and the steeper slopes suffer more from the strains of mechanical disintegration and gravity pull than the gentler slopes. In the present case steeper slopes mainly of valley sides and escarpments are affected by parallel retreat. The final phase of parallel retreat over some of the residual hills has been completed and hence convexo-concave slope profiles have developed over the rounded top hills of central table land where sandstone capping has been removed and weaker shales and mudstones have been exposed. Thus it may be conduded that the scarp zone of Maikal highlands is mainly characterised by parallel retreat of free-face slope profiles, where basalt capped mesa and butte hills and scarps are experiencing this process whereas the hills and hillocks of central tableland, being in senile stage, are marked by the processes of slope decline.

The selected three hill slope profiles viz. Kanchanpura hill of central tableland, Badhwa hill of Northern hilly tract and Maikal hill of Maikal highlands were measured. Kanchanpur hill has gentle, moderately steep and very steep slope elements while Badhwa hill has gentle moderate and free-face slopes and Maikal hill has all the six slope elements. Thus it is clear that gentle slope element is found in all the profiles. In the same way cliff slope element is present in Badhwa (50%) and Maikal hills (11.28%) only while this element is absent in Kanchanpura hill. Moderate and steep slope elements are absent in Kanchanpura and Badhwa hills.

The valley side slope of the major rivers like the Son, the Kunuk, the Sarpha, the Gorna and their major tributaries are subjected to slope processes through slumping caused by both natural processes and anthropogenic factors. The cultivation of valley side-slopes has been responsible for slumping at various places. The valley-side slopes of major rivers mainly over the plateau surface are more stable than the valley sides of the rivers draining through the alluvial tracts.

Thus it may be established that Maikal highlands and northern hill ranges are undergoing the process of parallel retreat of slope through back wasting of free-face element and removal of material from the rectilinear and basal segment through rill wash and gully erosion. It may be opined that structure in general and lithology in particular has played most important role in the development of slopes in different localities of the study region.

The spatial variation of relative relief indicates that Maikal highlands and northern hilly tract are characterised by moderate to high relative relief while central tableland is marked by extremely low and low velative relief. Different statistical measures of dissection index of small sample basins have been arranged which reveal that mean vlaue of all the sample basins fall in the low dissection index class viz. Gorna 0.08, Baghari 0.08, Murna 0.08, Jhiria 0.09, Bhaisan 0.09, Nagbandh 0.08, Kaser 0.06, Katna 0.06, Nargara 0.09 and Surpha 0.09. The standard deviation of the sample basins shows minimum deviation from the mean value because all the S.D. values range between 0.02 to 0.08. The spatial distribution of dissection index categories indicates that the planation surfaces of different altitudes like central tableland, northern hilly tract and Maikal highland are definitely characterised by low dissection index covering an area of 2892 Km^2 which is 78.80% of total area. Similarly the toe zones of escarpments of northern hilly tract and Maikal highlands are marked by moderately low dissection index category with 14.60% of the total areal coverage where as the dense network of streams in northern hilly scarps and Maikal scarps reveals that the dissection index rapidly increases towards the higher altitudinal zones of scarps, hills and ridges.

The authoress prepared superimposed, composite and projected profiles for the entire region which present the panoramic view of the relief of entire region and location of different planation surface on various altitudes. It is apparent from the superimposed profile of the region that planation surfaces are located at 450-550 metres, 700 metres and 900 metres altitudes where accordant summit levels are clearly visible. The projected profile (projected from north) presents a panoramic view of the region whereas the composite profile depicts the skyline surface of the entire region.

There is very high negative correlation between order and number which validates negative exponatial function model of Horton.

It is apparent that a strong positive correlation exists between order and cumulative mean lengths in all the 10 sample basins which ranges between +0.85 to +0.97 and is significant at 1% of probability level. These 'r' values clearly depict that cumulative mean length increases with increase in order and vice-versa. In the study area average slope appears to have strongly controlled the development of drainage net as the co-efficient of correlation of slope with drainage density, drainage texture and stream frequency are +0.72, -0.69 and +0.67 respectively. There is strong correlation among drainage density, stream frequency and drainage texture as is evident from the correlation matrix where 'r' vlaues are +0.81, -0.91 and -0.73 respectively. Basin area, basin perimetre and channel length are significant morphometric variables which determine the shape and size of the drainage basins. These variables have been affected by relative relief, average slope and geological factors. The co-efficient of correlation between average slope and drainage density stands at +0.81 which is high in nature. It may be concluded that order is significantly correlated with number of stream segments, cumulative mean length and mean basin areas whereas a very strong positive relationship exists between cumulative mean length and mean basin area which clearly validates the power function model of allometric growth.

The present study area is located in Gellert's zone of sub tropical hot moist, semi humid-region with developed dry season and rainfall with periodical rivers and dry non perennial rivers. In the present work, the authoress has used morphometric variables for the division of morpho-units of primary and secondary levels. The choropleth maps of relative relief, dissection index, average slope, drainage density, stream frequency and drainage texture have been super-imposed to obtain and demarcate the boundaries of primary and secondary morpo-units, which have been further verified by topographical maps, contour maps and tested during the period of intensive field work. The authoress has divided the entire Shahdol region into three primary and eleven secondary morpho-units.

The geomaterials in the present study region are affected by moderate physical and chemical weathering but these two weathering processes are so intricately interrelated and the biotic factors so positively co-operate with the physical and chemical processes that it becomes difficult to draw a distinct line between these processes. In fact, fluvial processes are the most dominant morpho-genetic processes in the present study region. The Tertiary upliftment added a new chapter in the geomorphic history of fluvial processes by uplifting the old peneplained surface and providing steep gradient to the rivers. The terraces and incised meanders of Lotna and Murna in their upper and middle reaches are the examples of the valley deepening caused by rejuvenation. The Bhaisan and Katna valleys are incised valleys and present a fine example of valley in valley topography, the case of topographic discordance.

The landforms of the region may be primarily classified on the basis of processes which have been responsible for their genesis into two categories viz. (i) landforms due to endogenetic forces and (ii) landforms originated by exogenetic processes.

Mesa and buttes, hills and hill ranges, cut-off spur mounds, tors, incised valleys, rapids and waterfalls, gorges, escarpments, ravines, stony waste, Tanrs and Dons are the major landforms of the region. The uplifted peneplains lying at various altitudes are the characteristic landscape features of the region.

Infact, the entire region is a part of older Gondwana land which witnessed various phases of folding, faulting, warping, seismicity, volcanic erruption, tilting, weathering, mass movement and erosion that has transformed the region into the store house of various landforms of different times and processes and placed the region into a palimpsest.

The detailed study of the region indicates that the region is suffering from the innumerable geo-environment problems of soil erosion, draught, floods, slope failures, ravines, wastelands and deforestation originated from natural and human factors. The dry summer months face severe problems of water scarecity. The foot hill zone of the Maikal highland and the Sohagpur basin regions are badly affected by the process of ravination, because of the malagricultural practices, deforestation and soil erosin. The wasteland is another problem of the region. Road construction in the interior of the hilly areas presents another serious problem.

The region is suffering from acute problems of water scarcity, sanitation, deforestation, illiterarcy, tribal population, lack of industrialisation, ravination, wastelands, slope failures etc. that need immediate solution. Actually the study area is rich in physico-cultural resources where poor people are residing because these resources have not been still exploited and developed due to ignorance, backwardness and illiterate tribal population.

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