

**MORPHOLOGY, LAND UNITS AND LAND USE STUDIES THROUGH
AERIAL PHOTOGRAPHS OF PARTS OF ASIFABAD AND SIRPUR
TALUKAS IN ADILABAD DISTRICT, ANDHRA PRADESH**

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ABSTRACT : Aerial photographs on a scale 1:60,000 (approx.), and landsat imagery (band 5 & 7) on scale 1:250,000 were interpreted for an area of about 725 sq. km. of parts of Asifabad and Sirpur taluks in Adilabad district, to study landforms, soils, water resources, land use and land cover, and their limitations and capabilities. Taking into consideration the slope angles, land units were demarcated from the toposheet on a scale 1:63,360. A few slope measurements were made at a few selected places in the field. Field reconnaissance survey was carried on to check the results of cropping patterns, land cover and soils, besides identifying geomorphic hazard zones. Morphologically the area is divided into (1) hills and flat upland terrain, (2) piedmont zone, (3) rolling plain and (4) fluvial plain. Sandstone, limestone, shale and basalt are the chief rock types, and sandy soil, alluvial soil and red earth are the soil types. Land use and land cover was classified into 13 types. Landforms, soils and water resources control the land use and land cover which are closely related. A few recommendations are made to ensure optimum utilisation and management of land resources.

INTRODUCTION

Even where a country is endowed with plenty of natural resources, a systematic planning is needed for proper utilisation of these with least disturbance to the environment. Planning for resource utilisation of an area requires a detailed knowledge of the landscape, i.e., landforms, slope, material, water (surficial and subsurface) and land cover and also current land use. The area studied is under semi-arid climate subjected to droughts. This work being the first attempt aims to study landforms in this area and correlate them with land cover and land use. Similar studies were made by Prudhvi Raju and Vaidyanathan (1977) in the coastal

district of Andhra Pradesh (Krishna Dist.). Iyer et al (1975) conducted a study on similar lines in the Hoshiarpur district of Punjab.

An area of 725 sq. km. between $19^{\circ}15'$ and $19^{\circ}30'$ N latitude and $79^{\circ}15'$ and $79^{\circ}30'$ E longitude was taken for the study. Broadly the area can be divided into two physiographic units; plateau and its remnants, and plains. The highest elevation is 630 m above M. S. L. (Rauta Guram Rajul Gutta) in the southwest. A majority of the hills fall in between the range of 330 m and 450 m. In the northeastern part of the area are some remnants of plateau with flat tops like mesas. There are a few

isolated hills in the northwest and southwest. The rest of the area is occupied by inland plains with the local base-level ranging between 170 m and 240 m above M. S. L.

The annual average rainfall is 995 mm. About 85% of the rainfall is received during the southwest monsoon, July being the rainiest month. December is generally the coldest month. The minimum temperature may sometimes go down to about 9°C (48.2°F). May is the hottest month and the temperature may go upto 46°C (114.8°F).

Pedda vagu is an ephemeral master stream, with its tributaries draining the area. Besides, there are many intermittent mountainous streams and a few springs flow down to join the Pedda vagu stream.

Limestone, shale, sandstone and basalt are the chief rock types. Shales, limestones and to some extent sandstones of Penganga and Sullavai series of the Proterozoic usually have a fine red or grey loamy soils over them (Anon. 1976). The soils over the Barakars and Kamthi are coarser and reddish, while those on the Talchers are fine sandy with an yellowish tinge. The thickness of the soils over these Gondwanas extend upto 2.5 m, while on the other formations it rarely exceeds 0.5 m.

METHODOLOGY

Aerial photographs (1:60,000), landsat imagery (Band 5 & 7) and toposheets (1:63,360) are the main tools used in this study. The features identified from the photos are transferred to toposheet. A few reconnaissance field traverses were made to identify and study the composition of material and crops, and the level of water table at different locations. The heights of river banks and terraces, the gradients of fans and piedmont deposits and the dips of strata are measured in the field.

OBJECTIVE

The objective is to identify landforms, land units and land use and also soil groups and correlate the relationships among them and to suggest a few recommendations.

GEOMORPHOLOGY

Geomorphologically the area can be classed into 4 units – (1) hills and flat upland terrain, (2) piedmont deposits, (3) rolling plain, and (4) fluvial plain. (Fig. 1).

Hills and flat upland terrain : Remnants of plateau (flat tops) and denudational isolated hills are the common features with relief. The highest elevation is 630 m above M. S. L in the southwest. The hill in the southwest which is composed of limestone overlain by Traps looks like stepped surface. The dip of the beds towards northeast is 21°. Broad rounded crest with steep scarps are the prominent features. Common slope elements on the hills are scarp face (free face), debris slope and piedmont slope. The northeastern part of the area is a near flat highland with these three slope elements. But the scarp face is not continuous all along the boundary of the unit. The highland in the northeast is composed of sandstone, limestone and shale which is partly overlain by Trap flows. The sandstone beds dip 22° towards northeast, whereas the shale and limestone beds dip 20° towards north and northwest. The tops of the hills are almost flat, but rounded crests are exposed where the Trap material is completely eroded. At the periphery of the unit, the shale and limestone are exposed with high ruggedness and steep sided gullies. Scree is the predominant feature in this unit. Two or three layers of trap flows are identified in this area but their extension is not clear.

In between the hill ranges and flat upland terrain, there are denudational hills. Their heights range between 300 to 405 m. These are made up of both shale and

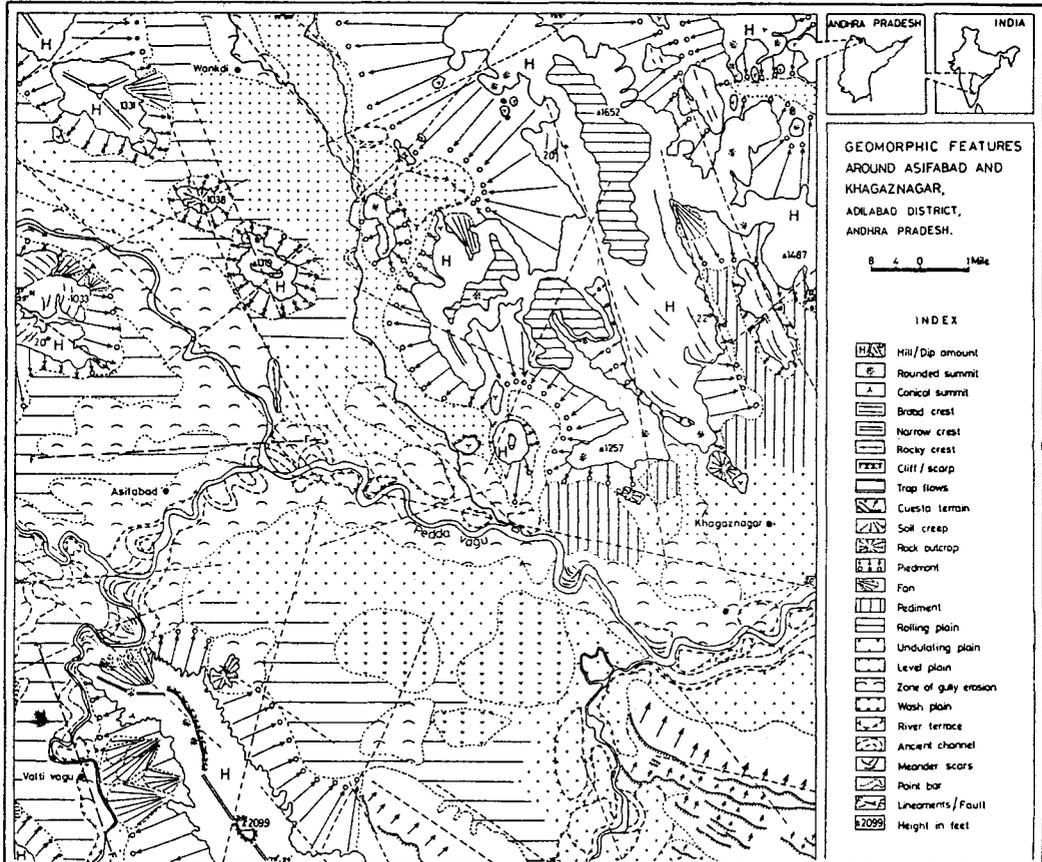


Fig. 1 : Geomorphic Features Around Asifabad and Khagaznagar

limestone. Comparatively more dissection is noticed in the shale than in the limestone. The shale is of a brittle and platy nature. Scarp face is almost absent. Exposed bare surfaces result because of soil creep. Skeletal soils are formed over these hill slopes. In the northwest is a limestone hill of 310 m, the crest of which is nearly flat. There is a slight displacement in the bedding due to a fault. Along the Pedda vagu stream section, antiforms of limestone and shale are exposed at ground level, and it is about 7 km north of Asifabad. The general dip is towards northeast.

In the southeastern part, gently dipping outcrops of sandstone are noticed and they dip towards northeast with an angle of 8° to 10° . There is negligible development of soil here.

Piedmont deposits : Except for a few number of conspicuous bulging forms like fans, the foot slopes of the hills are rimmed with unassorted material. There are sandy gravel. The zone descends with an angle of 2° to 5° except where the fans are present. The fans are differentiated from the surrounding terrain because of this convex form at the top. Mainly along the shale terrain, due to their susceptible nature to erosion, fans are formed by headward erosion and deep dissection by a number of streams. The thickness of the deposits visible at the stream cuttings is about 5 to 6 m. The thickness decreases towards the rolling plain, the next adjoining unit, with minor fluctuations. The material is angular to sub-rounded. The material along the hills is made up of colluvium in the western part and the gravel is mostly made up of kankar nodules (calcium carbonate) on the piedmont zone. A few relics of soft material. i.e., red earths and marl, in the form of mounds are left out. They become jelly-like when water is added to them. They are recognised by their light tone with fine texture on aerial photographs. The piedmont deposits are carried down by sheet flood, except at a few locations, concentrated drainage carries material

and distributes them into fan like forms. Drainage on the piedmont slope is incipient and sub-parallel.

Rolling plain : The plain shows rolling nature with an altitudinal variation ranging from 15 to 20 m. This phenomenon is due to the fact that a number of streams cut and form very wide interfluves. The composition of the plain is the same as that of the material along the hills, with decreasing percentage of gravel away from the hills, and this unit enters the fluvial material. Kankar nodules and tubular forms are very common. A few pebble layers (2–3) with irregular rock pieces at a height of 2 to 3 m from stream beds are indicative of fluvial action. This may be in this area due to sheet flood action and gravity rather than due to concentrated linear flows.

East of the hills is sandstone terrain predominantly composed of sandy soil which shows smoother undulations. The lows of the rolling plain containing comparatively finer material have gentle gradient with conspicuous break of slope with the 'highs' of the terrain. The erosional remnants of bevelled cuesta beds are exposed and stand high and dip towards northeast. The coarse brittle sands are the result of weathering on the exposed rock beds. At some places, for example, from east of Nowgaon to north of Rebna, the highs are prominently seen as rock-cut pediments. Lateritic gravel spreads over these pediments. The pediment close to Pedda vagu has a very gentle slope and the surface has been highly weathered. The water table is rather shallow because of rise of water in the numerous fine orifices in the sediment.

Major part of the terrain is composed of red earths, which is overlain by grey and black loamy soils at some places. Wash plains are confined to red earths in this area. With smooth surfaces on the mounds fine sediments (clay) get settled in the lows of wash plain. The red earths are very compact in their form and have a conspicuous

angular relation to the plains around them. This is so because of fine clay and silt composition of the red earths.

Fluvial plain : This is formed by fluvial action. The materials which were being deposited during the floods and get washed out in subsequent high peak flow, show evidence of the fluvial action. Differences in degree of dissection, forms, material composition and colour, are taken into consideration for classifying the unit into undulating plain, level plain, and dissected plain. In the undulating unit, the altitudinal differences range from 10 to 15 m. The mounds have a smooth surface with a few rock pieces strewn over. This unit is nearly flat except where cut across by streams. The material is black sandy loam to loam. The thickness of the material increases from rolling plain towards major stream beds. At the stream banks the thickness is about 25 to 30 m whereas at the peripheries of this plain which merges into the rolling plain, the thickness is 0.25 to 1.20 m. Two to four layers of pebble beds with individual layers of thickness of 30 cm to 90 cm are seen in the bank sections. The lowest layer is usually composed of large size material. For instance, near Bambara, 7 to 8 km to the NNE of Asifabad, the pebble beds are in 3 to 4 layers at the nose of an antiform. The layers are composed of material ranging in size from pebbles to boulders. The boulders are white in colour with a few grey. Most of them are derived from limestones and a few from quartzites. The soil over the fluvial plain is rich in organic material and the water table is shallow. Kankar material spreads unevenly on this unit. All along the course of Pedda vagu stream, dissected lands can be seen exposing unconsolidated material.

MISCELLANEOUS LANDFORMS

Piedmont fans : These landforms rest at the foot of the hills in the piedmont zone, and they are part of the rolling plain. They are distinguished from the piedmont zone by

their convex form. The slope ranges from 4° to 8° . The material is colluvium with a skeletal soil. Though streams mainly bring down the material and spread them at the foot slope occasionally surface creeps also occur. 10 km to the southeast of Asifabad, two stages in the development of fans are seen. It looks as though the lower one might have been due to fluvial action and the upper may be due to landslides. The Vatti vagu stream scoopes out the material from these units. Hence, steep scarp on the undercut slopes with a height of 25 to 30 m are seen within the fans. On the whole the fans are moderately dissected.

River terraces : These are minor in extension and are unpaired terraces. These are composed of sandy loam and are 0.5 to 1.0 m in height above the stream beds. Many them mainly along hill streams are temporary as they have been formed by sheet floods. Meander scars could be recognised over them.

Point bars and ancient channels : Point bars which are composed of sands are inside the meander of Vatti vagu (slip off slope) 8 km to the southeast of Asifabad. They are arranged in a curvilinear series parallel upto the present river course. The material is coarse sands with a little fine material. Ancient channels exhibit darker tones on aerial photographs, whereas the point bars with their close relation to streams, exhibit light tones. Ancient channels indicate the earlier stream courses. They are relatively at higher levels to the present course. The fineness of material decreases at lower levels.

Lineaments : These appear on aerial photographs as straight linear features. These may or may not be mega fractures/faults, but are known to be loci for substantial quantity of groundwater.

LAND USE AND LAND COVER

Land use and land cover is classified into 13 categories based on their loca-

tion, density of vegetation and human activity over them through the study of aerial photographs and supplemented by field observation. Land use is a cultural phenomenon whereas land cover is a natural phenomenon. As a whole the land use and land cover noted here is as it was at the time the photographs were taken. Minor details could not be mapped as the scale of the photo is too small to register/recognise them. Their classes are (1) hilly dense forest, (2) hilly moderate forest, (3) hilly sparse forest, (4) pediplain dense forest, (5) pediplain moderate forest, (6) pediplain sparse forest, (7) fluvial plain wet crops, (8) fluvial plain dry crops, (9) pediplain dry crops, (10) scrub vegetation, (11) barren land, (12) plantations, and (13) urban land. (Fig. 2).

The ruggedness of the terrain, deep water table and torrential floods are the hinderances for any successful farming to be conducted in this area. Majority of the area is cultivated for dry crops except in a few pockets of fluvial plain where wet crops are grown. These crops are usually cultivated in two seasons, kharif and rabi. It indicates that they are rain fed. Maize is next to jowar as the main crop. A few are rice fields which are adjacent to the river courses, at 5 km to the south of Asifabad and about 2 km to the north of Nowgaon. The fertile alluvial soils can support wet crops but lack of proper irrigation facilities necessitates growing of dry crops. Loamy red soils and alluvial black soils support only these dry crops.

Rolling plain is the major unit for commercial crops. But this plain is not intensively used for these crops, and only the uplands are used for these crops. Chalka (sandy soils and red earths) and Dubba (loamy soils) soils are confined to this plain. The chief varieties grown here are greengram, horsegram, redgram, sesamum, linseed, and castor.

Mango, cashew and banana are grown on piedmont zones with sandy soils.

Around Sirpur, Khagaznagar and west of Rebna and south of Asifabad, mango and eucalyptus plantations grow on uplands adjacent to sandstone terrain. Around Khagaznagar and southeast of Sirpur and north of Asifabad vegetables like brinjal, tomato, cauliflower etc., are grown in fields irrigated by well and tank.

In urban category, industries, mines roads and railway lines and settlement form a major part. Coal mines to the northwest of Tandur, Sirpur paper mill and Sirsilk textile mill provide employment to substantial number of people here. A new cement factory will be going into production shortly constructed very near to Asifabad. Balharsha-Delhi broad gauge railway line and a number of state highways pass through the area.

A big reservoir is going to be completed across Vatti vagu which is a tributary of Pedda vagu, 8 km to the south of Asifabad, between limestone hills. A few small tanks are constructed at the break of slopes on piedmont zone.

Scrub vegetation appears along river courses where dissection by gullies is quite prominent. The terrain has no soil formation due to severe erosion by gullies. Fine material deposited during floods are carried down stream leaving coarse skeletal material on this unit. A few pockets of land is barren due to occurrence of lime (calcium carbonate) mounds, and soil creep disturbing the stability of top soils is the other reason.

The forests in the area are dry deciduous. In general dense forests occupy the land of hill ranges and piedmont areas usually of limestone and shale terrain. Break of slopes and the junctions between successive deposits on the hillside, are favourable to thick vegetation. It is perhaps due to availability of enough water and different soil constitution/mineral components derived from different layers at their lithological boundaries. The piedmont zones and zones

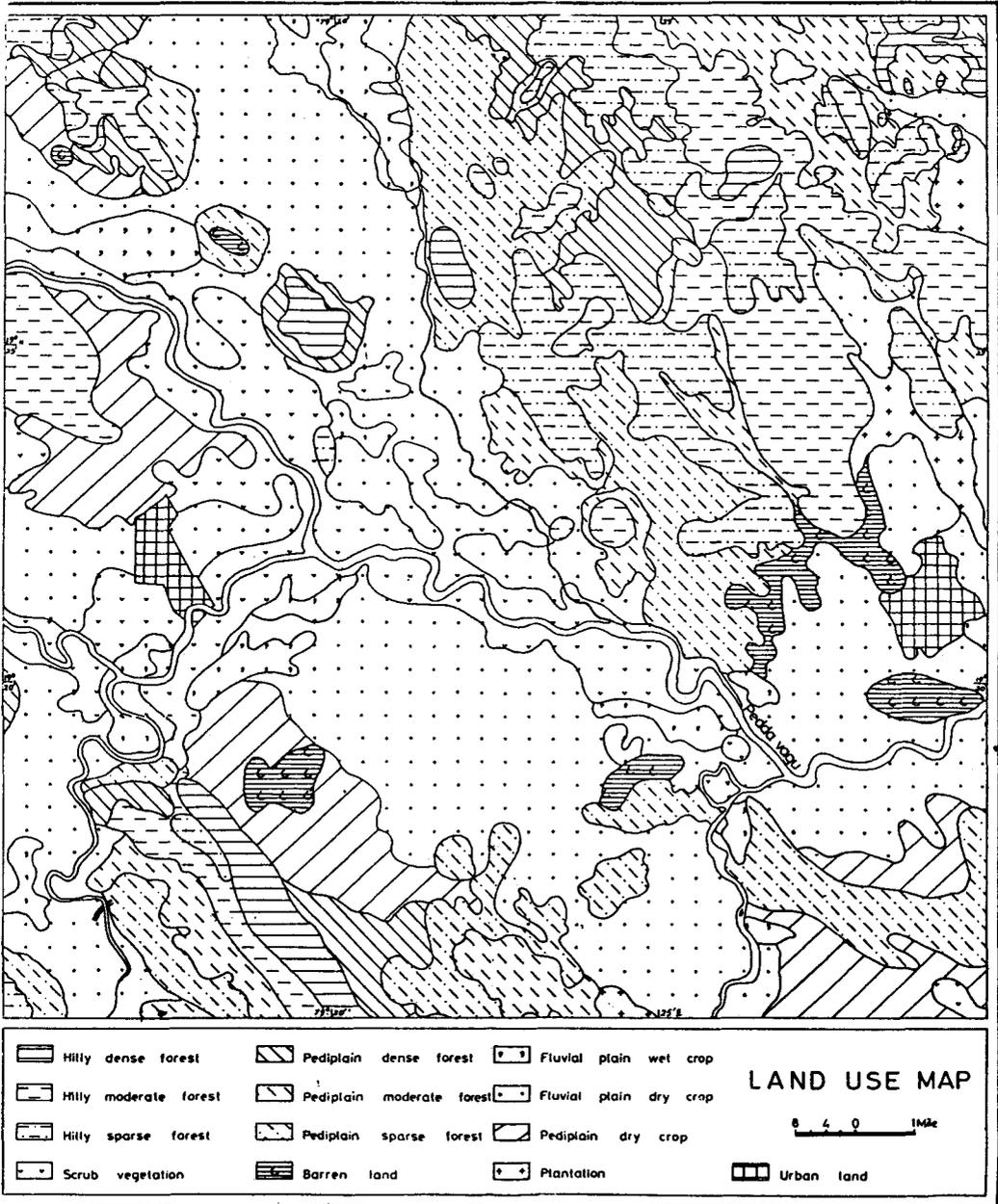


Fig. 2 : Land Use Map

a little above the debris slope support moderate natural vegetation. Here the existence of a thick soil horizon is the cause of this growth. Sparse vegetation is seen on residual/remnants of hills in shale terrain. Rapid soil creep and mass wasting are the reasons for lack of vegetation here. Wherever soil can withstand on slopes at a few pockets on this terrain, scrub vegetation grows. This is because of hollow areas on the slopes where water is collected and weathering also takes place with soil formation.

The principle forest produce are timber, fuel for domestic and industrial consumption, beedi leaves, bamboo etc., timber of various species like tedu (*tectona grandis*), Nallamaddi (*Terminalia tomentosa*) Yegi or Bijasal (*Pterocarpus marsupium*), Ippa (*Madhuca latifolia*), Tumki (*Diospyros melanoxylon*), Maredu (*Aegle marmelos*), etc., being important. Bamboo is the main forest produce.

Common shrubs are Tangedu (*Cassia auriculata*), Parijatham (*Nyctanthes arbor-pristis*), Danti (*Gymnosporia montana*), Palabariki (*Holarrhena antidysenterica*), etc.

LAND UNITS, CAPABILITY AND LIMITATIONS

The land capability in the area is poor. This can be partially overcome by adding organic manures and improving irrigation facilities. In addition, it is suggested that in the red earths, adding of coarse textured sandy soils may give better results in that they increase permeability and porosity of the soils to retain more water.

Land units are classed/demarcated according to classified slope units. In each land unit there is a possibility to have minor variations, but all of these cannot be taken into consideration. (Fig. 3).

CONCLUSIONS

1. A full understanding of landforms, soils, drainage and current land use in this area is essential to planners for future planning, in a proper way. This will help check losses of soil, drainage, etc., and so as to utilise the land upto optimum level.
2. Planners must be aware of serious erosion hazards of the soils, especially along major streams and hill slopes. The erosion can be reduced/nullified by growth of vegetation which aids in stabilising the slopes. Particularly along stream courses, the gullies can be blocked by stuffing with hay and useless fibrous material to preserve the soil of the land. It is therefore necessary that levelling up of dissected zones, by the gullies, is done. On higher slopes natural vegetation should be grown intensely while at the same time prohibiting deforestation by all means. Deforestation, if considered necessary anywhere, should be regulated by retaining the lower parts of trees (pods) in order to enable the roots to hold the soils firmly together.
3. Drought resistant and deep rooted grasses should be cultivated on banks of streams.
4. As the area has a potential to develop more surface water facilities a slope map of the area will aid in the planning of construction of minor tanks, reservoirs etc.
5. The groundwater should be exploited from favourable sites and used judiciously. Ancient channels, fracture zones and weathered areas are the most promising sites for wells.
6. It is advisable to avoid construction of large scale structures over lineaments, particularly if a stream is also flowing along or close to it. In the near future, the river might

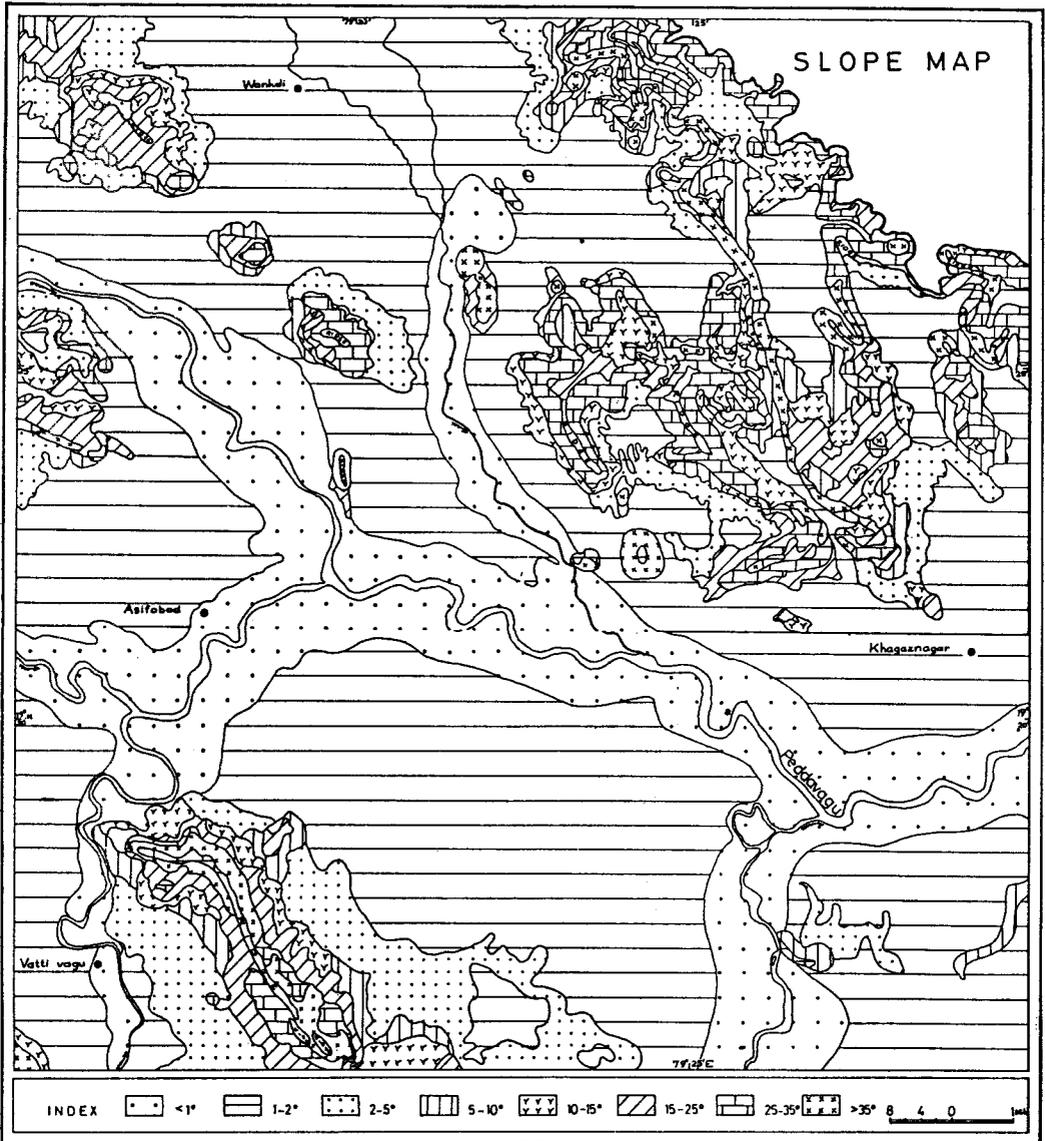


Fig. 3 : Slope Units

undermine the foundation of any structures built on them by flowing along the lineaments.

7. The accessible forests in the plains as well as on gentle slopes should be under intensive managements and are to be exploited systematically under different silvicultural systems appropriate for the locality
8. Where possible, areas of scrub may be converted to a pasture land provided adequate amount of moisture is made available and proper

methods are adopted in this change of land use.

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REFERENCES

- Anon. (1976). *District Gazetteers of Andhra Pradesh, Adilabad*, printed by Government of Andhra Pradesh, Hyderabad, pp. 3-19.
- Iyer, H.S., Singh, A. N. and Ramkumar. (1975). Problem Area Inventory of Hoshiarpur District through Photointerpretation, *Photonirvachak*, Vol. III, No. 2, pp. 79-86.
- Prudhvi Raju, K. N. and Vaidyanathan, R. (1977). Study of Landforms, Land use and Land units of a part of Krishna District, Andhra Pradesh from Aerial Photographs, *Jour. Ind. Soc. Photo. Int.* Vol. V, No. 2, pp. 41-46.

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