

THE STUDY OF HILL SLOPES AND ITS IMPACT ON LANDUSE AROUND SAGAR (M. P.)

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ABSTRACT : The area around Sagar is composed of two different types of rock formation viz. the Vindhyan sedimentary and the Deccan Traps. The evolution of landforms and hills slopes on these two rock formations is also characteristically quite different. The slope profiles of the Vindhyan hills and the Deccan Trap hills were prepared with the help of theodolite and Dumpy level. The characteristics of these profiles clearly show the difference in degree of slope in the Vindhyan and the Deccan Traps. In the Vindhyan hills all the four slope elements are clearly seen while in the Deccan Traps the scarp (free face) is missing. In Vindhyan hills profiles the maximum angle of slope is between 75° to 84°. In the Deccan Traps profiles maximum angle of slope is between 30° to 64°. In Deccan Traps hills the thickness of soil on debris slope and pediment is more than Vindhyan hills. These areas may be well planned. By adopting conservation methods viz. check dams, contours trenches and afforestation the soil profiles of the hills may be improved. The Deccan Trap hills areas may be put under reserve teak forest.

Sagar (23° 50 ' N and 78° 45 ' E) is situated in the north central part of Madhya Pradesh. The area selected for the present study is quite interesting both from geological as well as geomorphological points of view. It is a typical example of those regions of our country where both Vindhyan formations and Deccan Traps are found. The two formations differ in their structural and lithological characters. The evolution of landforms on these two formations is also characteristically quite different. Thus during the study of the geomorphology of the area, slopes in these two formations needed attention and intensive quantitative study. It is thus an attempt to study the actual characteristics of hill slopes in Vindhyan and Deccan Trap hills and to find out various possibilities of landuse to which the different zones of slope along the hills, can be put.

Geologically, Sagar and its surrounding areas fall in the extreme northeastern margin of the extensive Deccan Trap of Peninsular India. Being a marginal area the thickness of Trap is small. According to West (1959) in Sagar area ten flows of Trap have been recognised. But around Sagar, however, in the different Trap hills the number of flows varies. The thickness of different flows also varies from 20 to 100 ft. The Patharia hills on which the Saugar University campus stands comprise of the upper five flows. There is a slight dip in flows in the north direction. The bulk of the Deccan Trap shows a remarkable uniformity in both chemical and mineral compositions. But a variation in mineral and structural characteristics may be noted in different flows.

Around Sagar, one can see a large

number of exposures of the underlying older Vindhyan formations. The formations, met within the area under study, are the hills mainly composed of the Upper Rewa sandstone. The important characteristics of the Upper Rewa sandstone are that it is a massive hard, coarse-grained reddish dark in colour, compact and quite resistant to weathering and erosion and frequently breaks along the joints and bedding plane into cubical blocks. It generally presents a mixture of massive strata.

The author has conducted an extensive field work and has tried to analyse the trend of development of slope elements in Vindhyan and Deccan Traps in the Sonar-Bearma Basin (Rai 1971). The slope elements identified by Wood (1942) as : (1) Crest (2) Scarp (3) Debris, and (4) Pediment may be clearly seen here. During the field study, it was observed that the characteristics of slope elements of Vindhyan hills and Deccan Trap hills vary greatly. In the Vindhyan country most of the hills have developed all the four elements or in some hills they are still in developing stage. It is not a local phenomena but it has also been recognised in other parts of the country (Pandey, 1968). While it is interesting to note that in the Deccan Trap hills the second slope element, viz. Scarp (free face) is not clearly visible between the crest and the debris slope. The whole surface below the crest is covered by the debris.

For the present paper the author has prepared actual hill profiles of some of the typical hills of Vindhyan and Deccan Traps around Sagar, and has tried to analyse the variation in the degree of slope at different slope zones both on Vindhyan and Deccan Traps. It was also observed that at different slope angles how much and of which type the soil and weathered material accumulates. Thus the effect of this soil on the growth of vegetation at different degrees of slope has also been studied.

Procedure of Work

The author selected a few typical hills of the Vindhyan and a few of the Deccan Traps to prepare slope profiles from top of the hills to their bottoms. For preparation of profiles the instruments used were one minute Theodolite (Carl Zeiss) and Dumpy Level and foot staff. With the help of spot height or Bench Mark of the area, the readings for profiles were taken. Eight profiles, four of the Vindhyan hills and four of Deccan Trap have been prepared.

During field trips observations regarding the nature of soil and weathered material at different heights were also taken. The type of vegetation was studied at different heights during the preparation of profiles. The horizontal and vertical scales of profiles are so selected that all the details should be visualized from the profiles.

The slope in Vindhyan Hills.

The profiles of Vindhyan hills clearly indicate that all the four elements of slope are well developed.

Crest: The Vindhyan hills are characterised by fiat-topped surface with slight variation known as crest. The flat tops have a plano-convex surface exhibiting a slight slope towards their edges. The surface at places is covered by a veneer of soil and weathered material in the form of rock pieces. The thickness of soil varies from 2' to 6' and generally contains the mixture of sand. The rills descending down the slope are flooded with the weathered material in the form of solution or suspension. The bedded sandstone which is horizontal is resistant to weathering. The washing of the surface is therefore more rapid than the formation of loose weathered material. The bare rock surface is therefore a common feature. The weathered material accumulates in the hollows and depressions and is conducive to the growth of vegetation. The crest surface is covered with grasses, shrubs, small trees and a few big trees. Being a flat surface the soil erosion could be minimised by Planting

some more trees. As it is the highest part of the hills, it is not of much use. Only by planting some fuel trees the area may be utilized in a better way.

Vindhyan Hill Profile 1

Height in feet	Angle of Slope
1850	38°
1840	49°
1830	51°
1820	63°
1810	74°
1800	65°
1790	60°
1780	58°
1770	50°
1760	48°
1750	18°
1740	8°

Profile 2

1850	55°
1840	45°
1830	82°
1820	82°
1810	75°
1800	70°
1790	63°
1780	62°
1770	57°
1760	25°
1750	10°
1740	7°

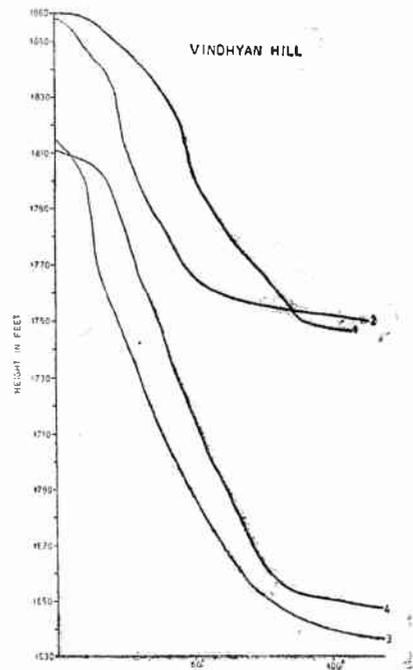
Profile 3

1810	48°
1800	60°
1790	80°
1780	84°
1770	82°
1760	68°
1750	63°
1740	61°
1730	60°
1710	58°
1690	56°
1670	52°
1650	39°
1635	10°

Profile 4

1800	61°
1790	71°
1780	71°
1760	65°
1750	64°
1740	64°
1730	61°
1710	60°
1690	59°
1670	57°
1650	9°

Scarp (free face): Below the crest comes the zone of scarp. In the Profile No. 1 and 2 the scarp face may be noticed at the height of 1800 to 1825 ft. and 1810 to 1835 ft. While in Profile No. 3 and 4 the scarp face is at the height of 1770 to 1800 ft. and 1770 to 1790 feet, respectively. Along scarp face the angle of slope is maximum from



75° to 84°. The zone of hill looks almost vertical in the field. The scarp surface is composed of bare resistant massive Upper Rewa sandstone having joints and cracks. Since the zone has a steep slope, the soil does not accumulate and the surface is completely devoid of vegetation. Only few shrubs and trees are noticed along the joints and cracks of the rocks. The Rewa sandstone is massive, so the scarp face is exposed in the form of steps of cubical blocks. It is a bare surface with steep slopes so there are no possibilities of any kind of soil accumulation. The soil produced on the crest is completely washed downward due to gravitational force and running water. It is almost a bare surface.

Debris : In Vindhyan country below the scarp comes the zone of debris, which has less slope in comparison to scarp. The height of the debris zone varies in different hill profiles. In the Profile No. 1 and 2 the height of debris is from 1755 to 1800 ft. and 1765 to 1810 feet. While in Profile No. 3 and 4 from 1690 to 1770 feet and 1690 1770 feet. The slope angle along the debris varies from 45° to 75°. The thickness of soil decreases from low angle to high angle. In Vindhyan hills the thickness of soil on the debris is found from 4 " to 8 " with coarse sand and angular rock pieces. Having gentle slope and good accumulation of soil, this zone is thickly covered with grasses, shrubs and some big trees. The growth of grasses and shrubs along the debris slope arrests the washing of soil during the rainy season. It is the best zone of the hill where the proper planting of trees may give more profitable land use of these hills. These hills are the chief source of fuel and timber to the rural population settled in the adjoining areas. Under conservation practices this zone of hill slope can be converted into a flourishing plantation of commercial trees or may even be made into rich pastureland. The growing of good quality grass will help

in two ways. It will be a good fodder for bovine population and it will also arrest the soil erosion. Due to illuse the hills just north of Sagar city are completely devoid of vegetation except for scanty grasses and shrubs. Due to over grazing and bare surface the soil erosion is vigorous particularly in the rainy season. Although along Vindhyan hills the quality of soil is poor. But it could be utilised by proper plantation of some good quality trees.

Pediment : Below the zone of debris slope is a broadly concave surface developed by the hill side recession which has been designated as a pediment surface. The profile No. 1 and 2 clearly indicate the zone of the pediment at the height of 1745' to 1755 feet and 1745 to 1765 feet. The angle of slope varies from 5 to 20 degree. In the Vindhyan hills the pediment surface has a slight slope from below the debris. In this zone also there is a soil deposit in the form of fine to coarse material. Due to ill practices of local people, the surface is almost bare with a little cover of grasses and few shrubs. Proper planning of the area may help in the good use of the land under cultivation. Along the pediment surface generally coarse crops are grown. By providing irrigation facilities and by use of fertilizers etc. the land may be brought under agriculture.

Degree of Slope in Deccan Trap Hills

It is interesting to mark the distinction between the slope elements of Vindhyan hills and Deccan Trap hills. In Vindhyan hills all the four elements of hill slopes are clearly visible. While in the Deccan Trap hills the second slope element viz. scarp (free face) is not clearly marked. The surface between crest and debris is completely covered by debris.

Crest : In the Deccan Trap country the hills attaining a height of 1500 ft. and above are characterised by a flat topped surface known as crest. The crest of Traps is more

flat than the Vindhya's which have only a little slope towards the edges. The surface is covered with thick reddish dark brown soil and weathered material in the form of laterite or lateritic soil. The soil found on the crest is more productive than that on the Vindhya's. The mineral contents include magnesium, sodium, potassium and iron. In the rainy season the surface soil is washed downwards in the form of rill or gully erosion. The rills descending downward are flooded with the weathered material in the form of solution or suspension. The surface is covered with thick grasses, shrubs, and a few big trees which obstruct the free flow of water and thus the soil erosion is minimised. Due to cutting, of the trees the surface looks barren. A proper tree planting in the area may be taken up. The Deccan Trap soil is very much favourable for the teak plantation. The climate of the region is also good for growth of teak trees.

Deccan Trap Hill
Profile 5

Height in feet	Angle of slope
1990	57°
1980	59°
1970	60°
1960	64°
1950	61°
1940	58°
1930	57°
1920	55°
1900	49°
1880	48°
1860	46°
1840	45°
1820	42°
1810	22°

Profile 6

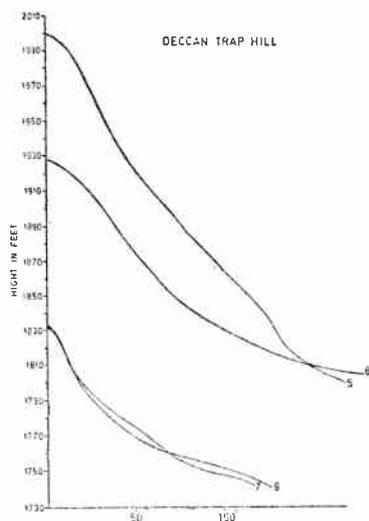
1820	52°
1810	59°
1800	64°
1790	52°
1780	41°
1770	39°
1760	29°
1750	16°
1740	12°

Profile 7

1820	54°
1810	64°
1800	63°
1790	48°
1780	40°
1770	37°
1769	36°
1750	17°
1740	13°

Profile 8

1930	32°
1920	38°
1910	52°
1900	57°
1890	53°
1880	51°
1870	49°
1860	46°
1850	42°
1840	33°
1830	26°
1820	34°
1810	17°



Debris : Immediately below the crest the slope gradually decreases and the debris slope continues to a long distance. The scarp face is not visible. The angle of slope on the debris slope varies from 64° to 30° . The height of debris surface in Profile 6 & 7 is from 1760 to 1800 feet and in Profile 8 is from 1840 to 1900 feet. The thickness of soil varies from 8" to 15" in the form of lateritic soil reddish dark in colour with some pebbles of rocks. It is the zone where large amount of eroded soil accumulates and due to thick deposit of soil the growth of grasses and shrubs is thick in comparison to Vindhyan. It is noticed that the thick cover of grasses and small trees stops the washing of surface soil during rainy season. Varma (1966) has suggested some measures for the conservation of soil erosion. In this zone of slope, soil and moisture of the area, however, encourage natural forest growth. These hills are the source of fuel and timber to rural population of adjoining areas. Due to ill-use the scanty forests are

badly cleared and they are now just barren surfaces. Thus having a thick soil deposit on this surface, the proper plantation of good quality trees like teak and growing of grasses will be a good fodder for the cattle. The plantation of teak will also increase the economic potential of the region.

Pediment : The surface below debris is a broad slightly concave surface developed by the recession of the hillsides known as the pediment surface. The profiles indicate that on this surface the angle of slope varies from 10° to 20° . It has smooth surface with little variations in relief. In Deccan Trap hills it is an extensive surface covered with thick black soil derived from crest and debris surface. This zone has also become almost devoid of vegetation. These are the grazing land for local bovine population. At places some land is under cultivation. Pediment surface is rich in black cotton soil and the land may be brought under permanent cultivation which will increase the economy of the region.

Conclusion

The above discussion brings out the distinction in the slope elements of the Vindhyan and Deccan Trap hills. There exists a vast field for the future studies on the quantitative analysis of hill slopes in the area. These studies may throw some light on the evolution of the Vindhyan and Deccan Trap hill slopes. The present study has merely initiated discussion on the planning of the area. By adopting some soil conservation methods, viz. check dams, contour trenches and afforestation the soil profiles of the hills may be improved and the land may be brought under proper land use. This will help in solving the food problem of growing population.

Acknowledgements

The author is grateful to Dr. (Smt) Pramila Kumar, Reader in the Department of General and Allied Geography, University of Saugar for discussion and valuable suggestions made in the preparation of the present paper.

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