GEOMORPHOLOGY AND LAND-USE
A CASE STUDY OF MEWAT

Dissertation submitted to the Jawaharlal Nehru University
in partial fulfilment of the requirements for the
award of the Degree of
MASTER OF PHILOSOPHY

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I certify that the dissertation entitled "Geomorphology and Land Use - A Case Study of Mewat", submitted by Mr Deen Mohammad, in fulfilment of six credits out of the total twenty four credits for the Degree of Master of Philosophy (M.Phil). of this University, is to the best of our knowledge, his original work, and may be placed before the examiner for evaluation.

(Chairman) (Supervisor) (Supervisor)

21.7.82.

A C K N O W L E D G M E N T

Sometimes words fail to express one's real gratitude, since acknowledgment is not mere play of words, but an attitude of mind, and now I am facing such a task.

My thanks are due first and foremost to my supervisor Dr. (Mrs.) S. Padmaja, who took a keen interests in this research work from its inception, and offered valuable suggestions and scholarly insight at every stage of this work. I am also thankful to Dr. Pratibha Mishra, who co-operated me in the last stage of this work.

Besides, I am very much indebted of the two big personalities, one is Professor Mumtaz Khan, who have been a continue source for me for the last 5 years as he has helped me through all the reliable means. Another is Professor Moonis Raza (my Prelim. and chief supervisor) with whom to express the sense of dedication and affection is completely beyond the capacity of my words. He is very much interested to bring us at the level, so that we could compete ourseleves from rest of the world. And that is why, I am very much indebted to him.

Besides, I am also indebted to Professor Bhalla, S.K. Thorat & Dr. Chadha, who helped me in managing my expenses through their projects last year. I would also like to thank all of the CRD teachers, especially for Prof. Aijazuddin Ahmad and Dr. K.S. Shivaswami, as I have found some human values in them.

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Among rarely friends, I have; I would like to mention some of the names in whom, I have found the reliable human talks. These are Mr. Qasim, Ajay Rajoria, Hashmi Gheyas, Imtiyaz, Rahim, Akhilesh Trivedi, Benjamin, Roy, Rath, Parveen & Tyagi. In addition, some of the others are equally able to be given thanks such as Mr. Yasin, Sachi, N.R. Das and Alam.

In the end, I must say that I will endeavour and incalculate philosophy, principal and practices of geomorphic research in the future proves of my learning. And now, with the name of God most gracious, most merciful who will lead us from the darkness, in lighting through learning, I would sum up.

Deenmohammad

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CHAPTER - I

CHAPTER - I

General Introduction

"Geomorphology which is concerned with landforms, materials and their related processes, is pertinent in all aspects of environmental management involving the physical phenomena. Significant advances in the mapping of a land's geomorphic characteristics have added an invaluable tool in assessing the potential of land for development, and in providing a valid basis for land use planning. Geomorphic processes do not operate in isolation. They are generally a part of a whole system of interacting phenomena.[1]" This interaction among different phenomena gives rise to various culturnl set ups over the surface among which Landuse is one of the most important aspect in which the geomorphic parameters play a significant role .

In a presidential address to the S.African Geographical Society, Dixey[2] stressed the need for more geomorphic studies to be oriented towards the needs of man - the necessity to understand geomorphic processes

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1. Cooke R.V. & Doornkamp J.C. (1974) 'Geomo. in Environmental Management' - Clarenoton Press Oxford pp.1-7.

2. Op ct pp.2.

has now been amply demonstrated in situation that involve such things as flooding, landsliding, soil erosion by wind or water, coastal erosion & deposition. Geomorphologists are increasingly realising the value of their work in the solution of applied problems & they are making some singularly important contributions. The identification of geomorphic units under landsystems mapping has given the needed impetus to tackle some of the environmental problems of these, landuse studies are the most important, which seem to be highly correspondent with geomorphic units. Such an intricate relation between Geomo. & landuse provide a detailed framework to assess the role of geomorphic parameters over landuse - One the relation is established, then it becomes easier to evaluate the critical levels beyond which the agricultural productions have to become restricted.

Literature Survey:

The past decade has witnessed an increasing change in the mode of landsystem studies in Geomo.

The geomorphological studies related to our topic of research "Geomorphology and land-use" can be considered into three stages:

1. Morphology and land systems in which mapping of geomorphological units have been done.
2. Correlation Analysis and
3. General distribution of land-use in a region.

1. Mapping of Geomorphological Units:

The very early researchers stressed their work on studying the landform units after analysing the topographic maps and their cartographic representation on detailed geomorphological maps. Thus, the regional variation in the units were characterised by their uniform shape, homogeneous geological structure and present day processes. Some of the interpretation elements include the degree in dissection of the terrain, drainage pattern, valley form and other erosional features. The landforms were grouped under various geomorphological units based on their genesis and processes.

The land system units were first made by Division of the land-use Research, CSIRO, of Australia taking morphology of region as a base, but the data used were the air-photographs. Using aerial photographs, a few studies on geomorphology have been carried out in different parts of our country also. Such studies have been utilized in the improvement and development of the region.

The purpose of studying the land system, being same as it was in the early stages. The difference is only of the data base and the tools, which used or are being used today.

In the second half of the 20th century, the source of the data base remained as the topographic sheets.

But as the modern technology and air-surveying is developing day by day, the technique of air-photo-interpretation is also being adopted in an enlarged scale. The geomorphological works, using topographical maps were as follows:

Gardiner[1], in 1972, has studied a morphometric approach to land-form aspects of land classification. In 1974, he studied the landform and land classification in North-west devon. Again, 1976, he studied land-evaluation and the numerical delimitation of Natural Regions.

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1. Gardiner V (1972) - A Morphometric Approach to Landform Aspects of Land - Classification - Unpublished Ph.D. Thesis, University of Exeter.

   Gardiner V. (1974) - Landform and land classification in North-West Devon. Reports and Transactions of the Devon-shire Association for the Advancement of Science. 106. pp.141-53.

   Gardiner V. (1976) Land Evaluation and the Numerical Delimitation of Natural Regions. - Geographia - Polonica 34, 11-30.

Mumta Desai[2], in 1976 has made a brief geomorphological accord of the South Koal Basin in Poona district.

Pandey (1965)[3] has studied topographic maps and interpreted the geomorphology of Jalore and Adjoining Regions in Rajasthan. In 1969, he[4] again worked on some of the aspects of Arid zone geomorphology.

Sharma[5](1970) had surveyed and studied the geomorphology of Ramgarh dome in Jaipur district.

Kayerkar and Wadhawan[6] have both studied on geomorphic classification of terrain.

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2. Mumta Desai S.M. (1976) A Brief Geomorphological Accord of the South Koal Basin, Poona. Geographical Review of India, Vol.38 No.3 & 4 pp.374.

3. Pandey S (1965) : Geomorphology of Jalore and Adjoining Regions in Western Rajasthan - Annals of Arid Zone Vol.4, 1965 pp.73-83.

4. Op.Cit.

5. Sharma H.S. (1970) : Geomorphology of the Ramgarh Dome, Rajasthan 'Geographical Review of India Vol. 32 No.3 pp.186-194.

6. Kayrkar (M.V.) and Wadhawan (S.K.) (1972) "A Geomorphic Classification of Terrain - Deccan Geographer - June 1972.

Enayat Ahmad[7] (1958) viewed on geomo.. of Chhota Nagpur plateau in Bihar.

Thus, all these above mentioned workers have delimited geomorphic regions on the basis of topographic sheets and described landforms respectively.

In the first procedure of first stage of interpreting the landscape aspects, topographic maps of the area were used to study and the broad and distinct patterns of relief were indicated by the help of contour lines.

Ghose[8] in 1965 studied geomorphology of Kitnod village and then, showed a distribution of available land-use in the village.

Christian and Stewart (1953) proposed a technique of carrying out reconnaissance resources surveys, applying geomorphology to divide land areas into land systems and land units on the basis of morphology, origin, chronology and dynamics.

Again, Subramanyam[10] of centre of Studies in Resources Engineering I.I.T. Bombay made out the land system units,

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7. Ahmad, Enayat (1958) : Geomorphic Outline of Chhota Nagpur, Geographical Outbook, Vol.2 pp.16-22.

8. Ghose B. Singh (1965) - Observations on Geomorphology and land-use of Kitnod village - Geographical Review of India Vol.(3) pp.144-156.

9. Christian C.S. and Stewart G.A. (in Gunn. R.H. et al 1969). Lands of the Queandeyan - Shoalhaven area. CSIRO publication, Land Research series No.25 pp.1-164.

10. Subramanyam V. (1978) - " Land System Studies for Resource Evaluation" - A demonstration Around Sagar, M.P. PHOTONIRVACHAK Journal of Indian Society of Photo - interpretation and Remote Sensing. Vol.6 No.1, 1978, pp.33.

chosen certain geologic, pedalogic, vegetational, hydrological and land-use aspects in and around 5 agar. He used topographic mapsiin preparing broad and distinct patterns of component land units. The several land units were identified, and for each such land, a representative site was chosen. Besides, during, his field surveys, detailed qualitative and quantitative descriptive data was also collected on all related parameters, such as geomorphology, soils, geology, vegetation, climate and land use. He, then, drew profiles to illustrate the land units on the basis of the topographical map supplemented by field data.

The present work by us is also near to the above study as we have represented the land units by both the dimensions vertically and horizontally.

The case study of Tijara is chosen because of its varied landscape, which becomes a conspicuous geomorphic unit in Mewat. Though Kishangarh and Alwar tehsils are also of the same topography but the adequate maps and relevant data could only be available for Tijara tehsil.

The eastern land of Tijara is highly irregular and rugged. It is well known that rugged areas in India are relatively more underdeveloped than even the under developed tracts in some of the lowlying plains.

Recently, however, much attention is being focussed on the urgent need for developing the hill areas

at a rapid rate, so that the people in such difficult regions would also derive the benefits of Modern technology.

2. Correlate Studies in Geomorphology and land-use:

Very few persons have studied the relationship between geomorphology and land-use. Vats[11] is the first who made an attempt to know the influence of micro-geomorphological units on land-use and crop-production.

A qualitative relation between morphology and land systems has been carried out by Raghavswamy and Vaidyanadhan[12] (1980).

Datye and Gupta[13] in 1980 have jointly studied the correlation between slope - (a geomorphic parameter) and

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11. Vats P.C. (1977) : Influence of Micro-geomorphic units on land-use and crop production. - A case Study of Village Dundli. The Deccan Geographer. Vol.XV No.2 pp.317-326.

12. Raghavswamy V. and Vaidyanadhan R. (1980) - "Morphology and Landsystem of a part of Visakhapattanam District, Andhra Pradesh From Air Photo Studies. PHOTONIRVACHAK - Journal of Indian Society Photo-interpretation & Remote Sensing, Vol.8, No.1 1980 pp. 9-19.

13. Datye V.S. and Gupta S.C. (1980) - Slope and Agricultural Land-use. An Analytical Study with reference to Poona. Transactions of Institute of Indian Geographers pp.16.

land-use, - (the cultivable lands only) and found very satisfactory results. An initial hypothesis was formulated by them that land-use is significantly related to slope of the area. Hence, to test this hypothesis, analysis was done at micro-level viz. the whole region was grouped into certain physical units - based upon distribution and amount of average rainfall (annual), relative relief altitude and soil etc. In their study, Datye and Gupta found that the plains and slightly sloping well drained lands were ideal for expansion of area under cultivation. This fact was reflected in the strong positive correlation between gently sloping lands and the cultivable lands.

Besides, some of the researchers has correlated geomorphic attributes with other than land-use variables like yield, agricultural productivity and surface features. Among such noteworthy workers. Pannalal Das and Bhattacharya[14] are twos, who proved that if the variation in land capability can explain the variation in yield it may be regarded as logical. Hence, a multiple correlation by Pannalal Das and Bhattacharya has been worked out between yield of Paddy and production

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14. Pannalal Das & Bhattacharya R. (1978) "Criteria for Land Capability Classification" - Geographical Review of India Vol.40, No.4, 1978 pp. 340-348.

variables like soil reaction, texture, organic-matter, potassium, Nitrogen, Phosphorous, beaching factor flood and drought, slope and input fertilizers.

Briefly, they reached on a conclusion and interpretated that it should be emphasized that no part of Indian agricultural land is free from the influence of social and economic forces.[15] But it is to be expanded further here that no land of world is free from the influence of geomorphic factors. In fact, it can be overwhelmingly stated that geomorphic factors play a predominant role on the spatial variation of land use of any region. To test this basic hypothesis, Mewat Region has been selected as a unit of study for this purpose and an attempt has been made to correlated geomorphic parameters with its land-use.

A bi-variate analysis through correlation, study was carried out by Subhas Chandra and Mukhopathyay[16] to find out the quantitative nature and degree of

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16. Subhas Chandra Mukhopadhyay (1979) "The Morphological Analysis of Landforms of the Tista Basin in the Eastern Himalayas, Eastern India Geographical Review of India Vol.41, No.4,pp.347-350.

relationship between variables like Relative Relief, Slope drainage density and power index and Ruggedity Index also.

Bharadwaj[17] has correlated the rockout crops of Gurgaon district with the agricultural productivity of the district.

Besides it all, Vats (P.C.)[18] has very recently worked on the geomorphic factors in Kharda village and their impact on land-use planning. He has based his study on quantitative analysis. Thus it became a good source to us to make a new flow of studies "Geomorphology and Land Use." in the mainstream of geomorphology - the science of landforms and landscapes.

Thus, on the whole, quantitative studies have revealed a few other points which are not at once apparent from a qualitative study the geomorphic surfaces at various altitudes which also conform with the sharply segmented long profile.

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17. Bharadwaj (B.K. - 1981 - Ph.D Thesis (Unpublished) CSRD, JNU.

18. Vats P.C. (1981) "Influence of Micro-geomorphic units on land-use and crop production of village KHARDA - The Deccan Geographer. Vol.XIX No.1, pp. 35.

Some researchers have done a monotonous study of distribution of land-use in respective regions of their choice. To name a few Saxena[19], Tewari[20], Chaudhry[21] Dayal & Sharan[22], Singh & Garg[23], Ayyar[24], Ahmad[25], Roy[26] and Amani[27] are the persons who have contributed to the landuse studies.

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19. Saxena J.P. (1968) Bundelkhand : A Study of Agricultural land-use in a transitional zone. 21st IGU Symposium on land-use *pp.35.*

20. Tewari A.R. (1968) "Some Principles of landuse planning in upper Ganga Plains. 21st IGU Symposium on land-use pp.45.

21. Chaudhry L.K.S. (1968) - Land Utilization in Ken Ton Doab of U.P. - 21st IGU symposium on land-use pp. 119.

22. Dayal P. Sharan A. (1968) - Land-use Patterns in the Bihar Shariff Area, Patna. 21st IGU pp.146.

23. Singh L.R. & Garg (1968) Land-use Patterns in the Sub-Himalyan Region of U.P. 21st IGU Symposium on land-use. pp.159.

24. Ayyar N.P. : Land-use and Nutrition in Bewas Basin, M.P. India. 21st IGU Symposium on land-use pp.198.

25. Ahmad A. (1968) - A Geographical Approach to the Problems of Land-Use in the Indian Desert. 21st IGU Symposium. pp.217.

26. Roy B.K. (1968) Measurement of Rural Land-use in Ramgarh. 21st IGU pp.225.

27. Amani K.Z. (1968) Land Utilization in village Golgarhi - 21st IGU Symposium on land-use. pp.247.

Mewat Region

Mewat is a region which inhabitates a large population of 'Meos' - a community whose physical features are rather distinct than those of the others; their vernacular is like 'rough' and 'harsh', their customs and ways of living are adifferent than the others, who reside in the same region, and their dress has also a specific uniqueness in the entire region. Thus, the aloof distinctiveness of the people of this community, in itself is a based criterion to delimit and to define the region as "Mewat"[3]. However, Mewat is an evidently a cultural region that derives its name from the "Meos", who have been the traditional inhabitants of this region.

Mewat is considered as the research area, mainly because of its unique character both in the form of physical and cultural heritages. The study area is representative of a section of India, which offers a multitude of natural landscape, and biotic phenomena. The interdependence of these two features is clearly evidenced in the study area and it was the main aim of this study to focus the attention on the impact of natural landscape on land-use.

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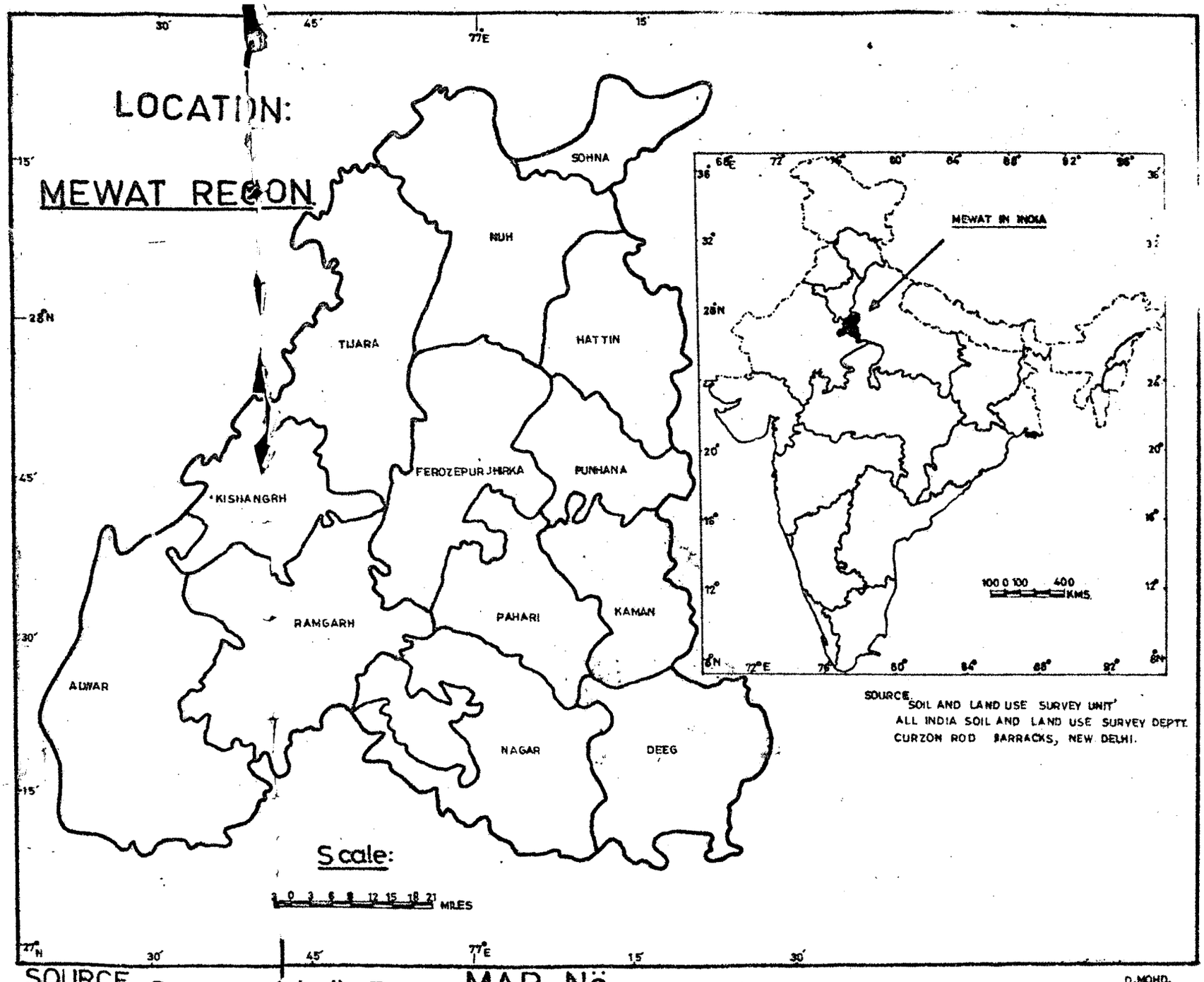
3. Hashim Amir Ali - "Moos of Mewat".
Y, 74441 M N7 L.O. General Section
Social Science Library.



SOURCE Survey of India Topo-sheets MAP No. 1

D.MOHD.

Location

The present area of study of Mewat has a geographical extension between 27° 15' North - 28°30' North latitudes, and 76°30' East - 77°30' Eastern longitudes. The area covers partly the states of Haryana, Rajasthan and U.P. The districts falling within the region are Gurgaon, Faridabad of Haryana. Alwar - Bharatpur of Rajasthan and Mathura district of Utter Pradesh.

Within these above mentioned five districts, there are 14 tehsils-cum-blocks namely - Alwar, Deeg, Ferozepur Jhirka, Hattin, Kaman, Kishangarh Nagar, Nuh, Pahari, Punhana, Ramgarh, Sohna, Tauru and Tijara in the region.

Delimitation of the area:

Delimitation of Mewat Region is entirely based on the concentration of Meo-villages[1]. Accordingly the Sohna block of Gurgaon district and Goberdhan of Mathura district in NE & SE of Mewat region respectively, also form a part and parcel of the region, but it is to be stated here that 150 square miles of the total Gurgaon area is restricted to Mewat Region. In a similar way 25 square miles of Mathura district is falling under the range of Mewat Region. Due to lack of proper availability of statistical data it was not possible to include these two blocks for the

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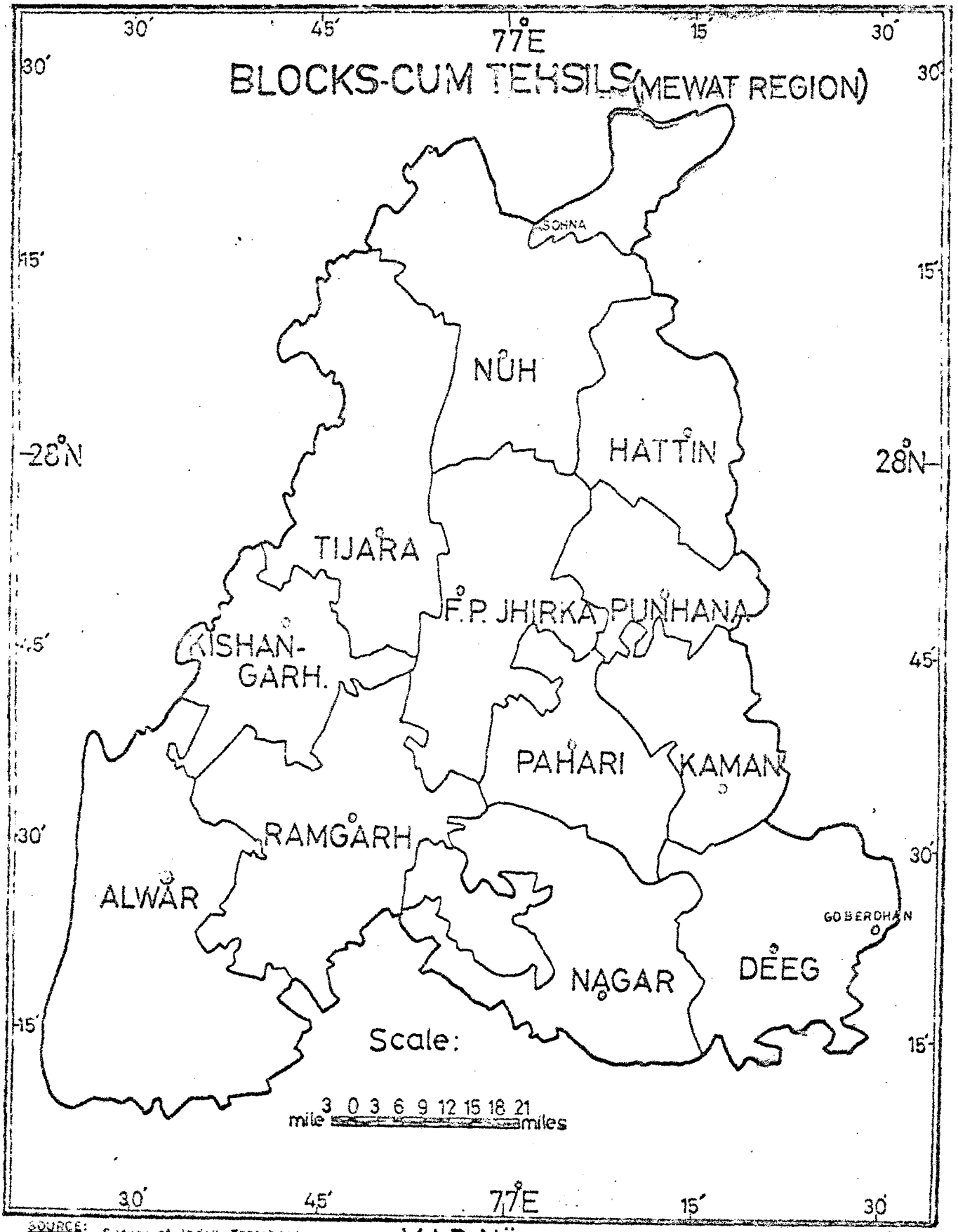
1. Hashim Amir Ali - "Meos of Mewat". "Dispersion of Meo Villages". pp.14.



SOURCE: Survey of India Toposheets.

MAP NO 2 2

D M

analysis of our present study. But, this fact does not deter us to draw the overall conclusions regarding the pattern of the study.

Geology:

The chief geological formation occuring in the region, is the famour belt of Aravalli ranges, traversing from SW to NE. The geology of this region has been first described by Heron[4] in 1917. He grouped the rocks from Delhi to Narnaul and southwards (upto Alwar) into what he termed the Delhi system. The rocks occuring within the region are said to be very old in their age. The stratification of these rocks might have occured in the Pre-cambrian period of the Archaen era. The rocks are characterized with the following geological succession in region: (fig. Map - 3).

Delhi System of Rocks

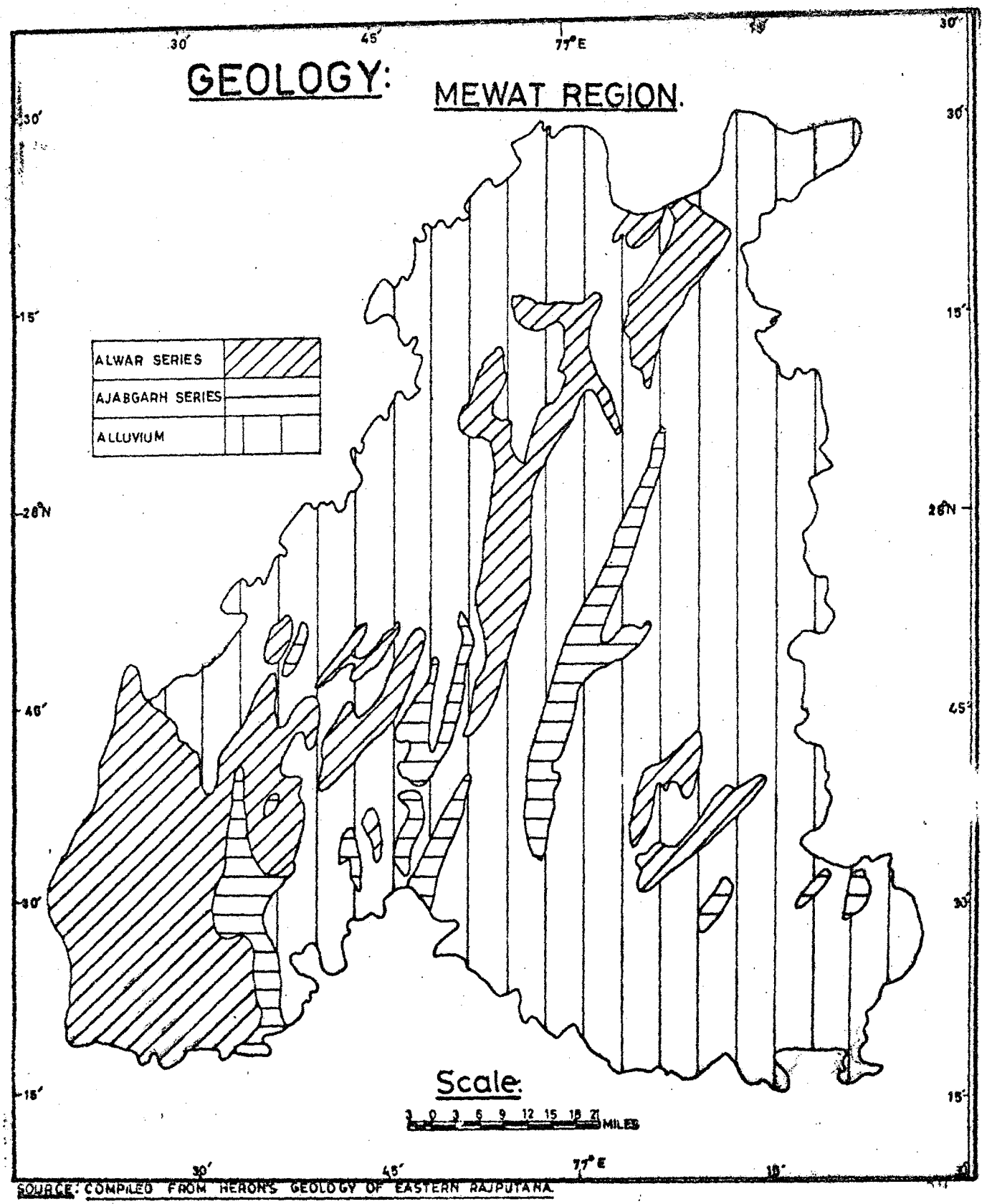
a) Alwar Series: Quartzites, Arkose grits, conglomerates, lime-stones, Mica schists and contemporaneous.

b) Ajabgarh Series:

Intrusives,	Slates and phyllites,
Pegmatite	Quartzitic sandstone
Quartisites	and quartzites, imprvali
Granites & Amphibolites	lime-stone, Marnstone,
	Breccia, Kushalgarh -
	limestone.

c) Alluvium of Pleistocene, Recent times.

4. A.M. Heran : "Geology of North-East Rajasthan and adjacent districts" - Memoir of Geological Survey of India Vol.XVII. published in 1917 - Govt. of India.



SOURCE: COMPILED FROM HERON'S GEOLOGY OF EASTERN RAJPUTANA.

MAP Nö 3 3

Delhi System of Rocks:

The largest and the most conspicuous rock group of Mewat area is the Delhi system of rocks. The famous ridge at Delhi is composed of quartzites belonging to this formation; and is exposed over major parts of this region, which are very predominent through out the region. The name 'Delhi system' is a general term for the rock types, extending upto Alwar, which have been homogeneous in their stratigraphical characteristics. It has been farther sub-divided into the following two series:

1. Alwar series:

A hill belt from Alwar to Delhi, traversing SW - NE is the structure of quartizites, Arkose grits, conglomerates, lime-stones and Mica-schists the famous 'Kala Pahar' in the region appears from Noganwan village in Ramgarh tehsil and disappears at Bhundsi village in Gurgaon tehsil, the extreme north eastern point of the 'Kala-Pahar' range. There is a projection of the main ridge in the form of anti-clinal dome in which dips are usually low.

Alwar series comprises of phyllites, slates and grits, impure lime-stone and breccias. The hills of Alwar have given their names to the quartzites belonging to Alwar. The hills of Kaman are also formed by the same type of rocks. From its northern termination to southward to about Nuh, the range is broad and complex structure lying along the axis of anti-cline in varying degree of parallelism.

At Sohna, the ridge twists sharply and the beds are highly altered. Here a road from Sohna to Rewari crosses the hill, showing a striking case of geomorphological control in road development. An excerpt here is quoted from Heron who describes this case, "……a striking case of how the sandy alluvium is piled up on the wind-ward side. On the east-side the road ascends the face of the ridge in zig-zag fashion to above the level of plain, the alluvium is met after a 'descent of about 50 feet. From the junction of rock and alluvium, there is a gentle descent to the normal level of the plain some miles further on." The trend of the hill forms a natural funnel for the prevailing wind carrying sand.

South west of Nuh the range is joined by an arm of the west and a narrow valley filled with wind blown sand, called 'Aduphur Valley' divides them into two hill series. They again diverge near Tijara but unite North West of Ferozepur Jhirka tehsil. The interval between them is due to the erosion of a zone of states, or other easily removable beds which vary in the amount of dip, from place to place and so by their alerting width of out crop cause the quartzite on each side of them to approach or recede. These tain out rapidly south wards. From Nuh to F.P Jhirka dips are regular to west and north west. The axis of the anticline lies to the east of the ridge, passing through the dome at Santhawari Mangal; only the western limb is visible near Ferozepur Jhirka. The eastern anti-cline again reappears and to the termination to the ridge at Noganwan village, the axis passes midway along it.

2. Ajabgarh Series:

There are five hills of Ajabgarh series in Mewat. Among them two series fork out from Rajgarh, one to NW and the other to NE respectively. The third hill appears nearby Tulera village in Alwar and continues North wards upto Dotana - a village 8 Km. South from Tijara. This hill of rocks have been the formation of bedded quartzites of light grey colour and fine grained in which ripple markings and the sun cracks on the surface beds are common. The fourth hill of Ajagarh series is lying in the middle of the lowlands of Mewat and being an adjoining barrier between Abrez and Bhayana - the two tracts of fertile land in Mewat. The fifth one is between Kaman and Mathura.

Ajabgarh series consist of mainly slates, phyllites, quartzites, hardstone, sandstone, granites and impure lime-stone. There are wide mines of granite silts called 'silly' in the hills of Ghata Basai near F.P Jhirka valleys. This bedded hill of rocks is considered to be about 10,000 feet of thickness.*

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* Dr.Wadia is of opinion that they are about 1524 meters or 5000' thick. - Geology of India pp-127.

Alluvium Tract of Mewat: Extensive & Coverage

The vast land of Mewat is covered by the alluvium deposits. The geographical extension of this tract is lying between Jamuna river in the east and 'Kala Pahar' (Aravelli Range) in the west. The recent alluvium formations are noted down in the eastern most part of the region. The intermontane lowlands are overlaid by the older formation of Alluvium deposits. It is expected that the alluvial thickness will be more than 1 1/2 meter towards Jamuna side and tapers to the western side, which is locally called 'Abrez'. Abrez land tract is an older alluvium, while 'the Bhyana' is a younger formation of the alluvium deposits. The clay of the both the alluviums is very fertile and suitable for making bricks, toys, utensils, and is found almost everywhere in the lowland tract of Mewat.

Generally, the alluvium is fairly stiff clay mixed with sand, particularly in Bhayana in the east from the Ajabgarh series of the hills. This hill tract is an adjoining line between both the alluvium tracts.

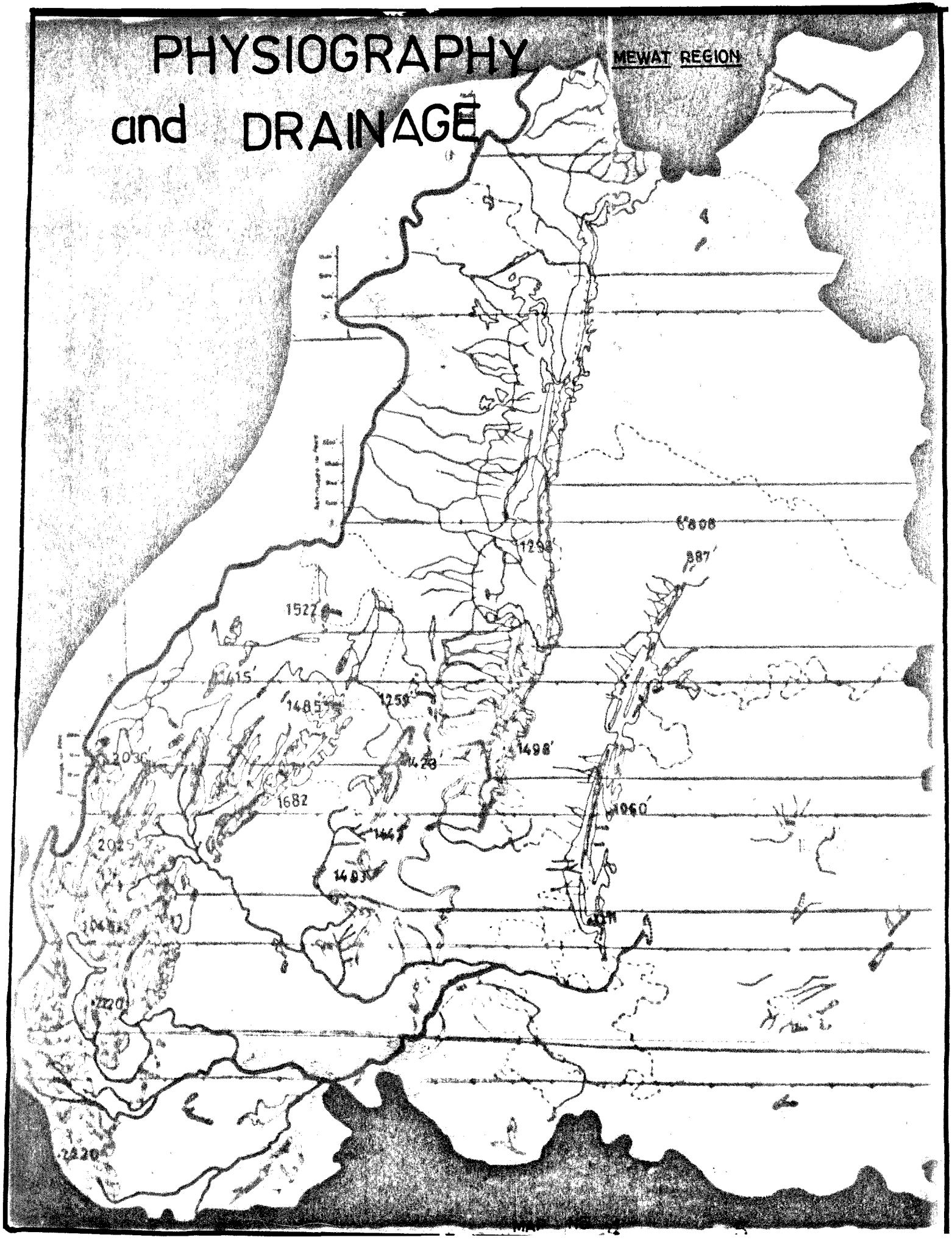
Except 'Abrez'and 'Bhayana', some intermontane valleys are also sedimented by the erosional soils of the hills. 'Ghansoli' and 'Kundla' are an example.

Physiography of the Region:

The area is situated at an elevation ranging from 300' to 1200' above M.S.L. culminating in summits with a

PHYSIOGRAPHY and DRAINAGE

MEWAT REGION



height of 2000' and having general gradients from the central hills towards each side (east and west). The geomorphic features of the terrain exhibit well marked sequences which differ from one another in their morphometric characteristics. (fig 4,5).

The Mewat can broadly be divided into three natural strips running from North to south. The western most region is that of hills and plateaus, and is, in fact, called "Pahaf Upar". This was once covered with dense jungles and had served the Meos, as a protection against their depradation. In times of peace it had provided grazing for cattle and thatching for their roofs. But now it consists mostly of forests reserved or protected by the respective state governments. The eastern plains are called 'Pahar Niche'. It is a flat rolling plain extending upto river Jamuna in the east. To the west, once again are evidenced lowlands which are mostly aeolian in character.

1. Highlands (Pahar Upar):

The western portion of the region is a plateau-like, with elongated ridges having an average elevation of 1000'* above mean sea level. The maximum height of the uplands is about 1530' feet, but Alwar side i.e.

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* The units are in F.P.S. system and not in C.G.S. system as per the availability of toposheets.

in the westernmost part of the region, the height reaches upto 2000'. Due to numerous streams flowing down the escarpment, the edges of the plateau appear furrowed at some places. The average slope per mile ranges from 0-5° towards east which is gradual, and 5° to 15° towards west which is comparatively steeper.

2. Lowlands (Pahar Niche):

More than 50% area of the total area is covered by lowlands of Mewat. It is further dividible into two sub-divisions:

1. Intermontane lowlands (Abrez) and 2. Eastern flood plains (Bhayana).

1. Abrez:

A long north-south valley between the two hills (Kala Pahar and Khanpur Pahari) constitutes the middle sector of Mewat and is known as Abrez. The soils of this area are clayey loam in character, but at several places e.g. Dhondh-Bhondh, Nangal sathawari and Rozka-Meo, the soils are pure sandy and sandy loams. Nearly 32% land of Abrez tract is lying useless from agricultural point of view. Salinity and alkalinity are a serious threat at several places in Nuh tehsil.

The water table is low in these areas of Abrez and drinking water is scarcely available. But there is a scope for the tapping water near the foothills.

During rainy season, this land of Abrez, gets a copious water through the myriad small rivulets which come down the hills and bring flood to the valley land. Almost every year, leaving an exception, the people of this lowland tract have to face great calamities of inundations called "Bharia" in the local term.

2. Bhayana (the easternmost floodplains):

The lowest tract of lowlands of Mewat appears that after crossing the16 miles to the east from the hill-line running parallel to 'Kala Pahar' in NNE to SSW direction. This lowland tract from Khanpur hill extending upto Yamuna river in the east, is formed by the newly laid deposits of Yamuna. The soils of this zone are very fertile and suitable for agriculture. They are called Bhayana, possibly deriving its name from Bayana, which was once its administrative nucleus, and still exists as a town and railway station.

DRAINAGE IN MEWAT:

In fact, there is no stream or river in the region, which is perennial in its entire course. (fig)
Ruparel or Barah, Chuhursidtt, Dhamukhar and Landoha (and Chawandi Nadi) are the only streams which flow through the region and carry the drainage of the hills. Several of these streams and rivulets and their tributaries have been impounded at suitable sites, the water of which

is used for irrigational purposes. The main streams of the Mewat Region are as follows:

1. Ruparel or Barah River:

It is also known as 'Lhaswari-nadi', but even it is mostly called by name of 'Barah'. It rises from Madhopur - Kushalgarh hills at a height of 2110' in the west of Alwar town and after running nearly 8 Kms. from north to south, it takes a sudden turn towards east from Bara (a place - about 19 Kms. south from Alwar town on the Alwar - Jaipur Road). At this point, the river leaves the hilly tract and enters the fertile central midland plains of the Alwar district, whereby its water is utilized for irrigation purposes in various ways. An 8 Km. long feeding canal/channel from Bara weir to Jaisamand lake has been constructed by diverting the Alwar share of the water to Jaisamand. The stream passes through the villages of Chand-Pahari, Muhabbatpur, Sohanpur, Jaitpur, Khunteta and Koat. It flows nearly 81 Kms. through out the region. Before entering the Bharatpur district, where its water is impounded in Sikribundh (which curves round in southern direction) and its water is utilized for the rabi crops in the winter flow. It's entire catchment area is about 1538 Km^2, and it has a maximum yield of 5,330 mega ft. It's principal tributaries are Narainpur, Talbrilesh, Kalighats, Sukri, Shamganga, Nalakarot etc.

which join the main river in its uppermost valley to the west of Alwar town. It's bed is quite sandy which gives rise to some vegetables and water melons in the summer season.

2. Chuhursidh Stream:

It originates from Chuhursidh hills at a height of nearly 2030' in Alwar tehsil, and flows from west to east upto a village Piproli in Ramgarh tehsil from where it changes its course towards north and finally enters Ferozepur Jhirka tehsil of Gurgaon district. The water divide of this rivulet is 2036' high above m.s.l. It flows 8 Km. in Alwar district and floods a portion of Ramgarh tehsil during heavy rains, rendering it suitable for winter sowings. Its other small tributaries are the Natas (small rivulets) like Ghata Basi, Shamsa - Shahpur, Mach-Tehadpur, Sotaka and Khitora-Bundi etc.

3. Landoha Freshet:

Landoha, the another well known stream in the region is formed by union of two streams. One flowing south from Jijara, is called 'Dhamulehar Ki Naddi and the other one joining it nearly at right angles from the west. Most of the water into these freshets come from wester aeolian plains of Jijara and Kishangarh tehsils. The central Aravalli range (KalaPahar) is the source and a great water divide of the realm, from which myriad

of small and medium size rivulets (nallas) collect water during rains and form a drainage system for the region.

So, after pursuing its southward course to a point nearly to the west of the southern end of the Ferozepur Jhirka tehsil, it sweeps round in a curve and crossing the border flows northwards upto the Jhirka valley and finally falls into the Kotla-Meoli Dahar in Nuh tehsil.

Landoha first traces its origin at an elevation of 1682' from the western Aravalli range. Most of the water from Baghore high hills flows into the Landoha freshet. The water coming from Jeroli-Baghore and Bagh-Berla tops flow-down the moderate to steep slopes. Besides, hundreds of rivulets join the flow (crossing 'Mirzapur-Chandawta-Gidawaz') between two hills of 'Ghatika and Jhos'. Here, it forms an estuary of three streams and then, running in a meandering form, washes away the agricultural fields, leaving behind sand beds hither thither. It joins the main landoha nearby Udalea and Nileach. It runs from North to South in its initial stage, then turns towards east near Sheikhpur, crosses the Delhi Alwar Road near Nowganwan and eventually enters the Abrez country of Mewat near Shakarpuri.

The catchment area of this freshet in Alwar district is 611 sq. Km. while in Gurgaon, its nearly 462 sq.km. It floods nearly 2,023 Hactares (5000 Acres) of agricultural land every year in Ramgarh and Ferozepur

Jhirka tehsils. The major tributaries are Holani, Kolani, Jeroti, Dhamukhar, Isnailpur, Chondawata, Raoka, Bidarka, Ghatika, Goll-Fullabas, Manothi, Mirzapur Chondawats and the other high perched villages of Mewat. Generally all the streams and rivulets are given their names on the name of either the places or the villages of Mewat. Today, nearly 16 bunds have been constructed in the catchment area of this river.

Other Natural water bodies of Mewat are as follows:-

1. Jaisamand Jhil in Alwar
2. Silisedh Lake in Alwar
3. Ramgarh-Lake in Alwar
4. Kotla-Meoli Dahar in Nuh Teh.
5. Khalilpur Jhil in Nuh Tehsil
6. Ugina Jhil and Canal drain

Climate of the Region:

The Climate of any region represents the sum total of several inter-related elements which are determined chiefly by latitude, location of the region, in relation to ocean and by geographical peculiarities.

Climate is an important factor to be taken into consideration in the geomorphological studies. It's the climate that modifies the topography of a region and has a direct impact on a particular landscape.

Mewat enjoys arid to Semi-arid type of climate. It is generally categorised as semi-arid mesothermal

(DB' da of Thornthwaite) with maximum summer rain but deficient in other seasons. The short climatic record of a few statrons, available in the region indicates the trend of climatic characteristics in the region.

Factors affecting the climate of the region:

Mewat lies between the three parallel strips of Aravallis and Jamuna river. These three parallel strips of Aravalli hills running from SSW to NNE, hardly exceed 2000' in height at any spot in Mewat. The region receives its highest rainfall mainly by the monsoons from Bay of Bengal, and partly by the Arabian sea branch as a result of which the incidence of rainfall is low. There is a direct correlation between climate and relief of the region. Just as the climate of a region modifies the relief, in the same way relief also plays an important role in modifying the local weather condition.

The western aeolian plains of Mewat, extending from the central Aravalli range, receives less rainfall than those of the areas falling in the foothills of Kala Pahar. Here rainfall is very scarce because of enormous extent from the hills and in terms of vegetation, which can be sparsely seen. The diappearence of vegetation in the plains also influences the climatic conditions. Hence, the western aeolian plains of Mewat are rather dry than those of the Eastern flood plains. However, we do not observe much inequalities in the climatic

conditions of the region as a whole, its more or less same, everywhere in the region.

Climatic seasons of Mewat:

Generally, there are three seasons in Mewat. Fagun, Chait, Baisakh and Jeth (March, April, May and June) are of summer months, in which westerlies flow with the sand-storms and hot bleeze, locally called 'loo'. The Asadh, savan, Bhadon and Kawar (July, August, September and October) are the months of maximum rain-spells of monsoonal rainfall. This rainy season in Mewat called as 'Chomasa'. The rest 54 months bring a cold, called 'Sardi'-'Jada' or 'Sheet Ka Mausam'.

Meteorologically, the above seasons can be categorized under following heads:-

1.	Pre-Monsoon season	March, April, May & June
2.	Monsoon	July, Aug., Sept.
3.	Post Monsoon	October, November
4.	Winter	December, January & February

Data Base:

For all the maps, Survey of India toposheets provided the base for analysing the individual geomorphic parameters. The toposheet No.53D, 53H, 54, A, 54E on scale 1" = 4 mile have provided the base for further

analysis. In the case study of Tijara tehsil, the map on a scale of 1:50,000 was obtained from I.A.R.I organization and a detailed investigation was carried out. The geological information was obtained from Geological survey of India and climatological informations from Indian Meteorological Deptt., New Delhi. Land-use data were obtained from tehsil headquarters, and the perdentages for analytical study were calculated from the map, which was prepared and compiled from India n forest Atlas.

Methodology:

Cartographic and statistical tools are the most important methods to represent the geomorphic parameters. All geomorphic maps for all geomorphic parameters were obtained, using the various morphometric techniques. The detailed methodology adopted for evolving the geomorphic parameters is being provided in Chapter No.-II. After obtaining these parameters, they have been super-imposed to obtained the geomorphological regions and the map respectively. The planning and development of land resources requires an intimate knowledge of the land, particularly its physical characteristics, partiThe demarcation of the land into several terrain units based on some attributes provide in a comprehensive way the physical characteristics of the land. Landscape (physiographical and morphological) approach and parametric

approach are the two methods adopted to delineate and classify the terrain into units. The landscape approach which classifies the land into various land systems uses geomorphic units as its fundamental basis with simple form and with a particular rock, soil and water regime with maximum homogeneity.[3]

The parametric approach classifies and quantifies the landscape on the basis of some selected attributes and their numerical measurements such as topographic, geologic, pedalogic and hydrologic parameters (Mitchell : 1973, Ollier, 1977.

In India, so far classification and division of land into units is concerned, it is based on land systems developed by CSIRO of Australia which are essentially morphological in approach. Some among the noteworthy contribution on land systems of different areas in India are by Subramanyam[4](1978) and Raghavswamy and

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3. Christian and Stewart (1953) (in Gunn.R.H.et.al.1969) Lands of the Queandeyan - Shoalhaven area CSIRO publication, Land Series No.25 pp.1-164.

+Godfrey (1977) Physical Aspects of Land-use. Environmental Geology. Vol.2, 1977.

4. Subramanyam V. (1978) "Land System Studies for Resource Evaluation." A demonstration Around Sagar in M.P.
PHOTONIRVACHAK - Jour.Ind.Soc. Photo-int. & Remote Sensing Vol.6 No.1 pp.33.

Vaidyanadhan[5] (1980) has in detail given the methodology being adopted in military studies for mapping different parts of India based on air-photo interpretation, which is also morphological in approach.

In the present study area, the basic unit of land classification employed is the terrain unit. Each unit is a sufficiently homogeneous piece of landscape with a certain slope and other parametric value. That is, it is based on amount, degree of slope as its fundamental unit and the relief characteristics as well as the drainage density. First the area of disturctive pattern was demarcated using toposheets and, then, slope is measured along 6 cross sections with a serial profile drawn in the region.

From a comparison of geomorphic map (Fig.) and the terrain unit map (fig.) it would be clear that most of the geomorphic units coincide with the terrain units. So a single parameter of slope accounts for different terrain units which in turn show parallelism with the geomorphic units. Hence the parametric approach adopted here to classify the land into different terrain units closely follows the landscape approach. The nature of terrain here is such that application of

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5. Raghavswamy & Vaidyanadhan (1980) "Morphology & Landsystems of a part of Vishakhapattanam, A.P. PHOTONIRVACHAK - Jour. Ind.Soc.PHOTO.Int. & Remote Sensing - Vol.8 No.1 pp.9-20

either approach does not lead to contradictory results. So this two way approach which combines slope with morphological parameters provides an effective means of mapping landforms also in this terrain. This method of combining parameters may prove a potentially valuable approach to map the land for various purposes by even those not well trained in geology and geomorphology.

Bi-variate analysis has been used to test the hypothesis of geomorphological parameters with the land use 't' test has also been applied to test the level of significance and level of confidence.

Hypothesis predominantly correlated with landuse:

In general Geomorphic Parameters are Relief (Absolute relief, relative relief and slope) has a positive correlation with forest lands, barren lands and scrubs. A negative correlation with wastelands and cultivable lands.

The drainage characteristics (Drainage density, stream frequency and dissection index) show a positive correlation with wastelands whereas a negative correlation with barrens and forests and cultivable lands.

The Climatic Parameter in the form of rainfall intensity has a negative correlation with agricultural land and a positive correlation with wastelands.

CHAPTER SCHEME:

The whole study has been framed into two sections A & B. The first section deals with geomorphic aspect of the region and the second part with the landuse and its relationship with geomorphic parameters. The first section is further subdivided into three Chapters and the Second part also into 3 Chapters. Finally followed by concluding remarks.

The first Chapter deals with a detailed general general introduction of the region with respect to its physiography, geology, climate and vegetation.

The Second Chapter analyses the geomorphic parameters and their distribution, which are chosen as the representative of physical lands capacity of the region.

Third Chapter gives an account of the geomorphic regions of Mewat and their identification with the help of geomorphological map.

In the fourth chapter the general distribution of landuse in the region is considered.

The fifth chapter synthesises the qualitative study of geomorphology and land-use, in which a quantitative relationship between landuse and geomorphology has been elaborated.

The last chapter deals with a case study of Tijara tehsil in the light of physiography, land-use, pedalogic and erosional characteristics.

This chapter also includes the concluding remarks summary and conclusion of the study as a whole. On the end, a few suggestions are being provided for the betterment of the area in the context of its present problems.

CHAPTER - II

CHAPTER - II

GEOMORPHIC PARAMETERS

Modern geomorphology is applied in character as well as integrated in approach. The structure, slope and available relief provide us a physical setting for a particular region. To divide a region into certain homogeneous regions, we have necessarily to deal with the study of the geomorphic parameters, which are significantly playing an important role in geomorphological studies. Spatial variation in the socio-economic conditions of a region are directly influenced by the physiography and physiographic environment of that particular region. To study the physiography of a region, we have to select some of the physiographic factors, such as geomorphic parameters; without which we will not be able to study the geomorphic units.

Christian & Stewart[1] in 1953 proposed a technique of carrying out reconnaissance resource surveys, applying geomorphological parameters to divide land areas into geomorphic units.

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1. As referred by Subramanyam, V. (1978) Land System Studies for Resource Evaluation in Sagar - PHOTONIRVACHAK Vol.6 No.-1.

The terrain characteristics of a particular region are important in evaluating their influence over one other, which are interdependent. With the help of geomorphic parameters, we will be able to draw the lines of simulation or uniqueness, occuring through out the region.

SELECTION OF GEOMORPHIC PARAMETERS

Though there are enumerous geomorphic parameters in the study. Only a few are selected keeping in view their possible impact over the general land use. In the present study, the following 8 parameters have been chosen, which reliably govern the land-use distribution in the region:

1. ABSOLUTE RELIEF
2. RELATIVE RELIEF
3. SLOPE
4. RUGGEDNESS NUMBER
5. DISSECTION INDEX
6. DRAINAGE DENSITY
7. STREAM FREQUENCY
8. RAINFALL INTENSITY

DATA BASE

Four teppgraphic sheets on quarter inch scale (1/4" = 1 mile) have been studied, and the broad and

distinct patterns indicated by the help of contours and drainage lines made out. For each such geomorphic parameter, a map has been drawn, which would be representing the site for such a parameter. Finally, an attempt has been made out to describe the parametric values occuring in the region. To give a final stage to the study, the correlations have been worked out between each and every values of the geomorphic parameter and the land-use of the region.

1. ABSOLUTE RELIEF

The terrain of a region is appraised on the basis of spacing of certain geomorphic parameters like - relative relief, roughness, dissection, drainage and ruggedness etc. Absolute Relief is one of them, which expresses an actual, maximum local relief in a region above its mean sea level.[2] In other simpler works, absolute relief is the actual height of a point in the field, above the mean sea datum.

In the area under study Absolute Relief ranges from 750' to 2000'. The total area of the region (Mewat) has, on the basis of absolute relief, been divided into 4 categories with an interval of 500',

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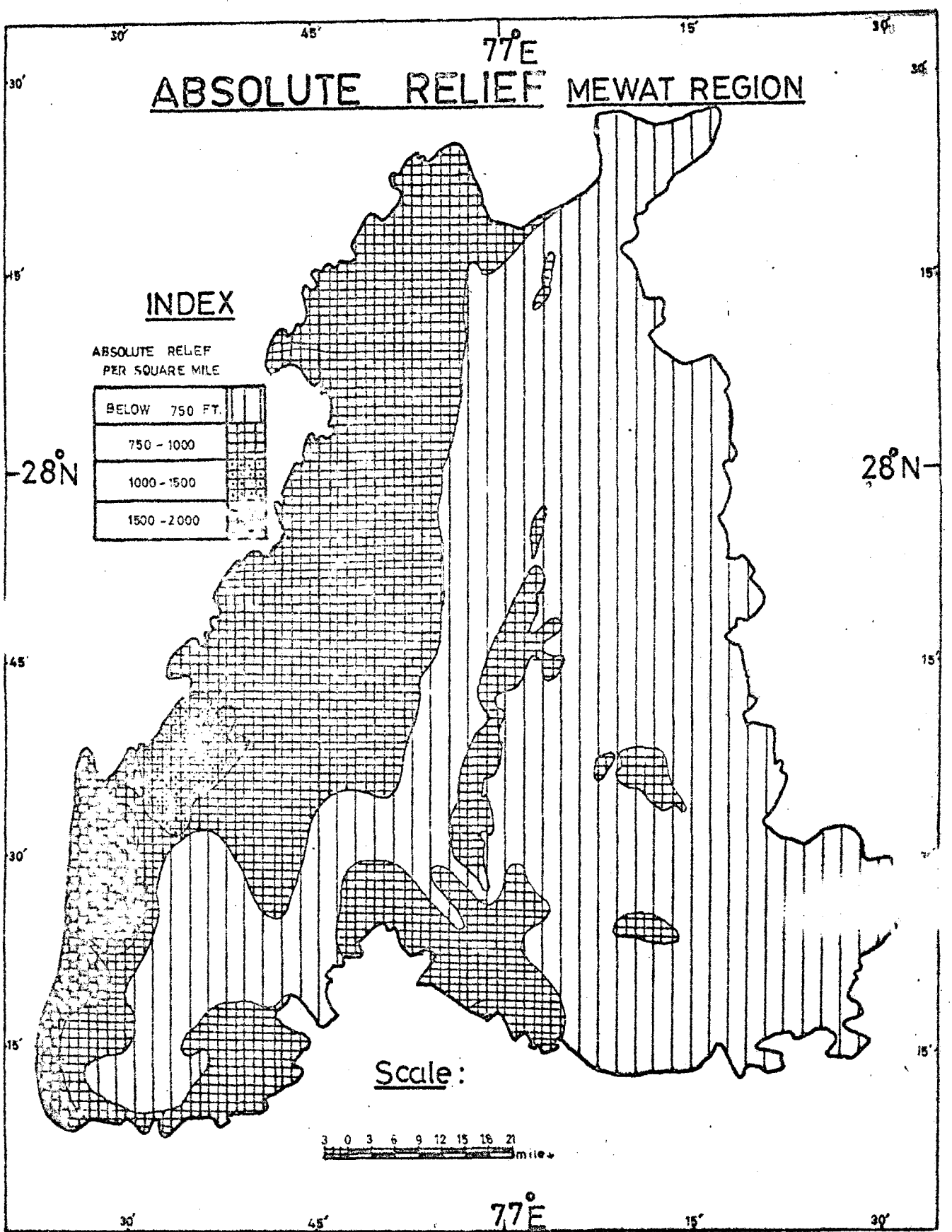
2. WILSON, LEE (1968) "Land Systems Encyclopedia of Geomorphology" edited by Rhodes W. Fairbridge Reinhold Book Corporation, New York pp.745.

ABSOLUTE RELIEF MEWAT REGION



SOURCE: Survey of India Toposheets

MAP No 6 6

D.M.

TABLE 2.1

% AREA UNDER ABSOLUTE RELIEF IN THE TEHSILS OF MEWAT

S.No.	NAME TEHSIL	ABSOLUTE RELIEF				To-tal
		750'	750'-1000'	1000'-1500'	1500'-2000'	
1.	ALWAR	34.30	35.33	4.00	26.00	100.00
2.	DEEG	100.00	0.00	0.00	0.00	100.00
3.	F.P.J.	75.00	25.00	0.00	0.00	100.00
4.	HATTIN	100.00	0.00	0.00	0.00	100.00
5.	KAMAN	99.00	1.00	0.00	0.00	100.00
6.	KISHA-GARH	0.00	90.00	10.00	0.00	100.00
7.	NAGAR	89.50	10.50	0.00	0.00	100.00
8.	NUH	60.00	40.00	0.00	0.00	100.00
9.	PAHARI	84.00	16.00	0.00	0.00	100.00
10.	PUNHANA	100.00	0.00	0.00	0.00	100.00
11.	RAMGARH	50.00	50.00	0.00	0.00	100.00
12.	TIJARAH	00.00	100.00	0.00	0.00	100.00
13.	MEWAT	55.00	4.00	38.00	3.00	100.00

Now, the results of the study show that most part of the region occurs below 750' viz. 55.55% area of the region (as a whole) is falling under the same category. Besides, 38.00% area of the region occurs in the relief category of 1000'-1500' (above m.s.l.). The remaining area of which 4% concentrates between 750'-1000' and 3.00% between 1500'-2000'. The area under the high absolute relief is comparatively very less. The points of maximum elevation are occuring mostly in the western hills of Alwar, where the high perched Mewati villages namely Ratan, Chuhursidh, Chandoli and Akbarpur etc. are inhibited. The table 2.1 provides a detailed information.

The Table 2.1 clearly shows that highest values of local height areoccuring in Alwar tehsil. 26% of the area lies between the heightof 1500' to 2000'. Area between 1000' to 1500' occurs in Kishangarh tehsil and in Alwar also. In Kishangarh 10% area lies within 1000' to 1500' of relief while in Alwar, only 4% area is lying within the medium absolute relief zones. Most of the tehsils have an area between 750' to 1000' of absolute relief, but in Deeg, Hattin and Punhana, the availability of such an area is nil. Maximum area about 50% is occuring only in the tehsils, where the ruggedness

number is also high. Such tehsils are Tijara, Kishangarh and Ramgarh. Tijara totally extends its area between 750' to 1000', while Deeg, Hattin and Punhana do not have more than 750' of height at any spot in the area.

2. RELATIVE RELIEF

Relative Relief is the difference in heights between the highest and lowest points in a unit area. It is directly related to the degree of dissection. The more the intensity of dissection, the greater is the relative relief.[3]

Following method has been applied, for calculating the relative relief of the area under study:

Relative relief = Maximum height - Minimum height.

Then, the difference in elevation between highest and lowest contour within each grid square is measured and plotted. Lines of equal relief, (isopleths) provide a somewhat better idea of relief than an ordinary contour map, since they are a measure of general steepness, though not of local steepness.

The obtained values of relative relief represent the nature of terrain of the region. The higher values of relative relief describe the steepness of the configuration and lower values indicate comparatively lower

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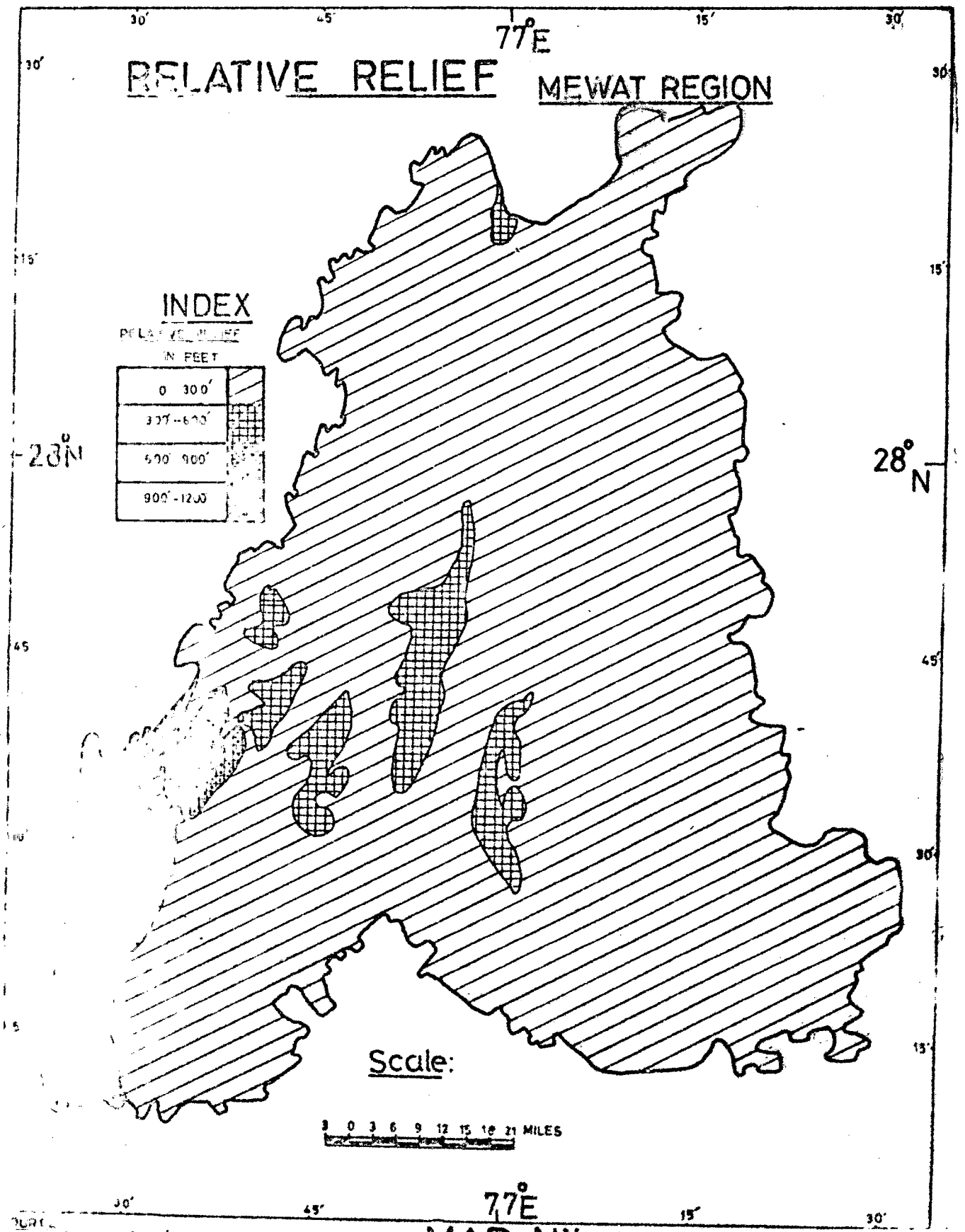
3. Op.Cit. (1968) Encyclopedia of Geomorphology pp.745.



Survey of India Toposheets

MAP No. 77

TABLE 2.II

DISTRIBUTION OF %AREA UNDER RELATIVE RELIEF IN TEHSILS OF THE REGION

S.No.	TEHSILS	0-300'	300'-600'	600'-900'	900'-1200'	TOTAL
1.	ALWAR	58.30	0.00	2.00	39.70	100.00
2.	DEEG	100.00	0.00	0.00	0.00	100.00
3.	F.P. JHIRKA	86.20	13.80	0.00	0.00	100.00
4.	HATTIN	100.00	0.00	0.00	0.00	100.00
5.	KAMAN	100.00	0.00	0.00	0.00	100.00
6.	KISHANGARH	75.80	12.70	11.50	0.00	100.00
7.	NAGAR	100.00	0.00	0.00	0.00	100.00
8.	NUH	100.00	0.00	0.00	0.00	100.00
9.	PAHARI	85.00	15.00	0.00	0.00	100.00
10.	PUNHANA	100.00	0.00	0.00	0.00	100.00
11.	RAMGARH	87.30	10.00	2.70	0.00	100.00
12.	TIJARA	95.50	4.50	0.00	0.00	100.00
13.	MEWAT REGION	82.25	10.71	2.84	4.20	100.00

gradients.

In present area of study, the values of relative relief range from 0 to 1200' with an interval of 300'. The total relative values have been categorised into 4 classes, such as 0 to 300', 300'-600'; 600'-900', and 900'-1200'.

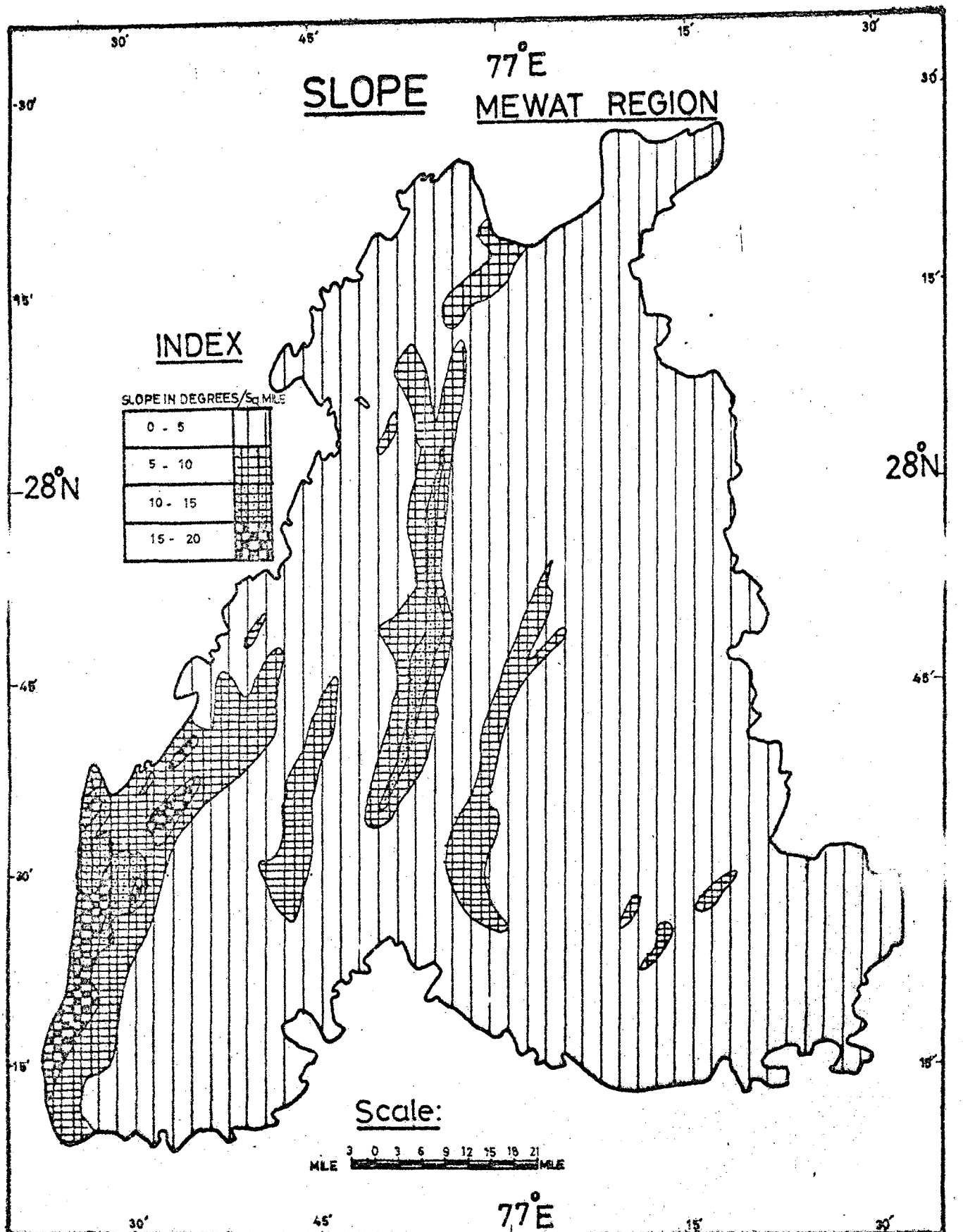
The Table 2.II reveals that only one tehsil viz. Alwar consists the highest relative relief in Mewat. Three other tehsils Ramgarh, Kishangarh and Tijara also have relatively highlands in the region. In case of the region as a whole, the largest area is occuring within 0 to 300' of relative relief. It is because most of the area of the region is flat.

3. SLOPE

As far as the study of slopes in geomorphology is concerned it is a basic aspect of geomorphological research. Geomorphology in a sense, is a study of slopes. The entire landscape is made up of slope elements. The problem of slope study can be dealt within two ways viz. analysis of a regional slope of an area and the evolution of hill side slopes. In the present study only the former aspect has been studied.

The average slope of the region has been studied by using two methods - one is Wentworths[4] and the another

4. Wentworth C.K. (1930) A Simplified Method of Determining the Average Slope of Land Surfaces - An Journal of Sciences. Series 5, Vol.XX pp.31.



SOURCE: Survey of India Toposheets

MAP NO 8 8

TABLE 2.III

DISTRIBUTION OF %AGE AREA UNDER SLOPE IN TEHSILS OF THE REGION

S.No.	NAME TEHSIL	0-5°	5°-10°	10°-15°	15°-20°
1.	ALWAR	55.00	17.00	7.00	21.00
2.	DEEG	98.50	1.50	-	-
3.	F.P. JHIRKA	80.40	14.60	5.00	-
4.	HATTIN	100.00	-	-	-
5.	KAMAN	100.00	-	-	-
6.	KISHANGARH	75.00	23.00	-	2.00
7.	NAGAR	86.00	14.00	-	-
8.	NUH	88.00	11.30	0.70	-
9.	PAHARI	95.00	5.00	-	-
10.	PUNHANA	100.00	-	-	-
11.	RAMGARH	82.00	16.70	1.30	-
12.	TIJARAH	89.50	19.00	1.50	-
13.	MEWAT	81.12	13.48	4.91	0.46

is modified.[5]

I. Wentworth's Method:

$$\frac{\text{Average No. of Contour crossings/Mile}}{\text{Contour Int.}} \times \frac{}{3361}$$

II. Modified Method

$$\frac{\text{Average No. of different value of contours} \times \text{contour interval}}{3361}$$

The constant in both the methods is the same but only contour crossings and contour values differ. However, the modified one gives comparatively better results than the former one.

The area under present study has a slope ranging from 0 to 20° per square mile. On the basis of slope gradient, it can be divided into 4 categories for further analysis:

No. - (1) Level to Gently sloping (0-5°)

No. - (2) Gently sloping to Moderately sloping (5-10°)

No. - (3) Moderate to steep sloping (10°-15°)

No. - (4) Steep to very steep sloping (15°-20°)

Most of the plain area of Mewat lies below 5° to 10° of slope. Area above 10° of slope is found to be more rugged and covered by wastelands and forests.

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5. Dhurandhar K.P.A. Modified Method of Slope - Assistant Prof. in Geog. CSRD, J.N.U. (Personal communication)

Table No.2.III reveals that the highest slope occurs in Alwar and Kishangarh tehsils, whereby 21.00% area of the total area is lying between 15°-20° of slope in Alwar tehsil and 2.00% in Kishangarh tehsil respectively. The slope 10° to 15° covers 7.00% area in Alwar tehsil, 5.00% in Ferozepur Jhirka, 1.30 in Ramgarh and 1.50% in Tijara. So far as the total region is concerned 81.12% is lying below 5° of slope and the remaining area of which 13.48% gets concentrated between 5° to 10°, 4.91% area between 10° to 15° and only 0.46% between 15° to 20°.

4. RUGGEDNESS NUMBER

Based on the above discussed diversities in local relief and terrain, the ruggedness number has been calculated for the whole of the region of Mewat, according to the formula given below.[6]

$$(Rn^*) = \frac{Dd \times R.R.}{5280}$$

* Where Rn stands for Ruggedness Number

Dd = stands for Drainage Density

RR = stands for Relative Relief

Table 2.IV reveals that 0.004 is the highest value of ruggedness number in the entire region. Otherwise, everywhere it is insignificant due to the nature of plain

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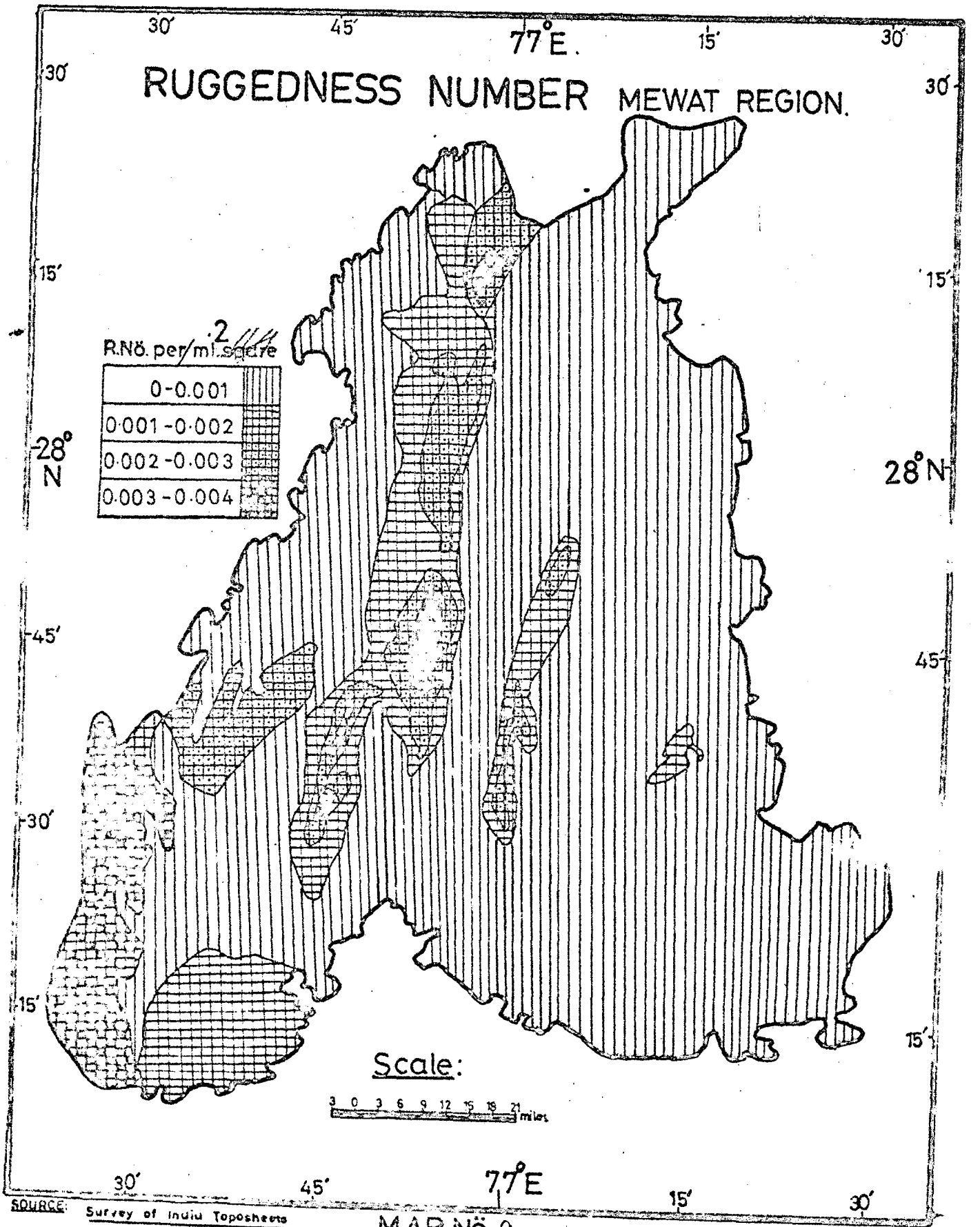
6. Mandal R.B. (1978) - Some Geomorphic Aspects of North Bihar. Indian Geographical Studies, Research Bulletin No.10 pp.17.

RUGGEDNESS NUMBER MEWAT REGION.



MAP NO 9 9

D.M.

TABLE 2.IV

% AREA UNDER RUGGEDNESS NUMBER IN TEHSILS OF MEWAT

S.No.	NAME TEHSIL	0-0.001	0.001-0.002	0.002-0.003	0.003-0.004
1.	ALWAR	29.30	30.70	5.00	35.00
2.	DEEG	100.00	-	-	-
3.	F.P. JHIRKA	75.00	13.70	7.30	4.00
4.	HATTIN	100.00	-	-	-
5.	KAMAN	96.66	3.33	-	-
6.	KISHANGARH	75.00	7.00	17.00	1.00
7.	NAGAR	96.00	2.00	2.00	-
8.	NUH	68.50	15.00	15.00	1.50
9.	PAHARI	79.00	19.25	1.75	-
10.	PUNHANA	97.60	1.40	1.00	-
11.	RAMGARH	70.30	15.00	11.60	3.40
12.	TIJARA	48.00	37.00	11.60	3.40
13.	MEWAT	85.77	8.52	4.66	1.05

land. That is why nearly 85.77% area of the total region lies below .001 ruggedity No. The remaining 8.52, 4.66 and 1.05 areas lie in .001-.002, .002-.003 and .003-.004 categories respectively.

Though, the highest ruggedness number occurs in Alwar tehsil, of which 35.00% area lies in the highest ruggedity. Next 4.00% area lies in F.P. Jhirka, and 3.40% of the total tehsils area is lying in two rugged tehsils namely Ramgarh and Tijara.

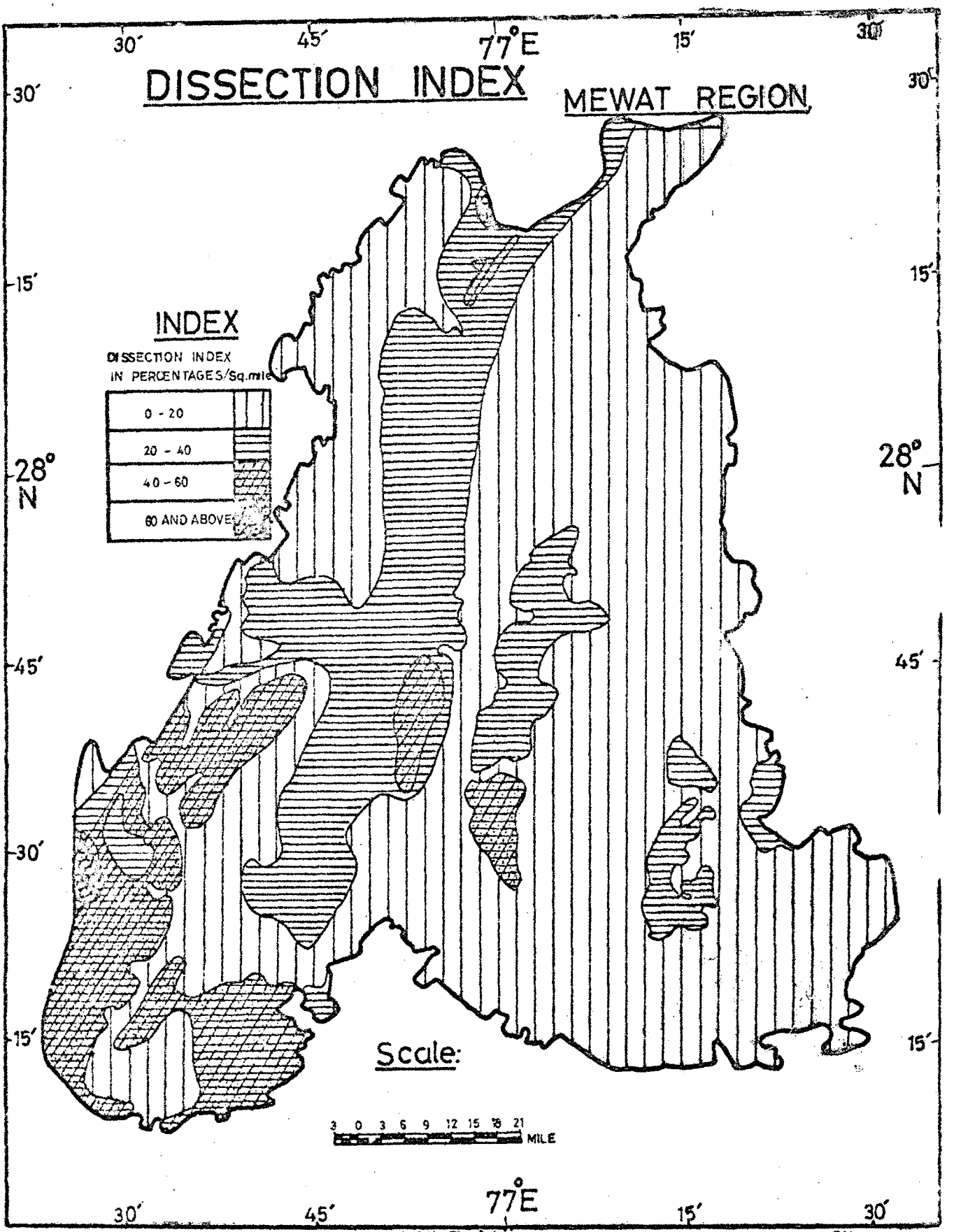
5. DISSECTION INDEX

Dissection Index deals with the relationship of the real area to the projected area between contours and is calculated in the light of formula as proposed by Slauctajas* (1936).

Dissection is correctly and directly related to the stage of cycle of erosion. Very high values of dissection closely correspond to youthful stage whereas low values are related to penultimate stage. The following scale of dissection may be suggested for the determination of the stages of cycle of erosion, particularly in case of present study area.

Dissection Index	-	Stage of Cycle:
0.2 (20%)		Old stage
0.2-0.4(40%)		Mature stage
0.4 (40%)		Young stage

* $\frac{\text{Max. elevation - Min. elevation}}{\text{Max elevation}} \times 100$



SOURCE: Survey of India Toposheets

MAP No 10

QM.

TABLE 2.V

% AREA UNDER DISSECTION INDEX IN TEHSILS OF MEWAT

S.No.	NAME TEHSIL	20%	20-40%	40-60%	60%
1.	ALWAR	51-50	7.50	38.00	4.00
2.	DEEG	91.50	8.50	-	-
3.	F.P. JHIRKA	48.80	40.00	11.20	-
4.	HATTIN	100.00	-	-	-
5.	KAMAN	79.00	21.00	-	-
6.	KISHANGARH	47.00	36.00	17.00	-
7.	NAGAR	86.00	7.00	7.00	-
8.	NUH	63.50	33.00	2.50	1.00
9.	PAHARI	78.00	12.00	9.99	-
10.	PUNHANA	90.70	9.30	-	-
11.	RAMGARH	52.67	44.00	-	3.32
12.	TIJARA	44.30	55.70	-	-
13.	MEWAT	65.25	29.11	5.39	0.25

Table 2.V clearly reveals an inverse relation between percentage area and dissection index. 65.25% area of the entire region lies below 20% of dissection index, 29.11% in 40% of dissection index and 5.39% & 0.25% in 60% and greater than 60% of dissection index respectively.

So far as the study on tehsil basis is concerned, Hattin is the only tehsil in which total area is lying in the 20% of dissection index.

Deeg comprising 91.50% area falls below 20% of dissection index. Punhana and Nagar comprising 90.70% and 86.0% respectively represent below 20% of dissection index. The maximum dissectionindex occurs in 3 tehsils of Mewat, namely Alwar, Nuh and Ramgarh, though the area occuring below maximum value of dissection is very meagre in these tehsils, which comprises of 4%, 1% and 3.33% respectively.

6. DRAINAGE DENSITY

There are many parameters of texture expression drainage density is one of them. Briefly speaking, texture may also be represented by drainage network and drainage density. Generally, a high drainage density results in a fine texture and a low density in a coarse texture.

Drainage density was first calculated by Strahler in 1957.[8] We have for our present study also applied

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8. STRAHLER A.N. (1956) -'Quantitative Slope Analysis' Bulletin of the Geographical Society of American, Vol.67 pp. 571-96 (N.Y. 1956).

the same method. Following is the formula for calculating it:

$$\text{(Drainage Density)} = \frac{\text{Total length of the streams in a square grid of one mile}}{\text{Total area of grid}}$$

The drainage density in the entire region ranges from 0 to 0.4 with an interval of .1. The table (2.VI) given shows that 75.42% area of the region comprises of below .1 drainage density and the remaining 9.73% area of the region comprises of .1-.2, 6.93% area comprises .2-.3 and 8.12% area comprises .3 to .4 drainage density. The highest area of the region has less than .1 drainage density and is concentrated in Deeg, Ferozepur Jhirka, Hittin, Kaman, Nagar, Pahari and Punhana blocks. That is to say that the entire lowlying belt of Mewat consists of the lowest drainage density.

The area under maximum drainage density occurs in 5 tehsils namely Alwar, Ferozepur Jhirka, Kishangarh, Ramgarh and Tijara. The maximum area, with maximum drainage density decreases regularly in Tijara tehsil thereby in Alwar, Ramgarh and Kishangarh. In Tijara tehsil 31.10% area to the tehsils area has the drainage density computed as 0.4 per square mile. In Alwar, this area is 22.66% and in Ramgarh it is 20.00%, while in Kishangarh it is 13%. In 5 tehsils, the density of drainage is nil. These 5 tehsils are Deeg, Hattin, Kaman, Pahari and Punhana.

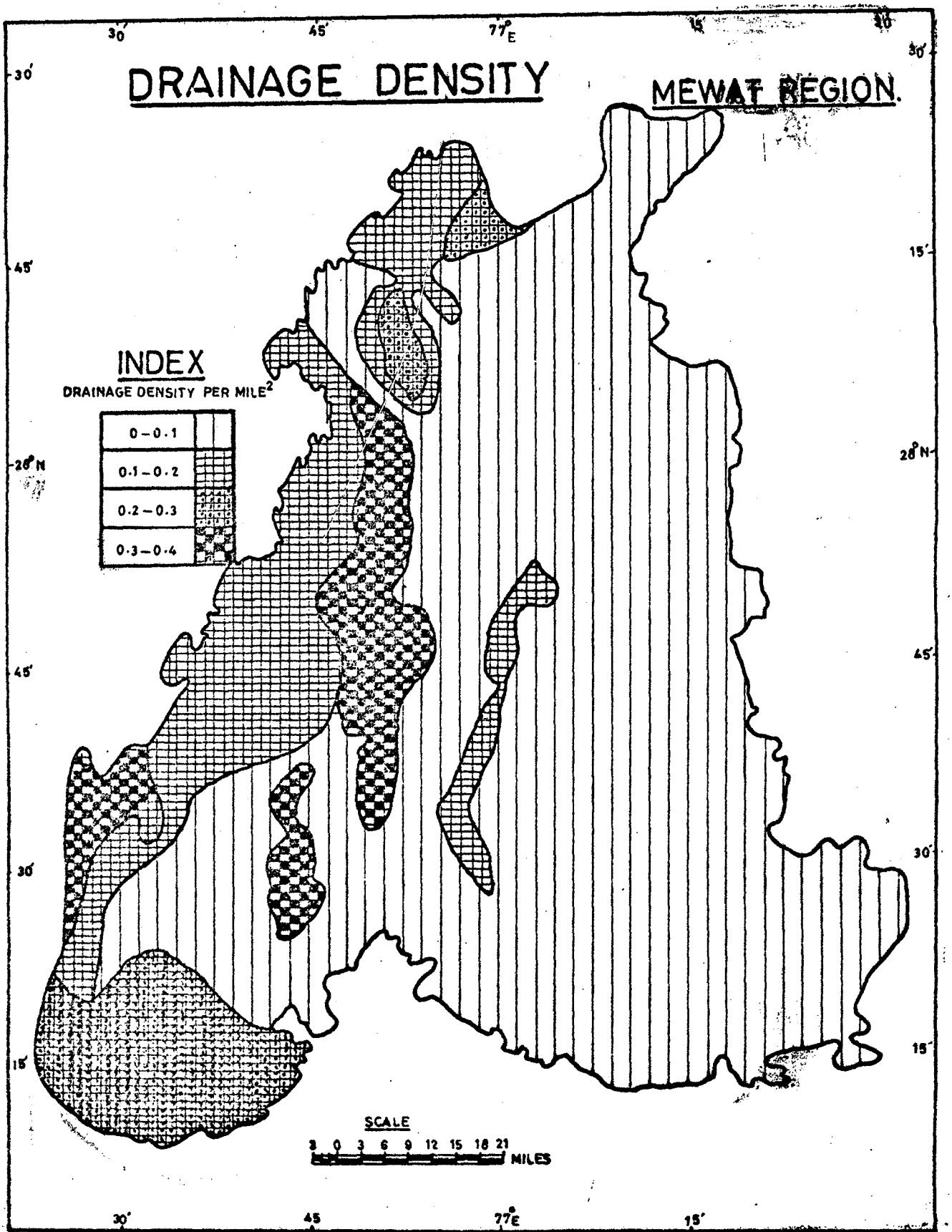
DRAINAGE DENSITY
MEWAT REGION.
INDEX
DRAINAGE DENSITY PER MILE²
0-0.1
0.1-0.2
0.2-0.3
0.3-0.4
SCALE
3 0 3 6 9 12 15 18 21
MILES
30'
45'
77°E
15'
30'
28°N
SOURCE Survey of India Toposheets
MAP No II 11
O.M.

TABLE 2.VI

% AREA UNDER DRAINAGE DENSITY IN TEHSILS OF MEWAT

S.No.	NAME TEHSIL	0-0.1	0.1-0.2	0.2-0.3	0.3-0.4
1.	ALWAR	30.33	3.00	44.00	22.66
2.	DEEG	100.00	-	-	-
3.	F.P. JHIRKA	85.00	12.80	-	2.20
4.	HATTIN	100.00	-	-	-
5.	KAMAN	100.00	-	-	-
6.	KISHANGARH	3.00	84.00	-	13.00
7.	NAGAR	96.73	3.27		-
8.	NUH	73.50	20.50	6.00	-
9.	PAHARI	100.00	-	-	-
10.	PUNHANA	100.00	-	-	-
11.	RAMGARH	74.50	5.00	0.50	20.00
12.	TIJARA	30.00	27.00	11.90	31.10
12.	MEWAT	75.42	9.73	6.93	8.12

7. Stream Frequency

Based on the formula given by Horton[1] (1945), the stream frequency for the region is calculated by the following formula:

$$S.f = \frac{\text{No. of stream segments}}{\text{Total area}}$$

$$\text{of } S.f = \frac{N}{A}$$

The frequency of streams in Mewat ranges from 0 to 8 and has been divided in 4 categories with an interval of 2 streams. The results obtained show that 77.70% area of the total region lying below 2 frequency of streams, while 18.45% area comprises a frequency of 4 streams per square mile. The remaining 2.84% and 0.83% areas receive 6 to 8 frequencies in a square mile.

Table No.2.VII reveals that the maximum frequencies occur in 4 tehsils of Mewat, namely Alwar, Ferozepur Jhirka, Ramgarh and Tijara, which comprise an area of 3.60%, 3.50%, 2.00% and 2.00 respectively to their total areas. In 3 tehsils i.e. Deeg, Hattin and Punhana, the stream frequencies are nil.

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1. Horton A.E. (1945) - A Quantitative Analysis of Streams pp. 285.

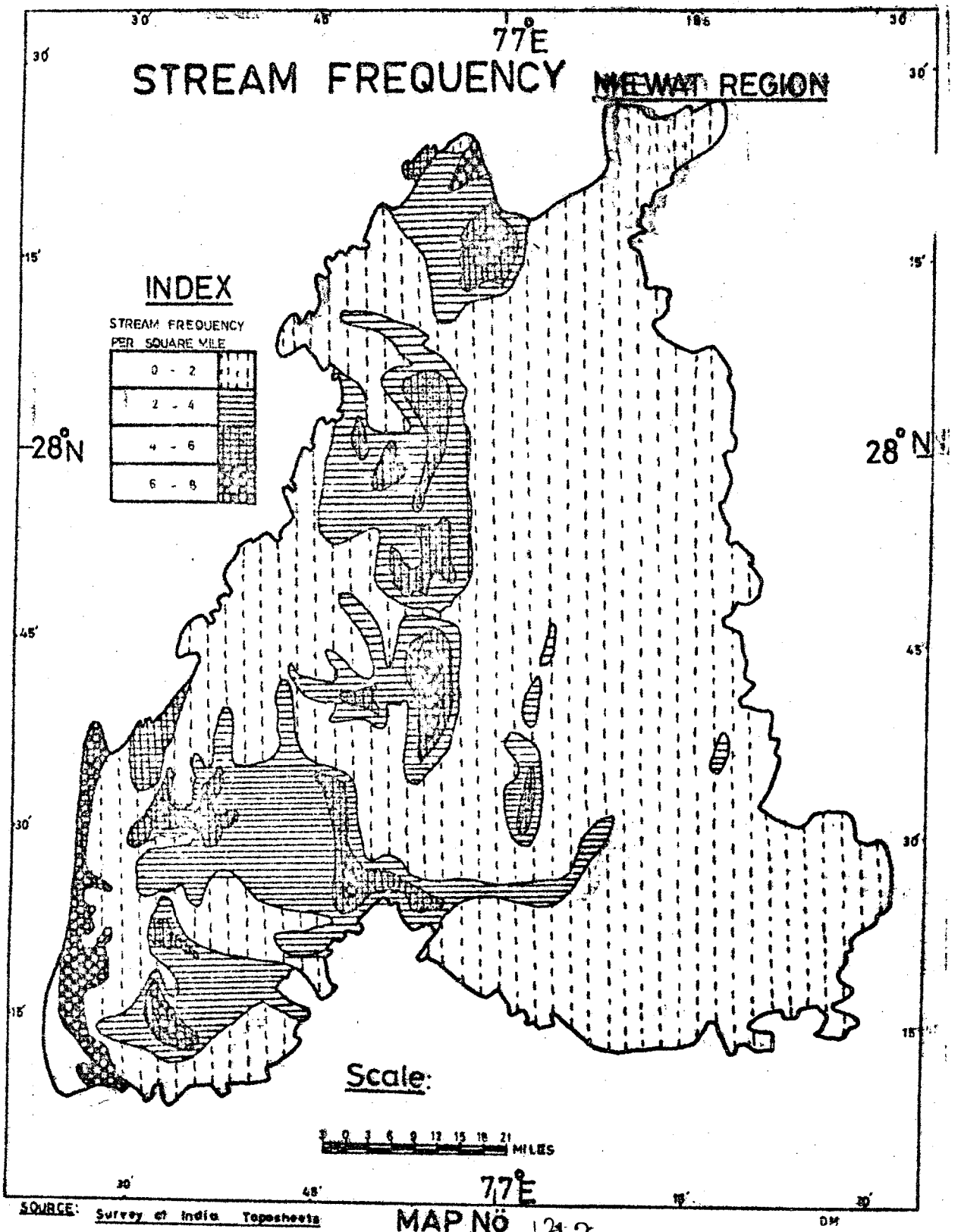

77°E
STREAM FREQUENCY MEWAT REGION
INDEX
STREAM FREQUENCY PER SQUARE MILE
0 - 2
2 - 4
4 - 6
6 - 8
28°N
28°N
Scale:
0 3 6 9 12 15 18 21 MILES
77°E
SOURCE: Survey of India Toposheets
MAP NO 12

TABLE 2.VII

% AREA UNDER STREAM FREQUENCY IN TEHSILS OF MEWAT

S.No.	NAME TEHSILS	0-2	2-4	4-6	6-8
1.	ALWAR	46.92	45.00	5.00	3.60
2.	DEEG	100.00	-	-	-
3.	F.P. JHIRKA	69.75	16.50	9.50	5.50
4.	HATTIN	100.00	-	-	-
5.	KAMAN	98.00	2.00	-	-
6.	KISHANGARH	93.00	-	7.00	-
7.	NAGAR	95.00	3.00	2.00	-
8.	NUH	70.00	20.00	10.00	-
9.	PAHARI	94.00	4.00	2.00	-
10.	PUNHANA	100.00	-	-	-
11.	RAMGARH	42.00	54.00	2.00	2.00
12.	TIJARA	39.00	48.00	2.00	2.00
13.	MEWAT	77.70	18.45	2.84	0.83

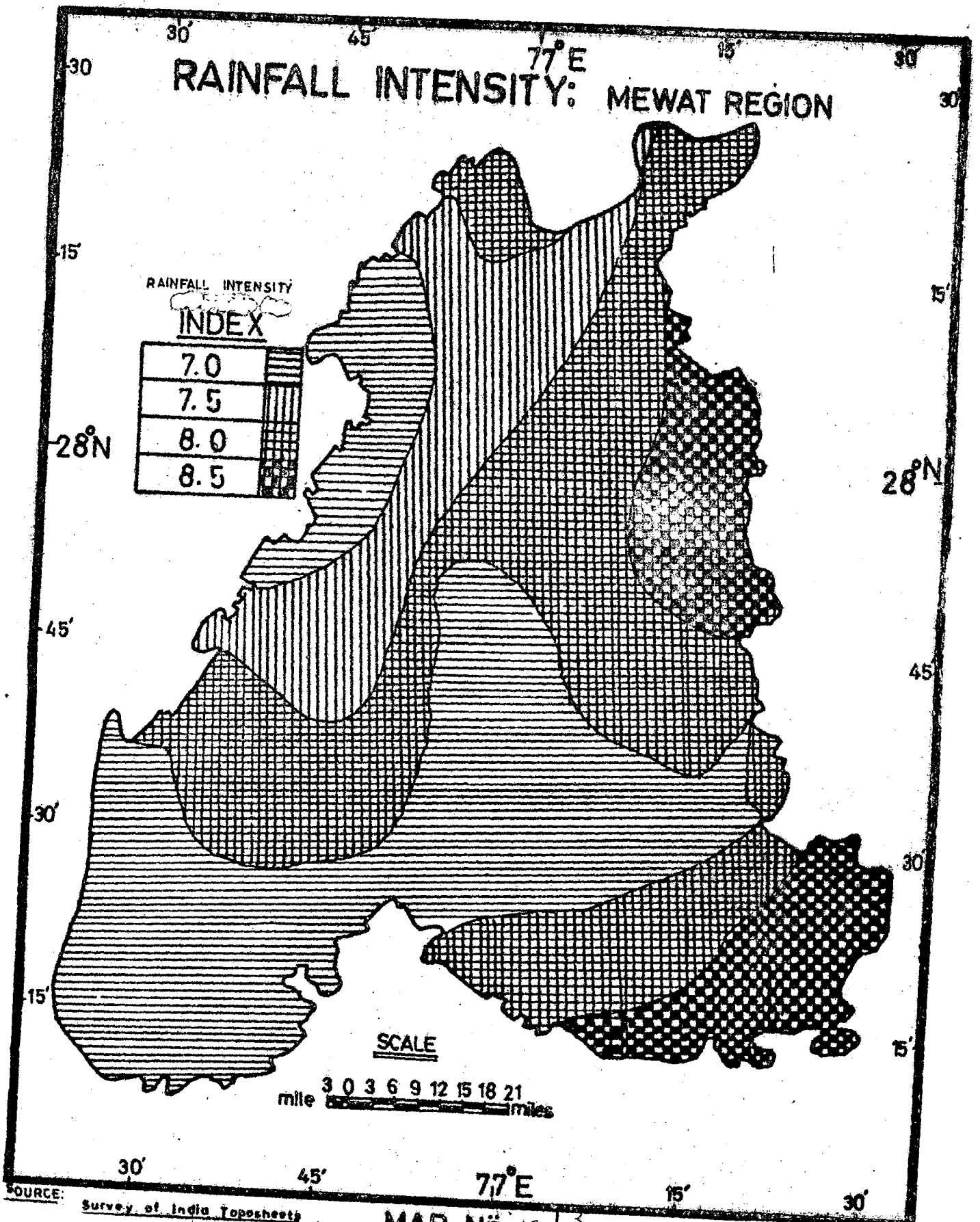
8. RAINFALL INTENSITY

Definition: Rainfall intensity is defined as total average rain fall divided by number of rainy days.

It remains, by and large same throughout the region. It is because of the region which is having less geographical extension. The intensity of rainfall ranges between 7 to 8.5 with an interval of 0.5 only. The highest rainfall intensity occurs along the eastern boundary of the region as its nearby Jamuna river washes out the fields with its irregular inundations in rainy season. In calculating the rainfall intensity for the region, an average rainfall of previous 20 years has been taken into consideration.

Table 2.VIII clearly shows that the maximum area of the region receives less rainfall and it is here that 40.64% area of the region is getting the intensity below 7.0 only. 14.25% of the total area receives maximum intensity of rainfall. Tehsils that is Deeg, Nagar, Punhana, Kaman and Hattin receive the maximum rainfall in the region. All these tehsils are lying in the flat Jamuna flood plains.

On the whole, from the descriptive analysis of various geomorphic parameters it is concluded that the variation in geomorphic values range markedly from high lying to lowlying areas. The physiography controls to a great extent the nature of geomorphic processes.



SOURCE: Survey of India Toposheets

MAP No 13

TABLE 2.VIII

% AREA UNDER RAINFALL INTENSITY IN TEHSILS OF MEWAT

S.No.	NAME TEHSIL	7	7.5	8.0	8.5
1.	ALWAR	86.00	-	14.00	-
2.	DEEG	3.00	-	19.00	78.00
3.	F.P. JHIRKA	50.00	-	50.00	-
4.	HATTIN	41.00	-	-	59.00
5.	KAMAN	40.00	-	60.00	-
6.	KISHANGARH	3.50	70.00	26.50	-
7.	NAGAR	-	-	49.00	13.60
8.	NUH	-	59.50	40.50	-
9.	PAHARI	87.50	-	12.50	-
10.	PUNHANA	-	-	38.00	62.00
11.	RAMGARH	35.00	-	65.00	-
12.	TIJARA	49.00	41.00	10.00	-
13.	MEWAT	40.64	10.80	34.04	14.25

CHAPTER - III

CHAPTER - III

GEOMORPHIC REGIONS OF MEWAT

The study of geomorphic regions provides an insight into the delimitation process based on certain basic geomorphic attributes. The landscape approach which classifie the land into various land systems uses geomorphic units as its fundamental basis with simple form, relief, soil and drainage regime with maximum homogeneity.[1]

The parametric approach classifies and quantifies the land-scape on the basis of some selected attributes and their numerical measurements such as topographic, geologic, pedalogic and hydrologic parameters.

Christian and Stewart first proposed a technique of carrying out reconnaissance resources surveys, applying geomorphology to divide land areas into certain land 'units' on the basis of the morphology of the region.

In India so far, classification and division of lands into certain units are being done on the basis of land systems developed by CSIRO of Austraili, which are essentially morphological in approach. Some among the noteworthy contribution on land systems of different areas in India are by Subramanyam[2], Raghavaswani and Vaidyanadhan

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1. Christian and Stewart - 1953 and Godfrey 1977 Proc. of Seminars on "Application of Photo inter and Remote sensing Techniques for Natural Resource Survey and Environmental Analysis Oct. 8-10, 1980 pp.

2. Subramanyam : PHOTONIRVACHAK, Journal of Indian Society of Photo interpretation, Vol.2 (1980) pp.

(1980)[3]. Besides, Chansarkar (1976) has given in detail the methodology being adopted in military studies for mapping different parts of India on the basis of photo interpretation, which is also a morphological in approach.

In previous studies, generally, certain geomorphic parameters were selected and then, generalizing the measured values, the areas of distinctive patterns were demarcated. For example, a single parameter of slope accounts for different terrain units which in turn shows parallelism with the geomorphic units.

The criterion, which we have adopted here to classify the area into certain geomorphic units very closely follows the previous landscape approaches. Only in three points, it differs from those of the previous studies. For instance (1) we have chosen comparatively more geomorphic parameters in classifying the land into similar geomorphic regions; (2) we have drawn the serial and superimposed profiles for each of the geomorphic parameters along 6 cross-sections (AB, BC, C-D, D-E, E-F and F-G) as representatives of the entire region. (3) The regions made through (by the help of these superimposed profiles of the 8 parameters) were, then tallied with the contour net in the region.[4]

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3. Raghavaswani Vaidyanathan: Proceedings of Seminar on "Application of Photo, interpretation and Remote - sensing Technique for Natural Resources Surveys and Environmental Analysis (1980)"Terrain Units and Slope Categories" pp. 43-47.

4. Proceedings of seminar on "Application of Photo-interpretation and Remote sensing Techniques for Natural Resources Survey & Environmental Analysis". Oct.8-10, 1980.

DESCRIPTION OF PROFILES:

The figures obtained of aerial profiles (fig. No. clearly depicts the vertical shape of the region. The drawn line for each of the parameter more or less portrays the same dimension and where relief is high slope, ruggedity, dissection and stream frequency are also automatically high. Rainfall intensity remains an exception. The superimposed profiles (fig.) of all the parameters along with the 6 cross-sections, thus have been taken as the prominent criterion in delimiting the geomorphic units. Thus, on the basis of the association of 8 geomorphic parameters, the study area is grouped into geomorphic provinces. Within a province, several sub-geomorphic units are also mappable. Absolute Relief, Relative Relief, Slope, Ruggedness Number and Dissection Index, which are the topographical expressions; and drainage characteristics like drainage density and stream frequencies including rainfall intensity (as an hydrological parameter) are also being dominant factors in the regions topography. The term "topography" refers to the configuration - the relief and contours - of the features that give variety to our landscape: our plains, plateaus, valleys, hills and other minor landforms.[5]

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5. CHARLES B. HUNT, 1972, Geology of Soils. pp. 55-56
Their Evolution, Classification & Uses
W.H. Freeman & Co.

Superimposition of all the profiles gives a broad frame in which seven geomorphic units have been identified in such a way that by incorporating the corresponding soil, vegetation, hydrological and land-use data, these may be regarded as the present geomorphic map.

Geomprphic regions can be considered on at least three scales of macro, meso and micro. In macro we study the continents, in meso the plains and in micro the relief features as mud cracks, ripple marks and tussock mounds on sand-dunes.[6] Here the second scale of considering the landform units have been applied for the study. It is because the region under present study is most probably a part of Indo-Gangetic divide and the Sahibi catchment. The central arravalli range separates both the plains (viz. Eastern Jamuna Floodplains & Western Aeolian Alluvial plains of Sahibi catchment).

On the basis of previous world studies, Mewat, accordingly consists of all categories of landforms, excepting the high mountains and sea coasts.[7] The maximum height of the hills is 2233 feet, occuring in the Western points of Alwar town of Rajasthan state. The present

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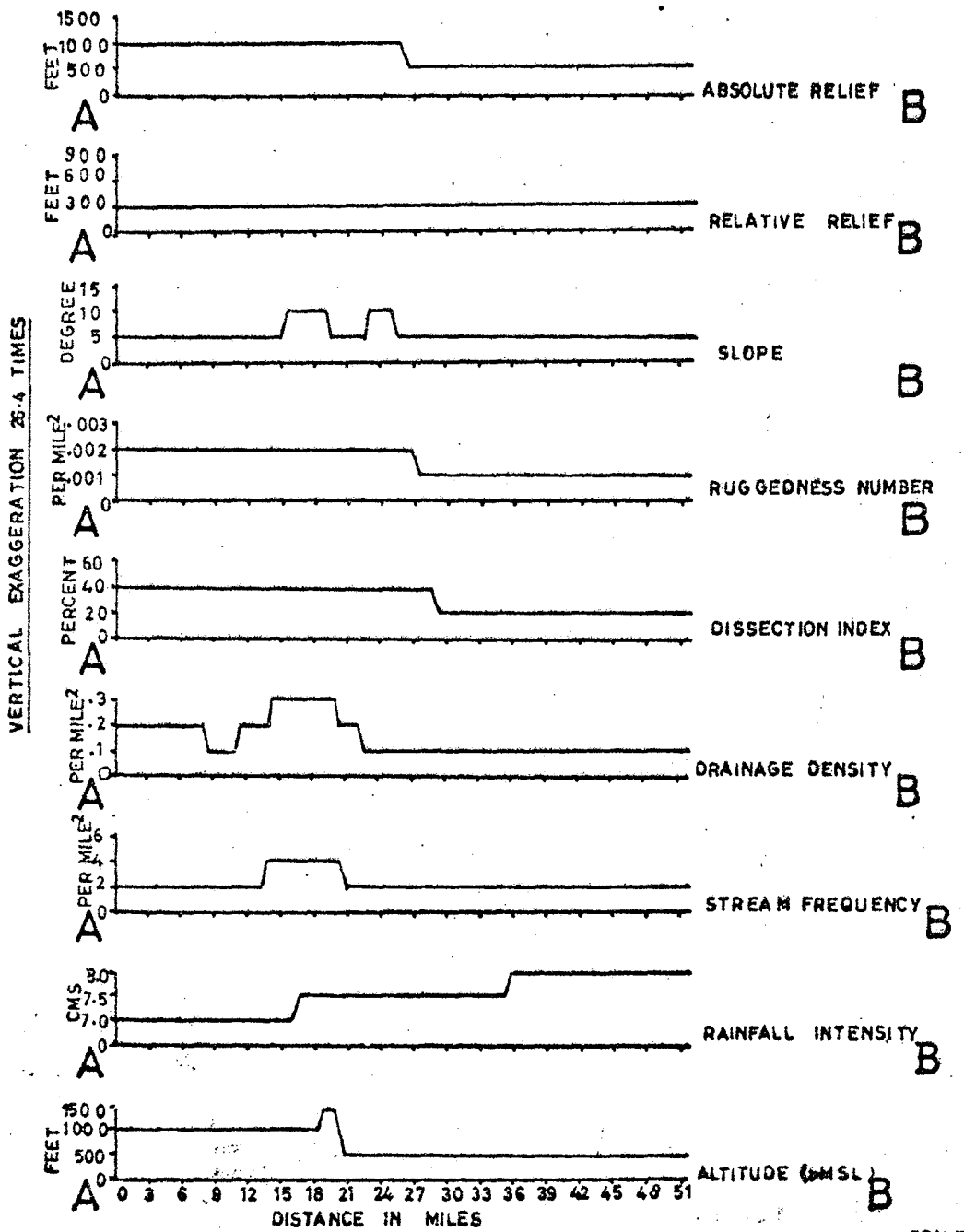
6. CHARLES B. HUNT, GEOLOGY OF SOILS. Their Evolution, Classification and Uses. W.H. Freeman and Company, 1972.

7. PATTON : STUDY OF LANDFORMS pp. 54-55.

GEOMORPHIC PARAMETERS ALONG 'A-B' CROSS SECTION



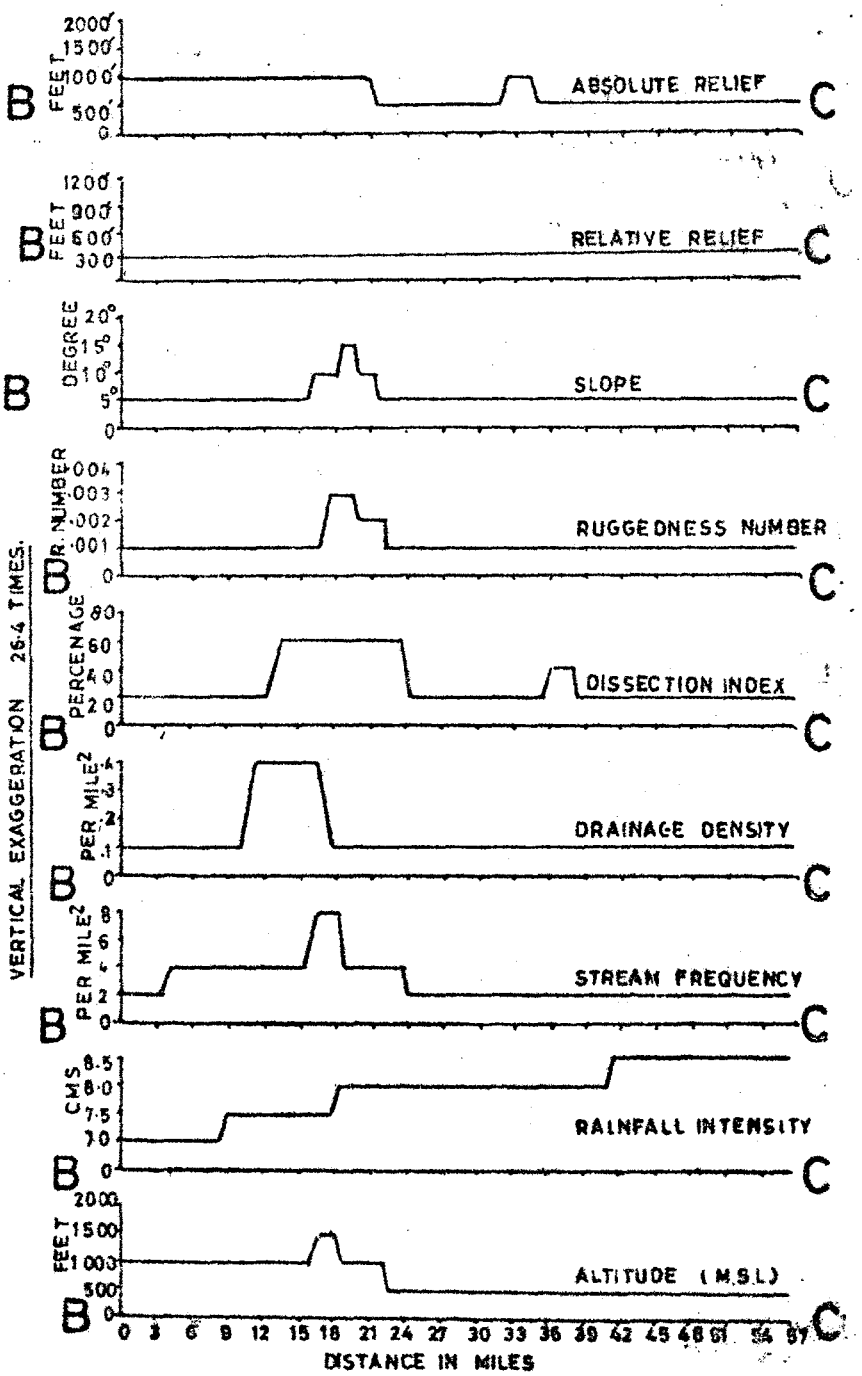
SCALE: 1" = 4 MILES

SOURCE: SURVEY OF INDIA TOPOSHEETS

Fig. No. 1

O.M.

GEOMORPHIC PARAMETERS ALONG 'B-C' CROSS-SECTION



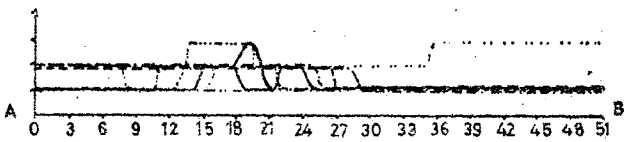
SOURCE: Survey of India Toposheets

Fig. Nö 2

SCALE:
1" = 4 MILES

D.M.

SUPERIMPOSITION OF GEOMORPHIC PARAMETERS ALONG VARIOUS CROSS SECTIONS.

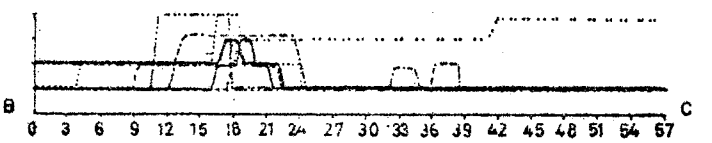


DISTANCE IN MILES

Vertical Exaggeration 26·4 Times

INDEX

		RANGING FROM
ABSOLUTE RELIEF	-----	0 — 2000′
RELATIVE RELIEF	.....	0 — 1200′
SLOPE	——	0 — 20°
RUGGEDNESS NUMBER	- - -	0 — .004
DISSECTION INDEX	----	0 — 80 %
DRAINAGE DENSITY	.....	0 — .4 m^2
STREAM FREQUENCY	.....	0 — 8 No/m^2
RAINFALL INTENSITY	.....	0 — 8·5 cm.
ALTITUDE (MSL)	——	0 — 2000′



DISTANCE IN MILES

Vertical Exaggeration 26·4 Times

INDEX

		RANGING FROM
ABSOLUTE RELIEF	-----	0 - 2000′
RELATIVE RELIEF	.....	0 - 1200′
SLOPE	——	0 - 20°
RUGGEDNESS NUMBER	- - -	0 - .004
DISSECTION INDEX	----	0 - 80 %
DRAINAGE DENSITY	.....	0 - .4 P./m^2
STREAM FREQUENCY	.....	0 - 8 No/m^2
RAINFALL INTENSITY	.....	0 - 8·5 cm
ALTITUDE (MSL)	——	0 - 2000′

Fig. Nö 3

SOURCE: Survey of India Toposheets.

D.M.

GEOMORPHIC PARAMETERS ALONG 'C-D' CROSS-SECTION

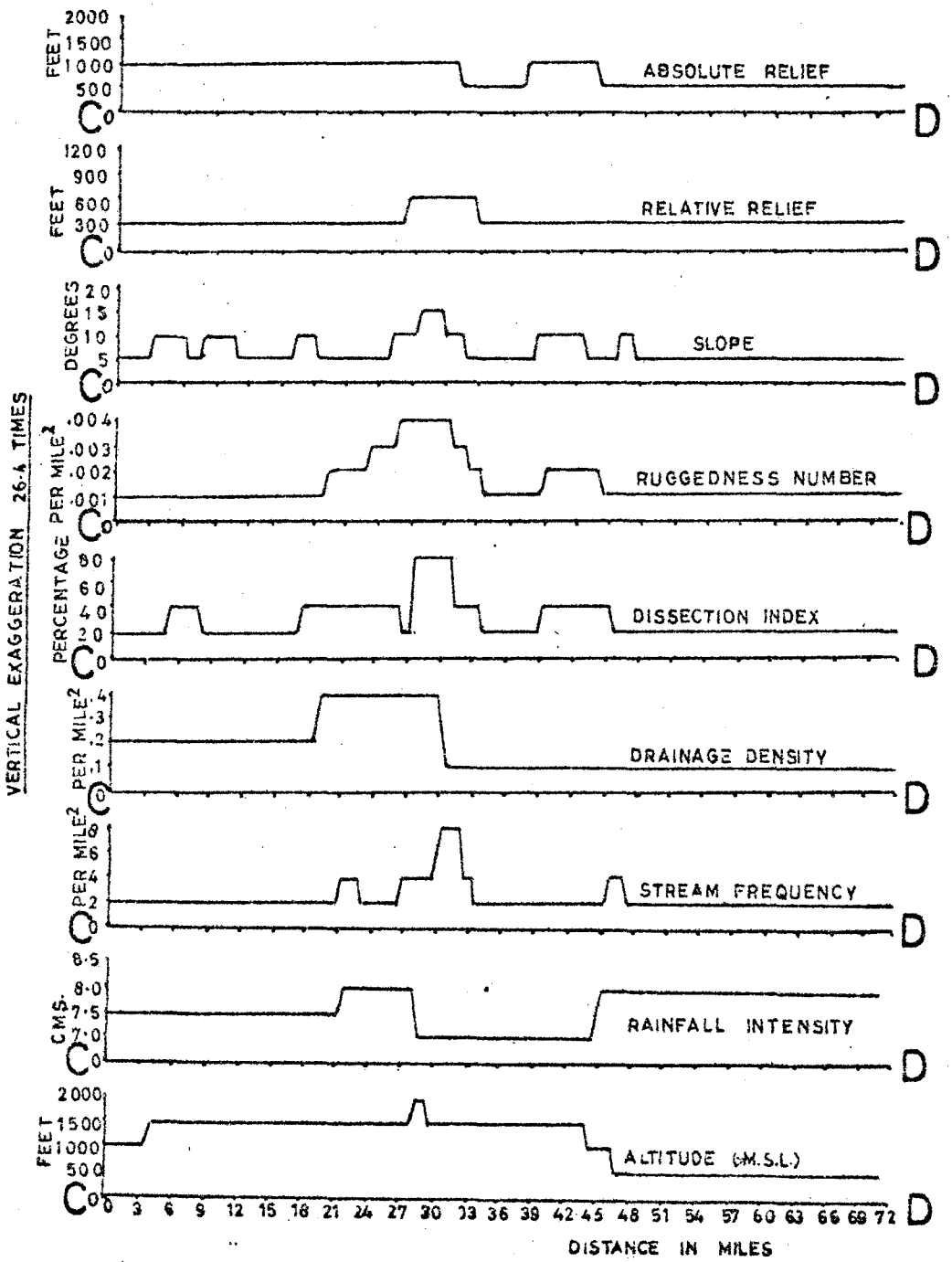


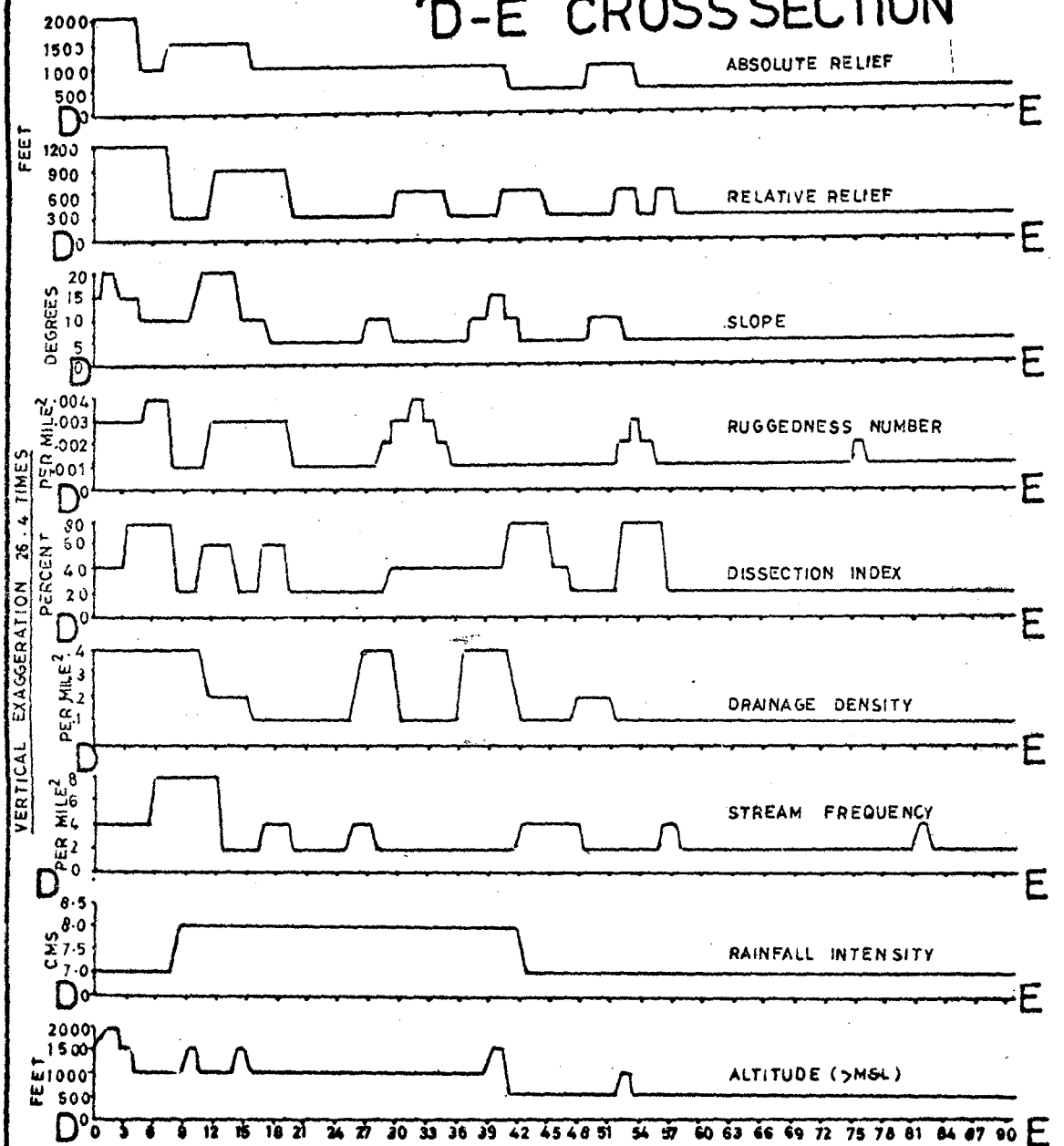
Fig. Nö 4

SOURCE: Survey of India Toposheets

SCALE: 1"=4 MILES

DM

GEOMORPHIC PARAMETERS ALONG 'D-E' CROSS SECTION



SCALE:

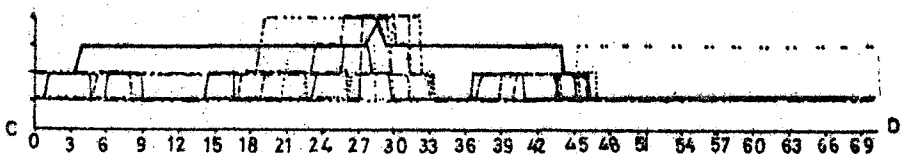
1 = 4 MILES

SOURCE: Survey of India Toposheets

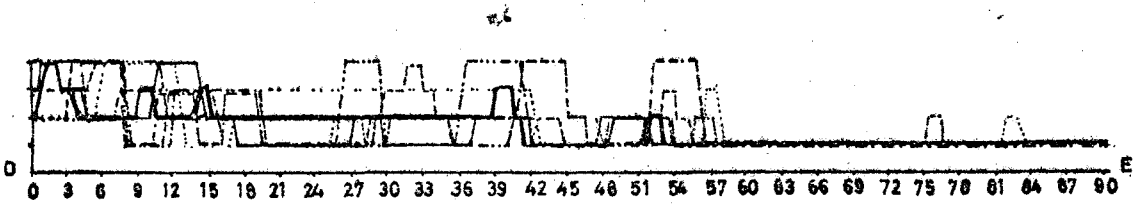
Fig. No. 5

D.M.

SUPERIMPOSITION OF GEOMORPHIC PARAMETERS ALONG VARIOUS CROSSSECTIONS.



INDEX		RANGING FROM
ABSOLUTE RELIEF	-.-.-.	0 - 2000′
RELATIVE RELIEF	-..-..-	0 - 1200′
SLOPE	———	0 - 20°
RUGGEDNESS NUMBER	- - -	0 - .004
DISSECTION INDEX	-.-.-.	0 - 80 %
DRAINAGE DENSITY	-..-..-	0 - .4 per m^2
STREAM FREQUENCY	.....	0 - 8 Nö/m^2
RAINFALL INTENSITY	. . . .	0 - 8.5 cm
ALTITUDE (M.S.L)	———	0 - 2000′



INDEX

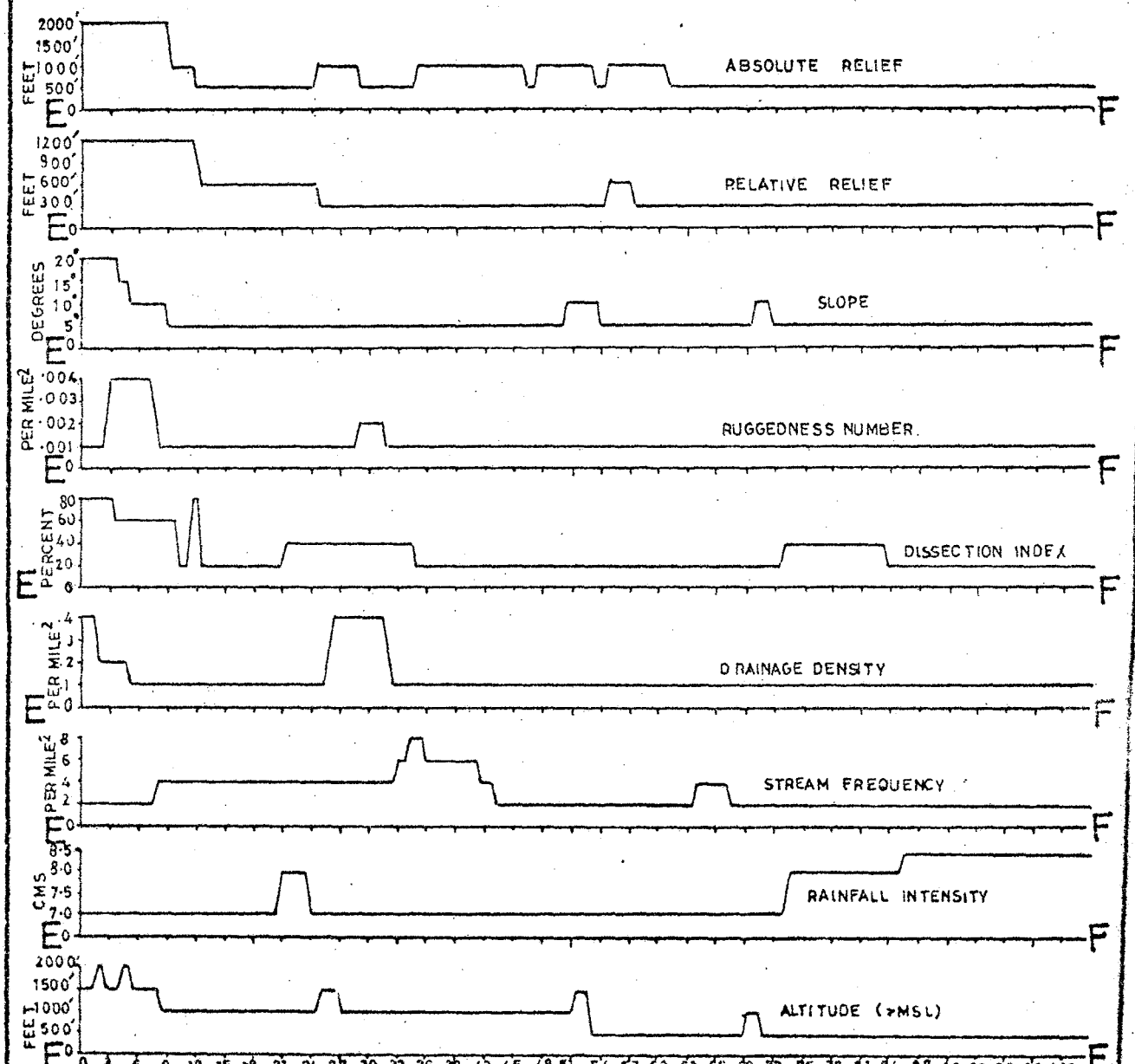
		RANGING FROM	
ABSOLUTE RELIEF	-.-.-.	0	2000′
RELATIVE RELIEF	-..-..-	0	1200′
SLOPE	———	0	20°
RUGGEDNESS NUMBER	- - -	0	.004
DISSECTION INDEX	-.-.-.	0	80 %
DRAINAGE DENSITY	-..-..-	0	.4 /m^2
STREAM FREQUENCY	.....	0	8 Nö/m^2
RAINFALL INTENSITY	. . . .	0	8.5 cm
ALTITUDE (MSL)	———	0	2000′

Fig Nö 6

SOURCE: Survey of India Toposheets

D.M.

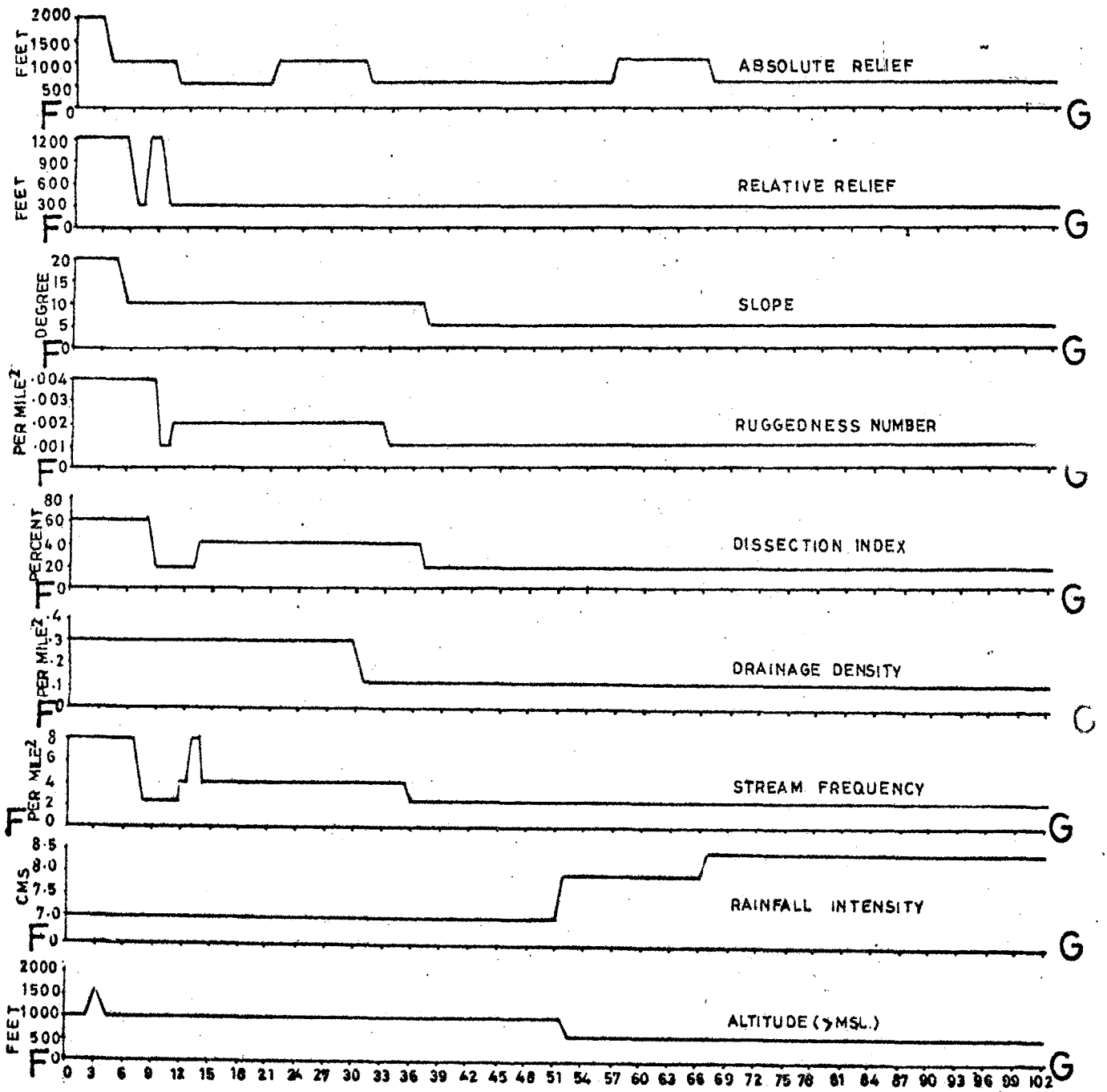
GEOMORPHIC PARAMETERS ALONG 'E-F' CROSS-SECTION



SOURCE: Survey of India Toposheets

Fig. No 7

GEOMORPHIC PARAMETERS ALONG 'F-G' CROSS-SECTION



VERTICAL EXAGGERATION 26·4 TIMES

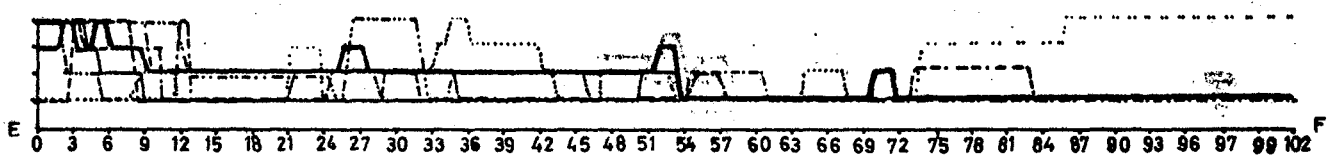
Fig. Nö 8

SCALE: 1" = 4 MILES

SOURCE: Survey of India Toposheets.

D.M.

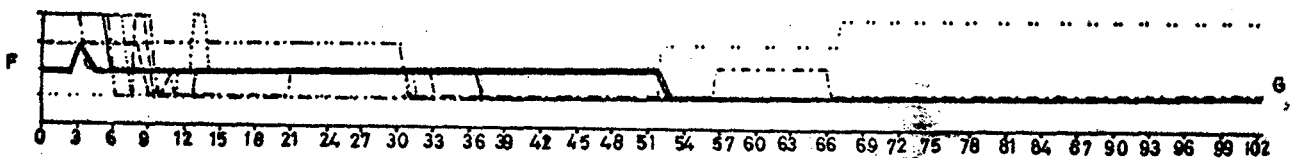
SUPERIMPOSITION OF GEOMORPHIC PARAMETERS ALONG VARIOUS CROSS SECTIONS.



DISTANCE IN MILES Vertical Exaggeration 26·4 Times

INDEX

		RANGING FROM:
ABSOLUTE RELIEF	-·-·-	0 – 2000′
RELATIVE RELIEF	-··-··	0 – 1200′
SLOPE	——	0 – 20°
RUGGEDNESS NUMBER	- - -	0 – ·004
DISSECTION INDEX	-·-·-	0 – 80 %
DRAINAGE DENSITY	·····	0 – ·4 / m²
STREAM FREQUENCY	·····	0 – 8 No m²
RAINFALL INTENSITY	·····	0 – 8·5cm.
ALTITUDE (M.S.L.)	——	0 – 2000′



DISTANCE IN MILES (Vertical Exaggeration 26·4 Times)

INDEX RANGING FROM:

ABSOLUTE RELIEF	-·-·-	0 – 2000′
RELATIVE RELIEF	-··-··	0 – 1200′
SLOPE	——	0 – 20°
RUGGEDNESS NUMBER	- - -	0 – ·004
DISSECTION INDEX	-·-·-	0 – 80%
DRAINAGE DENSITY	·····	0 – ·4 / m²
STREAM FREQUENCY	·····	0 – 8 No/m²
RAINFALL INTENSITY	- - - -	0 – 8·5 cm
ALTITUDE(M.S.L.)	——	0 – 2000′

SOURCE: Survey of India Toposheets

Fig. No. 9

D.M.

study of the area provides us a criterion to classify the region into certain geomorphic regions. Each unit is a sufficiently homogeneous piece of landscape with a certain slope value, dissection and other values of the other parameters.

Hence, on the basis of geomorphic analysis serial and super imposed profiles of all geomorphic factors, the region of Mewat has been divided into the following two major regions and their associated sub-units (Map No.).

A. Ridges & Valleys

AI Western Aravalli Range associated with valleys.

AII Central Aravalli Range.

AIIa - Dissected Piedmont Zone.

AIIb - Intermontane Midlands.

AIIc - Intermontane lowlands.

B. Plains Studded with Hillocks

BI Eastern Floodplains with sparse hillocks.

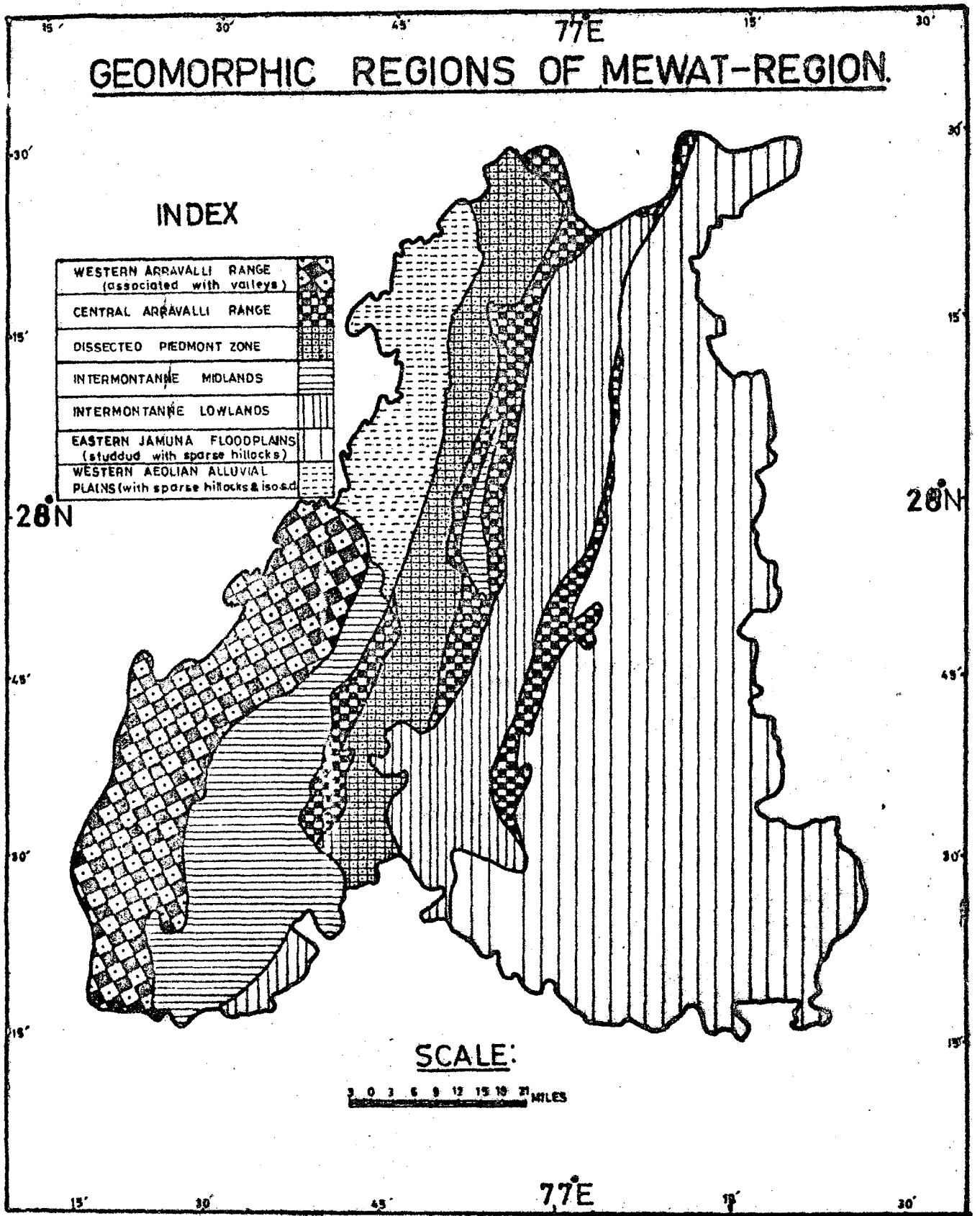
BII Western Aeolian Alluvial plains with sparse hillocks with scattered isolated and stabilised sand-dunes

The entire region on the basis of relief structure, slope elevation, ruggedity, dissection and drainage characteristics can broadly be divided into the following regions:

A. Ridges & Valleys

The western highland of the region is occupied by the ridges and valleys, dissected piedmont zones, intermontane midlands and lowlands between them. The parallel

GEOMORPHIC REGIONS OF MEWAT-REGION.



SOURCE: Survey of India Toposheets

MAP NO. 1+14

D.M.

ridges stretching from SW to NNE form the part of the anticlines. Slope of the ridges is quite steep and ranges between 10 to 20°. The riggee comprise of hard sandstone plus lime-stone belonging to the Alwar and Ajabgarh series of the Delhi system of Aravalli group. Drainage is mostly joint controlled and parallel to sub-parallel. Soils are not fully developed and mostly sandy in nature. The climatic conditions remains almost same throughout the region. This broad geomorphological unit covers almost half of the area (55.50%) of the entire region of Mewat.

The geographical extension of the region is 27°N to 28°30'N latitudes and 76°30' E to 77° Eastern longitudes. The tehsils which are partly or wholly falling in this region are Alwar, Ramgarh, Kishangarh, Tijara, Ferozepur Jhirka and Nuh. Thus broad region is further divisible into the following sub-geomorphic units.

AI Western Aravalli Range (associated with longitudinal hills and valleys):

This unit is identified in the south-western part of the region. This unit shows high ridges attaining a maximum height of 2233'. The absolute relief varies from 1000 feet in the east to 2000' in the west. Relative relief ranges from 600' to 1200'. Slopes are moderately steep to very steep and range between 10° to 20°. The range comprises of hard sandstone, which geologically

belongs to the Alwar series of Delhi system. Ruggedness is high but dissection is low.

The map No. shows that this geomorphic unit forms south western boundary of the region having western parts of Alwar and Kishangarh tehsils. It has an elevation ranging from 1000' in the east to more than 2000' in the west, and occupies the higher position in the present topography of the region. The western Aravalli ranges are characterised by flat topped table lands, separated from one another by scarp faces. These scrap faces are highly dissected by headward erosion of the ephemeral streams meeting the mainstream in its lower reaches.

Geologically, this region belongs to Alwar series of the Delhi sub-system, which comprises of hornstone, slates, phyllites, quartzite and sandstones.

In addition, the ranges are well associated with the valleys also. The important and well known valleys in the region are as follows: Jindoli Ki Ghati which consists 52 mors (folds) a road passes through it, Umr[illegible]-Ghati, Ratan Valley and Chuhursidh etc. are other valleys.

The density and frequency of streams is comparatively higher than those of the lowlying areas in the east. On the whole this geomorphic unit of the region may be the most rugged zone.

AII. Central Aravalli Range:

Central Aravalli ranges are the most important geomorphic features in the region, as it is an important watershed divide, which contributes the rainfall water to the region through a myriad of small ephemeral rivulets, orginating from the tops of these hills. These hills are actually running very parallel to each other, in the mid of Mewat and upto Sohna block of Gurgaon district. The elevation varies from 750' in the east to 1500' to the top lands of the hills. It slopes gradually towards west but falls rapidly to the eastern lowlands.

The main range of the central hills is 'Kala Pahar', which extends from Noganwan - the southern point to Bhundsi - the northern end. This hill is constituted of several valleys also. The local well known valleys are Jhir valley connecting Tijara and Ferozepur Jhirka through a direct bus service.

Besides this, Bandhawa ghati connects Tauru town to the Nuh tehsil of Mewat. The other valleys like Navalli, Nangal Lapala, Sareta, Arandka, Roophas, Kultanpur, Kansali, Ghagas, Shadipur-Adupur, Seroli, Indore and Jeroli etc. all provide a media to the people of high perched villages of Mewat and those who are living in the lowlying plains.

The extension of Central Aravalli range starts from Delhi in the North to Noganwan village, a southern most tip. It covers an area of about 6.43% of the total area of the

region.[8]

This range of hills and plateaus is further divisible into 3 sub-geomorphic units such as:

A1In : Dissected Piedmont Zone:

The high lands of Mewat, in fact is the region of great inequalities and present a rich panor[illegible] of topographical features. By and large it is a gently sloping land, which can for the sake of convenience be divided into two sub-divisions. (1) Upper Piedmont zone with a slope of 5% followed by the lower piedmont plain, which merges imperceptibly with a still gentle sloping plain characterised by aeolian deposits of the westward shifting Sahibi Nadi. It is evident that this is an ancient base level of denudation re-raised and now being redenuded to a new and lower base level.

Another feature of this zone is the presence of conspicuous and closely spaced ephemeral channels (called Nallas in local tongue). These have, here developed due to a considerable degree of rain water infiltration in the weathered rocks, especially along the joints. Owing to high relief and resultant slopes, surface run-off has more erosion power. Better infiltration in this environment of weathered and jointed rocks can be expected at the foot hills on the western slopes of 'Kala Pahar'

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8. Haryana Distt - Gazetteer 1882 to 1912
Archaeological Survey of India - Delhi.

(Central Aravelli Range), where usually vast rocky piedmont zone can be seen. It has a gentler slope and surface run off is allowed down due to the presence of a thin cover of a detritus. The gidawaras (highly zig-zag land) of Gwalada, Hamiraka, Allahpur, Baghora, Gol-Phullabas, Burja and Mirjapur etc. are included in the central long strip of piedmont zone.

Geologically, it is a part of residual Ajabgarh series extending in NS direction. The Ajabgarh series separates the Alwar series near Gol (a high perched village) and continues upto Adupur valley in the North. Some residual hillocks of the Ajabgarh series can be seen uptil Jhiwana in Kapukra block. The slopes of piedmont display shallow to medium ravines having very deep course textural soils of dark yellowish brown to dark colour. Generally these soils are suitable for growing different species of grasses and that is why the long piedmont zones of Mewat are used as the grazing lands.[9]

The intensity of erosion is severe to very severe and the management is very very poor in the eastern part of the zone viz. in the foot hills of Kala Pahar. It displays a ravinous dissected and undulating landscape.

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9. Soil & Land - Use Survey Department
I.A.R.I. Pusa Road, New Delhi (personal communication).

Due to bad topography and lack of any soil conservation such land yields more silts to the reservoir. This dissected but most probably flat region extending across Ramgarh tehsil in the south and continuing throughout the region covers an area about 8.29% of the total area of the region. In Tijara, its location is falling in the eastern part of the tehsil, is actually a prolongation of Kala Pahar range. It is made up of Ajabgarh and Alwar series of Delhi system and comprises of gravellish, quartz yellowish soils and silty loam. The absolute relief ranges from 500' to 1500', relative relief 0 to 900', ruggedness number 0 to.003 and dissection from 20 to 60%. Besides if drainage density (.4) and stream frequency (8 streams per mile) is the highest in this zone.

AIIb - Intermontane Lowlands:

This tract extends across the Palaria station in the north (on Alwar - Tijara Road) and continuing upto the southern boundary where Mewat ends. More or less the midlands are quite plain patches, where the slope elevation is not ranging more than 5° at anywhere. These are an elongated valleys wider towards south and tapering towards north. Two inter-ridge midlands have been observed in the uplands of Mewat. One is Ghansoli-Kolgaon tract including Burja tract also. Second is the Kundla - surrounded by the hills of Tijara and that of

Kala Pahar in the east. The soils are very fertile and are brought by the small rivulets from the top of the hills and are well deposited in the bottom of the foothills. Henceforth, the clayey soils are available here. It would not be incorrect, if we call midlands as a series of foot-slopes of the high hills formed of unassorted rock fragments and soil material brought down by streams. These were essentially sandy silts, gravels, but within some patches clay is also found. The average elevation of these midlands hardly exceed 1000' anywhere. Slope is very gentle to moderate sloping and soils are deep to very deep with medium textured. The whole tract of midland covers nearly 10.07% of the total area of the region.

AIIc : Intermontane Lowlands:

The intermontane lowland of Mewat is called "the "grain bowl" (Naj ka Katora) of the region. The relief characteristics are quite indiscriminative throughout the region. It is quite a plain unit, where slope hardly exceeds 3° anywhere in the region. The unit seemdsto be developed either by deposits brought predominantly by stream flowing through it. Or the Jamuna inundations. Old river courses are very much seen in this plain unit. The material composition is silty clayey loam.[10] Drainage

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10. Raghavswamy V. - "Study of Landform Land Use and Land Units Photonirvachak Vol.VI No.4, 1978 pp. 43.

is very scarce and dissection and ruggedness number values are below 20% and .001 respectively. The soils found are of two types sandy loam and clayey loam. Clayey loam widers in north while tapers in the south. This tract of lowland in Mewat comprises of three tehsils namely Ramgarh, Ferozepur Jhirka and Nuh. This narrow strip between the two hills are parallel to each other, traversing south-west to north east direction; extends across SE Ramgarh and continues through Roska Meo and Dhunela - the last points of northern Mewat boundary. Further it continue upto Bhundsi a 16 kms from Sohna (the tourist complex in Gurgaon).

During rainy days, most of the water from uplands, enter through landoha freshet in the lowlands and being a cause of havoc and inundations(called 'Bharia' in the region) those sometimes become the great disasters for the surrounding areas. The total area covered by this geomorphic unit is 11.93% of the region as a whole.[11]

B. PLAINS STUDDED WITH SPARSE HILLOCKS

It occupies the eastern most part of the region and half of the western most part of the NNW region. The plains are divisible into two parts namely BI-Eastern Jamuna flood-plains with sparse hillocks and BII-western aeolian alluvial

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11. Haryana Distt. Gazetter of 1882 - 1912
Archaeological Survey of India, New Delhi.

plains with sparse hillocks and isolated sand dunes.

BI - Eastern Jamuna floodplains with sparse hillocks and the ash-taboos:

This unit is an extensive flat land, almost level with 0 to 10 of slope. Drainage, dissection and other relief characteristics are negligible. It extends along Jamuna river and shows active signs of riverine influence. The relicts of the central Aravalli range have been taken as the line of demarcation between older and newer alluvium plains. The older alluvium tract is called Abres while, the newer one is called Bhayana. It receives the clayey silt from the floods every year and a veneer of newer alluvium is deposited, which form the fertile upper layer. Hence this tract is an another "grain bowl of the region". In fact, the soils of this tract are very fertile from agricultural point of view. The elevation of this tract is below 500' throughout from mean sea level. The area occupied is 44.22% of the total area of the region. And covers vast parts of Mathura, Kaman, Nagar, Pahari, Punhana and Hathin blocks of Mewat.[12]

The alluvium at some places is so deep as 40 feet underlain by sand beds of 2 to 3 feet thickness. The

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12. Gazetter of Bharatpur disst. of Rajputana 1958.

topography is almost flat, except for certain micro relief at places like the ash taboos and small conical hills. All high populated villages of Mewat are inhibited over these taboos, Sehoas Singar, Nai, Bichhor, Kot Bahin , Kathol, Thalchana, Shikrawa, Utawar and Luhinga etc. Some of the conical hills are at Chokha, Luhinga, Kaman, Pahari etc.

BII : <u>Western floodplains with scattered hills and isolated sand-dunes</u>

These plains are relatively higher than those of the eastern floodplains. Summer winds (called 'loo' or Jhagar with high temperatures) play a dominant role in shaping the aeolain plains of the area under study. The great geomorphological significance of wind occurs in Tijara, Kishangarh and Tapukra blocks. The action of wind consists of the transportation of loose dust or sand particles. The dust is lifted by the turbulance of air in April, May, June and some times even in July (as it today, 1982) is dragged along as the bed load in water streams. But especially, it is significant in the western parts of the region falling within Sahibi catechment area.

The aeolian plain by and large are the flat units with the scattered hills and isolated cum stabilized sand-dunes. The soils are less productive, however, the irrigation facilities are available everywhere as the ground water table is near from the upper earth surface.

The infrastructure facilities in the region can

play an important role in making the soils more fe. Drainage is rare but very useful to the region. The of streams in towards west, that means the slope gradual. lowers down towafds west upto Sahibi main channel.

The soils are varying from deep dark to yellowish brown and sandy loamto pure sandy, which have developed over aeolain deposits, occuring on very gentle to moderate sloping stabilized slopes. These soils are excessively drained due to their loose structure, which increases the permeability to a great extent. Moderate wind and water erosion is common.

Mewat region on the whole offers a wide scope for further delimitation of Geom units, though the seven units which are broadly recognised from the geom analysis provide a base with which the landuse can broadly be correlated in the foregoing pages.

CHAPTER - IV

CHAPTER - IV

LAND-USE OF MEWAT

LAND USE : Meaning & Definitions:

Land use is any kind of permanent of cyclic human intervention to satisfy human needs, either material or spiritual or both from the complex of natural or artifactial resources which together are called "land". Land carried ecosystems and land use is the application of human controls, in a relatively systematic manner to the key elements within any ecosystem in order to derive benefit from it.[1]

Land being the carrier of those ecosystems which provide the most benefits to mankind, is the overall natural resource; its use always involves specific surface areas; land is therefore a truly geographical concept. The land as we see it today is in many areas the result of a combination of both its natural genesis and the human influences which have been brought to bear on it in the past and those of which are still active in the present.

Land is a dynamic concept; it carries ecosystems but is itself also a part of these ecosystems. One of its

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1. VINK A.P.A (1975) Advanced series in Agricultural Sciences. Land Use An Advanced Series in Agriculture, New York pp.11-13.

main components, the soil is itself a complex ecosystem containing animals and plants of different sizes and activities. Land, although tending towards a steady state, is therefore never truly stable. The land viewed as landscape, as observed today by both visual and other methods of perception, may achieve near stability from certain points of view, but this stability is the result of complex interactions of a multitude of phenomena and processes.[2]

The best definition of land therefore is one which involves the geographical aspects of "a tract of land" and reads: "A tract of land is defined geographically as a specific area of the earth's surface; its characteristics embrace all reasonably stable, or predictably cyclic attributes of the biosphere vertically above and below this area including those of atmosphere, the soil and underlying rocks, the topography, the water, the plant and animal populations and the results of past and present human activity, to the extent that these attributes exert a significant influence on present and future uses of the land by man."

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2. Op. cit. pp. 11

3. Op. cit pp. 11

Purpose & Scope of Studying the Land-use:

Why geographers should study land use is basically essential to be decided first. To a geographer, land means space or habitat rather than the nature itself, always active and having its own processes of change, development and decay. Since geography is primarily interested in studying the existing integrations of diverse phenomena which by their existence, determine the variable character of an area, geographers must study the total amalgam of various types of classes of land giving a particular character to an area. The task for geographer is to study and correlate the relative role of various land classes and their variations in time and space in determining the total biotic potential or natural productivity of land resources of an area.[4]

Land use studies comprise of the description of the whole arrangement or integration of various types of land found in an area, the factors responsible for this complex, and its effect upon the society. Though, the scope of land use studies is to evaluate the physio-biotic base of land resources, their changing use or misuse by the society in its past and present.

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4. TEWARI A.R. & CHAUHAN K.N. (1978) - "Some principles for Land Use Planning in Upper Ganga Plains." - 21st IGU Symposium on Land-use pp.45-47.

The very purpose of geography and its spatial branch, geomorphology is to study the reality of earth surface. Land-use is obviously a reality in itself. The conversion of land from one major use to another, manifests itself as a three dimensional reality in space, time and inter-relationships. The gradual increase of cultivated land in these plains of Mewat has got its three aspects of which the foremost is that cultivated land has been occupying more and more space on higher relief surface, secondly this expansion took a certain span of time and thirdly there were definite related factors of growing population in the region. Hence, food demands and technology brought forth this increase. Thus land use involves extremely complex integrations of phenomena; natural and human, determining the degrees of use of land resources for specific purposes. Regionalism is the soul of land-use. Therefore, it should be treated as regional study and not merely a topical one, since inherent character of the region and the existing land-use are reciprocally interdependent and inter-related.[5]

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5. TEWARI A.K. & CHAUHAN K.N. - (1968) Some Principles of Land Use Planning in Upper Ganga Plains - 21st IGU Aligarh pp. 46-47.

Selection of Land Use Categories:

Though in the data we have included all the 9 categories of land use, which Dudley Stamp had proposed a long back in England, but for our analytical study (i.e. correlation analysis between geomorphology and land use) we have selected only five broad groups of land-use. These are as follows:

1. Area Under Forests
2. Barren Uncultivated lands
3. Scrubs and Pastures
4. Wastelands
5. Cultivable lands

The criterion as to why we have chosen, only the above 5 categories is clear cut as the very purpose of this study is first to bring into lime-light the impact of geomorphological parameters on the land-use of the region. Now, if we shall include all other types of land-use, like of NSA (Net Sown Area), ASMO (Area Sown More than Once) GCA (Gross Cropped Areas) and Land put to Non-Agricultural uses etc., the results of the correlates may loose their strongness, because the above remaining four categories are more close to the economic factors i.e. innovation of modern technology and the infra-structural facilities etc. Therefore, these factors should not be considered under geomorphology (the science of landscapes) its association with landuse.

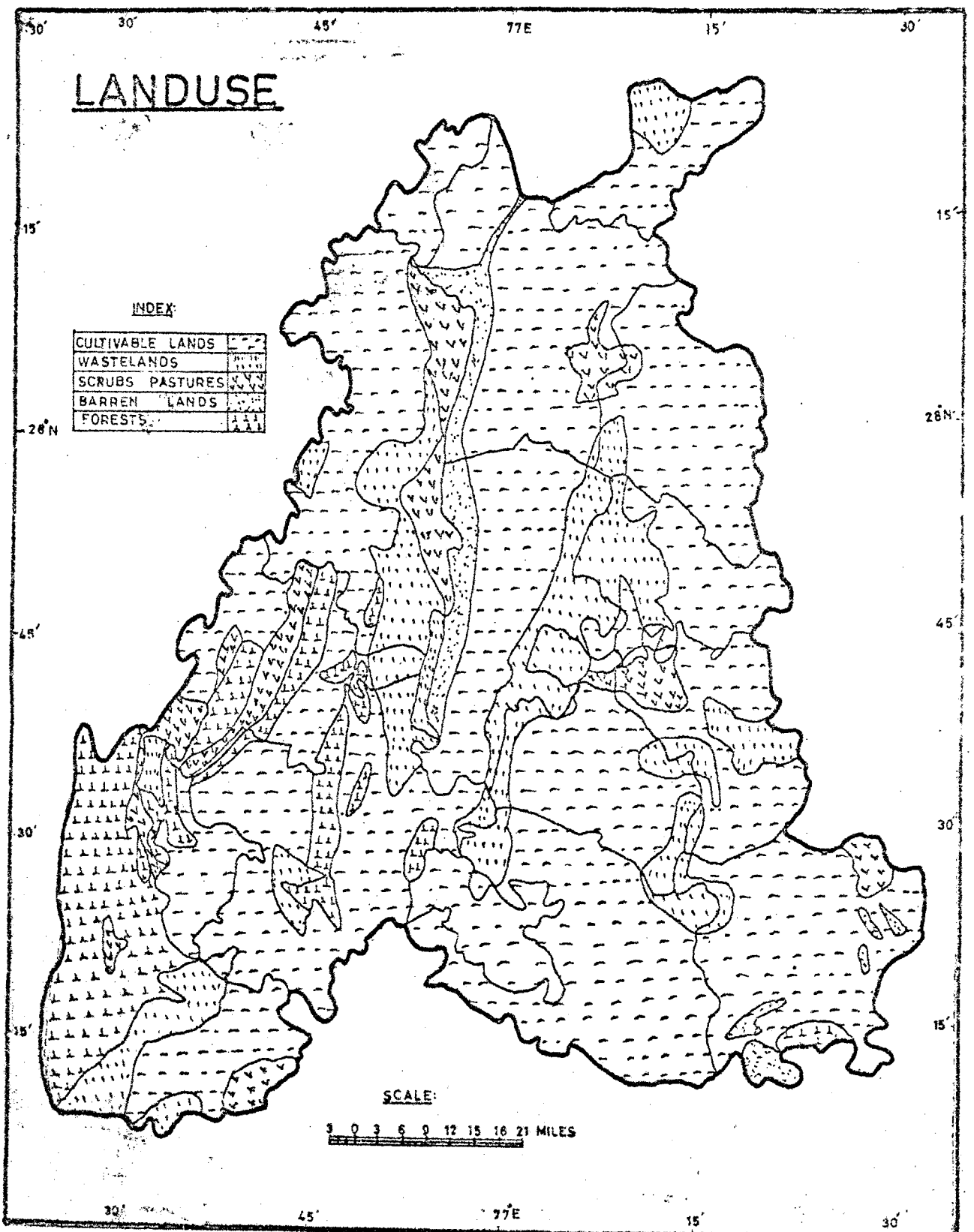
Secondly, till now many studies have appeared on land productivity and its causative factors, but there has been very little projection of the impact of geomorphic parameters on land-use in general. In this study an attempt has been made to describe the general pattern of land-use and also to associate these with geomorphic regions.

LAND-USE - A General Distribution:

In the background of physical environment, as described in the previous chapters, the author has attempted to study the existing land use of Mewat Region, through the toposheet interpretation and extensive surveys of the twelve selected tehsils falling in the region. The land-use data has been collected from the 'Revenue Records' of the year 1980-81. (map No.)

The general land-use of the region as a whole shown in TABLE 4.1 gives a summary of proportions of land, devoted to various uses in the region.

It is apparent from the TABLE 4.1 that 74.20% of the total area is lying under cultivable lands, and the remaining 25.80% is devoted to the other type of land-uses, as 2.85% under forests; 6.14% under barrens; 6.22% under landput to non-agricultural uses; 0.95% under permanent pastures and grazing lands; 1.39% under cultivable wastes and 8.27% area is under fallowlands- including



MAP No 1515 D.M.

GENERAL DISTRIBUTION OF LAND-USE IN MEWAT REGION
YEAR 1980-81

(Area in Hectares)

S.No.	Name Block cum Tehsil		Total Geographical area	I Area under forest	II Barren lands	III Dandput to Non-agri.uses	IV Permanent Pastures	V Cultivable wastes
1.	ALWAR		92,372	7,657	6,054	14,753	1,897	3,019
		a.	(12.35)	(1.02)	(0.80)	(1.97)	(0.25)	(0.40)
		b.	(100.00)	(8.28)	(15.97)	(6.55)	(2.05)	(3.26)
2.	DEEG		N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
3.	F.P. JHIRKA		81,416	-	12,509	1,338	331	692
		a.	(10.88)					
		b.	(100.00)					
4.	HATTIN		39,979	-	3,925	1,457	89	1,530
		a.	(5.34)		(0.52)	(0.19)	(0.01)	(0.20)
		b.	(100.00)		(3.64)	(9.81)	(0.22)	(3.82)
5.	KAMAN		35,385	-	2,098	7,192	1,391	795
		a.	(4.73)		(0.28)	(0.96)	(0.18)	(0.10)
		b.	(100.00)		(10.49)	(4.58)	(2.81)	(1.96)
6.	KISHANGARH		74,775	9,421	3,563	1,671	848	589
		a.	(10.00)	(1.25)	(0.47)	(0.22)	(0.11)	(0.07)
		b.	(100.00)	(12.59)	(2.23)	(4.76)	(1.13)	(0.78)
7.	NAGAR		46,838	-	2,408	2,579	280	443
		a.	(6.26)	-	(0.32)	(0.34)	(0.03)	(0.05)
		b.	(100.00)		(5.50)	(5.14)	(0.59)	(0.94)

a. %to total area of the region
b. % to total area of tehsil

Contd.

VI A Fallow lands	VII NAS	VIII ASMO	IX GCA
—			
5,146	53,803	19,951	73,754
(0.68)	(7.19)	(2.66)	(9.86)
(5.57)	(58.23)	(21.59)	(79.84)
N.A.	N.A.	N.A.	N.A.
19,953	45,933	24,523	70,456
530	33,891	14,248	48,139
(0.07)	(4.52)	(1.90)	(6.43)
(1.32)	(84.77)	(35.63)	(120.41)
6,716	26,647	7,389	34,966
(0.89)	(3.56)	(0.98)	(4.67)
(9.16)	(70.81)	(16.36)	(81.32)
—	—	—	—
4,859	53,863	16,724	70,587
(0.64)	(7.20)	(2.23)	(9.44)
(6.49)	(72.03)	(22.36)	(94.39)
—	—	—	—
4,457	36,668	7,733	44,401
(0.59)	(4.90)	(1.03)	(5.93)
(3.59)	(78.28)	(16.51)	(94.79)

8.	NUH	104,796	-	8,722	2,464	532	-
	a.	(14.01)		(1.16)	(0.32)	(0.07)	-
	b.	(100.00)		(2.35)	(8.32)	(0.50)	-
9.	PAHARI	38,020	-	1,269	674	510	645
	a.	(5.08)		(0.16)	(0.09)	(0.06)	(0.08)
	b.	100.0		N.A.	N.A.	N.A.	N.A.
10.	PUNHANA	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
11.	Ramgarh	57,948	30	2,953	8,154	1,263	1,229
	a.	(9.74)	(0.02)	(0.39)	(1.09)	(0.16)	(0.16)
	b.	(100.00)	-	(14.07)	(5.09)	(2.17)	(2.12)
12.	TIJARA	63,555	4,236	2,770	6,409	364	1,846
	a.	(8.49)	(0.56)	(0.37)	(0.87)	(0.04)	(0.24)
	b.	(100.00)	(6.66)	(10.00)	(4.35)	(0.57)	(2.90)

a. % to total area of the region
b. % to total area of Tehsil.

9,280	39,445	18,935	58;380
(1:24)	(5.28)	(2.53)	(7.80)
(8.85)	(37.63)	(18.06)	(55.73)
13	25;411	4;626	30;037
(0.01)	(3.39)	(0.61)	(4.01)
N.A.	N.A.	N.A.	N.A.
N.A.	N.A.	N.A.	N.A.
5,850	38;488	13;034	51,522
(0.78)	(5-14)	(1.74)	(6.89)
(10.09)	(66.41)	(22.49)	(88.91)
5,309	42;863	17,359	60,242
(0:71)	(5.73)	(2.32)	(8.05)
(8.35)	(47.31)	(27.31)	(94.78)

current and other than current fallows.[6]

1. Forests

Forested lands, which occupy very large areas in three tehsils of the region (Alwar, Kishangarh and Ramgarh offer a number of reversible land uses. They provide an extremely persistent and durable land cover that is relatively easy to reestablish either naturally or by seeding or planting wherever necessary. Forests help to clean the air, build and hold soils, and produce a wide variety of goods and services. In the practice of forest management, emphasis can be on timber production, recreation, watershed protection, wildlife, or grasing, depending on purpose and land suitability.

Forestry and Related Wildlands

Naturally forested lands, because of their renewing, flexible and generally durable land cover permit a number of combined uses.

Wildlife & Forests

There are many natural compatibility between wildlife species and forest cover. A good supply for year-round sustenance of wildlife is a basic need. As a general point, most food for wildlife has to be fairly close to the ground.

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6. CHAUDHRY L.K.S. (1978) Land Utilization in Kenton's Doab of Utter Pradesh - 21st IGU Symposium on Land-Use pp.124-125

Outdoor recreation and forests

Outdoor recreation and forests naturally go together, but their relationships are complex. They are also often complicated by the deep feelings people have about forests. People in general like trees and forests. But they also many have strong, varied and often ill-formed ideas regarding them.

As a land-use, outdoor recreation can be characterised by intensive use of relatively small areas and extensive use of large areas either separately or in many combinations. For example, resorts, picnic areas, or heavily used parts in or near by urban areas require relatively little spaces and the recreation experience is essentially complete in the area.

Grazing and Forests

Domestic livestock grazing and timber production are of limited compatiability as land-uses. The basic reason is that grass and trees are often vigorous competitors for the same land space and one will dominate the other. For example, grazing is often permittible in natural hardwood (deciduous tree) areas. Particularly if the soil is of good quality, the results are unsatisfactory unless grazing is carefully controlled as to season of year and the number of livestock permitted in the area. Soil compactions and tree damage especially to young trees may result, and grass and other low vegetation is

stimulated to the detriment of tree growth. A land use choice is necessary : either emphasize grazing use and retain some trees for protective livestock cover or emphasize tree growth and sharply restrict or exclude grazing.

Water and Forests

Forests are extremely effective in watershed protection. They protect the soil and stabilize stream flow. Indeed, the maintenance of sustained water yield from streams, lakes, and underground acquifers is of overriding importance in land-use in which forests play a major role.[7]

In this Study only natural forests are considered where the dry trees like Dhak, Kesula, Ker-Karil etc. are found. The total area under forests in Mewat i of the total region. Out of which 7.40% lies in western Aravalli ranges, which are associated valleys and foothills. The main forest are forests, Sariska animal sanctuary, Itare

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7. Kenneth P. Davis (1976) La Mcgraw Hill Book Co.

8. Kenneth P. Davis (1976) Land-Use pp.33 McGra

2. Barren Uncultivated lands:

The barren areas are those which are not fit for any agricultural purposes, even these areas have practically no good soil to hold vegetation. However, in recent years in some barren areas of Ferozepur Jhirka tehsil and Nuh tehsil, attempts are being made (by the Haryana Govt.) to grow some kind of grasses and trees so that the particular spots can later be brought as developed 'Tourist Resort Centres'.[9]

The barrens of Mewat are totally unproductive in their present state. They are spots of intensive soil erosion and dissection along and on the footslopes of hills, and in the central lowlying areas. Wherever they occur exclusively sand covers its zone. It is evident from the field observation that erosion along central Aravalli range (Kala Pahar) is mostly due to indiscriminate excavation of earth materials and irrational reclamation of land for cultivation to raise dry foodcrops and several commercial crops. In the rolling plain of the western part of the study area, available plain areas are being used for cultivation without paying proper attention to the surrounding sloping lands due to which the erosion hazard (removal of sands and silts by sheet erosion exposing the Kankar gravel, which is of no use) is turning,

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9. SHARMA J.K. (1980) "Use of Landsat in Mapping Land Utilization" Photo Nirvachak 1980 Vol.I pp.17.

even the cultivable lands into non-productive land. With practically no irrigation facilities through canals etc, the agriculture in these plains is entirely dependent upon rainfall. If rain occurs, people grow rainfed crops, such as - Moong Masina, Pulses, Jowar, Gowar etc.

3. Landput to Non Agricultural Uses

Landput to non-agricultural uses includes build up area, water bodies, canals and roads etc. 6.22% of the total area falls under this category.

4. Permanent Pastures and Grazing Lands

Large areas under pastures and grazing lands are located mainly in the piedmont zone and western and eastern alluvial plains of Mewat. The Tijara Roondh is totally used for grazing. During the monsoon due to some rain, wild grass grows, but at the beginning of summer most of the grass dries and area (western Aeolians) looks barren. Actually the grass lands in the western aeolian alluvial plains are not associated with pasture-land as practically no cattle herds are seen in this area throughout the year. The cattle mainly herds in the watersheds or in the stream banks where some sort of grasses are grown, but only during summer and winter season. During rainy season grasses are easy to be found

out everywhere in Mewat.[10]

5. Culturable Wastes

Extensive culturable wastes are an index of maladjustments in the farming techniques. The total area of culturable wastes in Mewat for quinquennium ending in 1980-81 averaged at 1.39% of the total area of the region as a whole. This much %age is calculated from the data obtained from village papers of 'Revenue Records'.[11]

It is important to note that the major programmes of land reclamation and management in the region have to deal with these 1.39% lying as culturable wastes. From the table 4.1, it is clear that there is comparatively small area under culturable wastes in eastern tehsils of Mewat namely Nagar, Deeg, Pahari, Ferozepur Jhirka, Hattin, Punhana and Nuh etc.

6. Fallow Lands

The distribution of fallowland in the area under study (TABLE 4.1) reveals interesting features. Percentages of fallowland decrease with marked improvement or

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10. SHARMA J.K. (1980) Use of Landsat in Mapping Vol I Land Utilization pp.17 PHOTONIRVAN.

11. SAXENA J.P. (1968) BUNDELKHAND: A case Study of AGRICULTURAL LAND USE IN A TRANSITIONAL ZONE - 21st IGU Symposium on Land-use pp.36.

deterioration in the agricultural potential. The highest percentage of fallowland are reported from tehsils such as Ferozepur Jhirka, Deeg, Nuh, Kaman, K,Garh Alwar, Ramgarh and Tijara. Tehsil Pahari has the lowest percentage of fallow land. Assured water supply through canals and tube-wells or electric pumps make fallowing pointless.[12]

The area under all types of fallows (old, new or current) in Mewat shows a gradual downward trend since independence. But inspite of this healthy trend, the area under fallowland still remains quite high particularly when seen in the light of the hectares of pastures and forests etc.

7. NAS (Net Area Sown)

The above table (4.1) reveals that the net area sown in the region amounts to 52.15% of the total reported area in 1980-81. The highest %age of net sown area was reported from Hattin tehsil, which was 84.77% of the total areas of the tehsil, the lowest amount of net sown area has been reported in Tijara tehsil, where it is only 47.31% of the total area of the tehsil.

8. ASMO

The highest %age of double cropped area (ASMO) has been found in Hattin tehsil (35.63%). It is because this

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12. AHMAD AIJAZUDDIN (1968) A Geographical Approach to the Problems of land use in the Indian Desert -21st IGU Symposium on Land-use pp.218.

tehsil of Mewat is rich in canal - irrigation and the soils are also of very productive nature (sandy and clayey loams)[13] the lowest %age of ASHO is available in Deeg tehsil where it is only 10.93% of the total area of the tehsil.

9. GCA

The gross cropped area in Hattin Tehsil amounted to 120.41% of the total area of the tehsil. This is the highest percentage of gross cropped area in the entire Mewat. The lowest percentage of gross cropped area has been found in Nuh tehsil, where it is only 55.73% of the total area of the tehsil.

Land Use Under Various Geomorphic Regions

A broad picture emerges out in front of us when geom map is overlaid on the landuse map of the region (map no.). In the following pages, a descriptive analysis is provided where landuse pattern is viewed under various geomo regions:

1. Western Aravalli Range

The forests are mainly located on the eastern slopes of western ranges of Aravallies, in the three tehsils of Mewat namely Alwar, Kishangarh and Ramgarh. Some forested areas exist in Tijara tehsil on the tops and foothills of central Aravalli Range. 7.40% of the area of the total

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13. CHAUDHRY L.K.S. (1968) "Land Utilization in Kenpons Doab of Utter Pradesh -21st IGU Symposium on LandUse pp. 127.

LAND USE WITHIN GEOMORPHIC REGIONS OF MEWAT.

KEY TO REGIONS:

A- Ridges & Valleys.

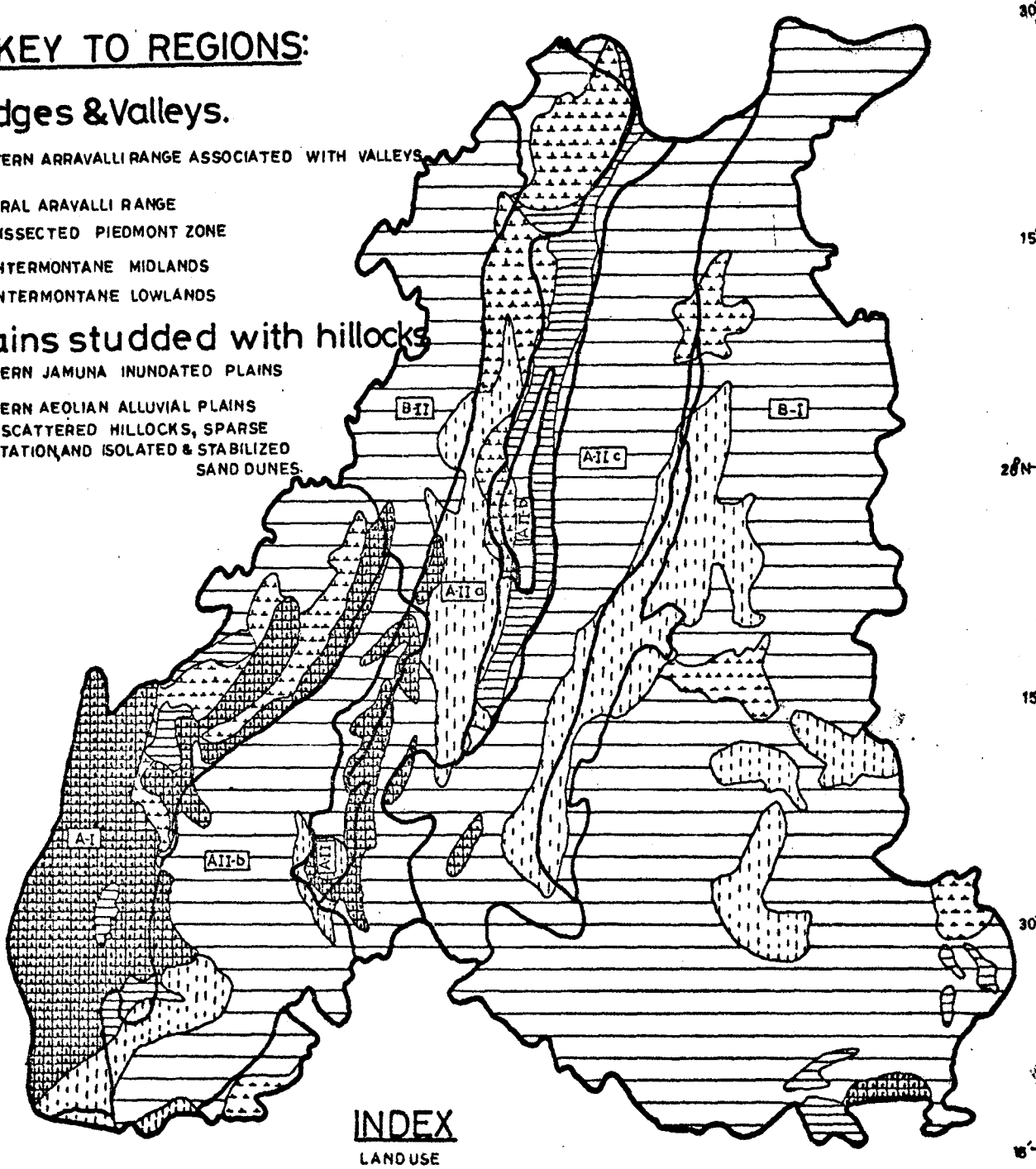
A-I WESTERN ARRAVALLI RANGE ASSOCIATED WITH VALLEYS

A-II CENTRAL ARAVALLI RANGE

- a DISSECTED PIEDMONT ZONE
- b INTERMONTANE MIDLANDS
- c INTERMONTANE LOWLANDS

B Plains studded with hillocks

- I EASTERN JAMUNA INUNDATED PLAINS
- II WESTERN AEOLIAN ALLUVIAL PLAINS WITH SCATTERED HILLOCKS, SPARSE VEGETATION AND ISOLATED & STABILIZED SAND DUNES.



INDEX

LAND USE

ARABLE LANDS	
WASTE LANDS	
SCRUBS AND PASTURES	
BARREN LANDS	
FORESTS	

Scale:

0 3 6 9 12 15 18 21 MILES

SOURCE: SURVEY of INDIA TOPOSHEETS PLUS INDIAN FOREST ATLAS

MAP NO. 1615

TABLE 4.2

LAND-USE WITHIN GEOMORPHIC REGIONS
(MEWAT - 1980-81)

S. No.	Geomorphic Regions	Land-use in % to the total area of the Region					
		I	II	III	IV	V	Total
1.	A.Ridges & Valleys	10.33	5.04	5.80	7.77	26.60	55.55
2.	B.Plains studdes with hillocks	0.30	0.76	2.25	4.86	36.27	44.45
3.	AI-Western Aravalli range assoc.with valleys	7.40	1.06	2.94	0.51	1.69	13.59
4.	AII-Central Aravalli	0.72	2.94	-	1.69	1.90	7.25
5.	AIIa-Dissected Piedmont zone	1.10	0.25	2.63	2.78	3.00	9.76
6.	AIIb-Intermontane Midlands	0.86	0.82	-	1.29	8.03	11.00
7.	AIIC-Intermontane lowlands	0.25	-	0.22	1.50	11.96	13.93
8.	BI-Eastern Jamuna flood plains	0.23	0.74	2.15	4.51	32.33	39.98
9.	BII-Western Aeolian plains	0.06	0.01	0.09	0.35	3.93	4.47
	TOTAL	11.63	5.80	8.05	12.63	62.87	100.00

Index for land use categories

I Area Under Forests
II Barren lands
III Scrubs & Pastures
IV Wastelands
V cultivable lands.

region lies under forests in western Aravalli range. The total area of the western Aravallies is calculated to be 13.5% of the total area of the region. Only 7.40% area lies under forests and the remaining area concentrates as 1.06% under barren lands, 2.94% under scrubs and pastures; 0.51% under waste lands and 1.69% area under cultivable lands.

2. Central Aravalli Range

The total area of the region under land-use categories falling in the above geomorphic regions is 7.25% of the total area. Out of which 2.94%, the highest of this region lies under barrens and of the remaining 1.90% area concentrates under cultivation, 1.69% under waste-lands and 0.72% under forests. The pastures and scrubs are totally absent within this geomorphic region.

3. Dissected Piedmont Zone

Out of 9.76% area of this region, 3.00% area of the total region of Mewat lies under cultivation; of which the remaining area 2.78% is under wastelands; 2.63% under scrubs, 1.10% area under forests and only 0.25% area under barrens.

4. Intermontane Midlands

This geomorphic unit covers an area of the total as 11.00%. Out of this 8.03% area is already been devoted to the agricultural purpose. Out of the

remaining area 1.29% is under wastes; 0.82% is under barrens and 0.86% is under forests.

5. Intermontane Lowlands

The highest percentage of land put to proper use lies within the intermontane valley lands. 11.96% area lies under cultivation, 1.50% area under wastelands and 0.22%, 0.25% is under scrubs and pastures respectively.

6. Eastern Jamuna flood plains

This region covers a total area amounting to 39.98% of the total Mewat. 32.33% area, which is the highest in the region, lies under cultivation. The remaining area is split into following heads as 4.51% under wastelands, 2.15% under scrubs and pastures, 0.74% under barrens, and 0.23% under forests. It is observed from the table that the highest area under agricultural land lies only within this geomorphic unit of Mewat.

7. Western Aeolian Alluvial Plains

Out of total area of this unit (4.47% of the total region), 3.94% area is devoted to the agricultural fields and 0.35% lies under wastes. While the remaining 0.09, 0.01 and 0.06% is under scrubs, barrens & forests respectively.

PATTERN AND TREND OF LANDUSE IN MEWAT

On the basis of map analysis, it is revealed that this region has about 62.87% area under forests. However the revenue records show that 72.50% area of the total

was under gross cropped area during the period 1980-81. On the whole, it can be inferred that the cultivable area is more or less around 60% of the total.

Generally, forests, pastures and wastes are found on hills and extensive cultivation is carried in plains and intermontane midlands and lowlands.

The present study reveals that the landuse patterns under different geomorphic units vary according to physical potentialities of the units. Flat plains have good agricultural potentialities, whereas hills and highlands are not suitable for cultivation. Besides, the western aeolian plains and the central lowlying saline buried plains have comparatively less agricultural potentialities.

A broad landuse pattern for the region as a whole has been identified from the data obtained after the analysis of the land use maps. The TABLE 4.2 gives the general land-use figures for all 12 tehsils-cum-blocks falling in the region. It will be seen from the tables that out of 12 tehsils, in 6 tehsils more than 60% area is cultivated. These tehsils are Deeg, Hattin, Kaman, Kishangarh, Nagar and Ramgarh. Four tehsils namely Tijara, Nuh, Ferozepur Jhirka and Alwar, which lie in the high land tracts, the Wage of cultivated lands is almost half of the total area of the particular tehsil.

CHAPTER – V

CHAPTER - V

Part A

Geomorphology and Land Use

A. Qualitative Analysis:

A few studies on geomorphology and land systems have been carried out in different parts of our country. But a very few studies can rarely be seen on the association of geomorphology and land-use. However, whatever the studies have been done are of much importance. Such land system studies in our country have been utilized in the improvement and development of the regions. The very purpose of this study is to obtain basic informations through geomorphic maps on different aspects of landforms, land units and current land-use; their capability and limitations to ensure proper development and management of the land resources in the study area. Similar studies were carried out by Cook et.al. (1974), Iyer and Srinivasan by the Division of the Land Use Research, CSIRO Australia.[1]

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1. Raghavswamy V. & Vaidyanadhan R. (1980) Morphology and Land Systems of - a part of Nishakhapattnam District - A.P.

Balkrishna Bharadwaj[2] has made an attempt (unpublished Ph.D.thesis, CSR, JNU) to associate some of the geomorphological parameters and rock out crops with the agricultural productivity in Gurgaon District.

The Significance of Landform Studies:

The surface of the earth has been sculptured by the natural forces, which act upon it, and, increasingly, by man. The kinds of natural landform which characterise a region, the slopes of the hills and valleys for example, are determined by a combination of geologic factors acting in association with other factors, including (1) climate, (2) the composition, structure and attitude of the rocks; and (3) elevation above the base level of erosion. The active working forces are water, ice, wind, and gravity. The landscape is dynamic and changing, with material being removed from one place and deposited in another. The rates of denudation and deposition change in short cycles from season to season and in long cycles from one epoch to another. The branch of geology which deals with the origin and nature of landforms is

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2. PHOTONIRVACHAK - Jour. of Ind. Soc. Photo.Int. & Remote sensing, Vol.8, No.1, pp.11-13.

commonly referred to as physiography. It is important that the civil engineer and planner understand that in sculpturing the land, the natural forces of erosion have worked toward establishment of slopes and gradients that are relatively stable. When the work of man changes, a hill slope destroys its equilibrium, the natural forces immediately set about restoring a stable slope. Natural restoration involves mass movements through soil creep, slumping, or even landslides. Where, for example, the lower part of a natural process work to reduce the over-steepened slope. The result might range from a slow creeping encroachment of soil on the highway to sudden falls of large masses of rock and soil. In this example, proper design of highway would include stabilization of the hill slope, and the necessity of stabilizing the slope should come from advance study and experience and not as an unpleasant and costly surprise after construction.

From geologic maps, topographic maps, and air-photographs the gain or texture of the land, the characteristic landforms, and the drainage patterns are immediately apparent, and many conclusions about earth processes and earth materials of value to the engineer and planner can be drawn without over setting

foot on the ground. In fact, such terrain analysis have been made for many years by military geologists who commonly must provide data on construction sites for airfields and other buildings, sources of construction materials, water supply, and transportation routes before the terrain has been occupied. These data on land-use are the same as those needed by the planner who goes about his task with less urgency and therefore, with opportunity for more thoroughness than his military counterpart.*

Geomorphic Control on Land-Use:

The geomorphology of the region has an impace- direct or indirect on the land-use of the region. In case of present study area, hills are mostly covered with forests and barrens, while the valley floors, which are covered with transported sediments by the existing ephemeral streams from the surrounding hills are principally being put to either grazing lands or left as wastes. Besides, all the lowlying eastern plains plus central midlands and the western Aeolian Plains, are put to the agricultural use. The valleys like Jhir, Baloj and Bandhawa are being converted for

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* FLAWN (T. PETER) 1970 : Conservation, Land Use Planning And Resource Management Harpers Gerscience Series Environmental Geology Publisher.

the development of forest plantations and grasslands, so the tourist complex can be developed in the area (map 13)

In Tijara & Kishangarh tehsils, land use is more potential for the subsistance of human beings. Western portion of Kishangarh, Alwar and Tijara is thinly populated because of the existence of forests and wastelands. Structure and dynamics of land-use will depend on intensity of human impact, which ultimately is dependent on pressure of population on existing land.

Briefly speaking, the analysed maps of our study area can be of much help to the researchers and the planners, who think ever to develop this area[2].

In the foregoing analysis, the eight geomorphic parameters chosen as representatives of physical landscape are correlated with landuse.

1. Absolute Relief and Land Use:

Absolute Relief in the study area ranges from 750' to 2000'. The total area has been divided into 4 categories, (as discussed earlier in the 2nd chapter of thesis) with an interval of 500'.

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2. Kundalia P.C. and Chenniah G.C.H. - "Spatial Analysis of Land Use Over Idduki distt. - PHOTONIRVACHAK "National Remote Sensing Agency.

(a) Land Use < 750':-

Results of the study show that most of the area below 750' is occupied by the agricultural fields. 56.46% area of the region as a whole, lies below 750' of absolute relief. Out of which 48.84% area is liable for cultivation, and 4.37% area is lying as waste-lands in the region. The wastelands include some patches of whittish soils due to the waterlogging of surrounding areas. The remaining 0.80%, 1.34% and 1.11% (of the region) concentrates under scrubs and grasses, barrens and dhak forests respectively. Thus it is observed that abolute relief below 750' offers maximum land for cultivation.

All eastern tehsils namely Deeg, Nagar, Pahari, Punhana, Kaman, Hattin, Nuh, Ferozepur Jhirka and a part of Ramgarh fall in this region.

(b) Land-Use 750'-1000':-

The absolute relief ranging from 750' to 1000' occupies an area of 33.58% of the total area of the region. Here 20.80% area lies under cultivation, 7.24% under wastes, 3.00% under pastures, 4.16% under barrens and 1.38% under forests. It covers a little part of Nuh and Ferozepur Jhirka tehsil. The western Aeolian Alluvial plains of Tijara and Kishangarh tehsils are totally falling under this category of absolute relief.

(c) Land Use (1000-1500'):-

The relief ranging from 1000' to 1500' covers an area of 3.63% of the region, and this totally falls under forests and scrubs. There are 3 tehsils falling under this category of relief and its land-use, namely the Alwar, Kishangarh and Ramgarh.

(d) Land-Use (1500'-2000'):-

Finally, the rest of 3.36% area falls between 1500' to 2000' of absolute relief and is totally occupied by the dense forests. The tehsil falling under this category is only Alwar where large area of the hill slopes and foot tops is covered by dense - Dhok forests. The Ratan, Chamarsidh, Madhogarh, Siligedh, Sariska etc. are the forests on hill tops and foot slopes.

Thus, from above discussion, it is observed that the frequency of agricultural land decreases inversely with the height. In addition, detailed informations can be obtained from the table given below:

TABLE 5A-I

ABSOLUTE RELIEF AND THE LAND-USE OF THE REGION

S. No.	ABSOLUTE RELIEF	CULTIVABLE LAND	WASTE LANDS	PAS-TURES	BARRENS	FOR-ESTS	Total
1.	750'	48.84	4.37	0.80	1.34	1.11	56.46
2.	750'-1000'	20.82	7.24	3.00	4.16	1.38	33.58
3.	1000'-1500	0.13	0.00	1.50	0.00	2.00	3.63
4.	1500'-2000'	0.03	0.00	0.00	0.00	3.33	3.36
5.	TOTAL	69.82	11.61	2.30	5.50	7.82	97.03

Proving the hypothesis with the help of numerical tables, throws light upon certain important qualitative relationships between different categories of absolute relief and the land-use. The inspection of the above table reveals that absolute relief above 1000', imposes serious limitations to the cultivation of crops. From the point of view of agricultural development in the study area, the relief below 750' is most significant and offers minimum limitations to bring the land under cultivation. The high relief, that is, above 1500' to 2000' offers minimum opportunities for the extension of bringing the land under plough.

2. Relative Relief and Land-Use:-

The obtained values of relative relief, reflects the nature of terrain of the region. It being the difference in heights between the highest and lowest points in a unit area, and are directly related to the degree of dissection. More the intensity of dissection, more is the relative relief. In the present study area it ranges from 0 to 1200' with an interval of 300'. The total relief (relative) has been categorised into 4 divisions, such as 0 to 300', 300'-600', 600-900' and 900'-1200'. Later, an attempt has been made to know the land-use, lying under each of the above categories of (Relative Relief).

(a) < 300':-

The obtained results of the study show that most of the land below 300' of relative relief, is occupied by the cultivable agricultural fields. 86.90% area of the region as a whole, lies below 300' of relative relief. Out of this, the maximum area (about 68.29%) of the region is lying under cultivation. And the remaining area (8.61%) of which concentrates under wastelands, 3.60% under scrubs and pastures, 3.67% under barrens and 2.73% under forests. Therefore, it is apparent that relative relief below 300' is offering the maximum land for cultivation and the relief above 600' impose severe limitations for bringing the land under plough.

(b) 300'-600':-

The Relative Relief between 300'-600' occupies nearly 7.42% area of the entire region. Here, only 1% area remains under cultivation, another 6.42% area goes to wastes (2.97%) scrubs (0.48%), barrens (1.83%) and forests (1.14%) respectively.

(c) 600-900':-

Thirdly, the relief (Relative) categorized as 600' to 900', is occupying only 1.64% area of the total region. Here, the area under cultivation is zero (Nil), while scrubs and forests are covering 1.22% and 0.42% respectively.

(d) 900'-1200':-

Finally, 4.40% area falls between 900' to 1200' of relative relief. Most of the area (3.57% of the region) is occupied by the forests. Remaining 0.83% is lying under wastes. Detailed distributions can be achieved from the table given below:

TABLE 8A-II

RELATIVE RELIEF AND LAND-USE

S. No.	R.R.	Cultivable lands	Waste-lands	Scrubs	Barrens	Forests	Total
1.	0-300'	68.29%	8.61%	3.60%	3.67%	2.73%	86.90%
2.	3008-600'	1.00%	2.97%	0.48%	1.83%	1.14%	7.42%
3.	600'-900'	-	-	1.22%	-	0.42%	1.64%
4.	900'-1200'	-	0.83%	-	-	3.57%	4.40%
5.	TOTAL	69.29%	12.41%	5.30%	5.50%	7.86%	100.00

The above table reveals that there is a direct relationship between land use and the relative relief. A perusal of the table shows that the relative relief above 600', impose serious limitations to the extension of agricultural, lands, and offers minimum opportunities for the extension of cultivable lands. It's relative relief provides a particular type of land-use in the region. From agricultural development point of view the relative relief below 300' is most significant in the entire region.

3. Slope and Land-use:-

Slope is one of the most dominant factor, which has a significant control over the growth and expansion of any kind of land-use. The area under study has a slope ranging from 0 to 20° per square mile. Based on the slope gradient, following 3 categories have been identified.

a. Level to Gently sloping lands (0-5°)

b. Gently sloping to Moderately sloping (5°-10°)

c. Moderately sloping to steep sloping lands (10° and above)[3].

(a) Level to gently sloping lands (0-5°):-

The results obtained show apparently that the slope from 0 to 5° have larger area under cultivation, which consists 87.07% of the total area of the region. Out of it 68.00% area is already occupied by the cultivable lands. Remaining 7.91%, 3.30%, 4.00% and 3.86% areas lie under wastes, scrubs, barrens and forests respectively.

(b) Gently to moderate sloping lands (5°-10°):-

10.39% area of the region is occupied by the moderate sloping lands, out of which only 1.29% area is available for cultivation and the remaining area concentrates as 4.00% under wastelands, 1.50% under scrubs and pastures, 1.60% under barrens and 2.00% under forests.

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3. 3. I.A.R.I. Pusa Road, New Delhi Land Use & Soil Survey Unit (Personal Communication).

(c) Moderately Sloping to Steep sloping lands (10°-20°)

The land containing slopes 10° to 20° occupies only 3.44% area of the region. Forests cover 2% of land, while the other uses of land are equally distributed such as .50% under wastes, .50% under scrubs and .44% under barrens.

TABLE 5A - XII

SLOPE AND LAND-USE

Area in %ages to the region

S. No.	SLOPE	CULTIVABLE LANDS	WASTES	SCRUBS	BARRENS	FORESTS	TOTAL
1.	0-5°	68.00%	7.91	3.30	4.00	3.86	87.07
2.	5°-10°	01.29	4.00	1.50	1.60	2.00	10.3
3.	10°-15°	-	0.50	0.50	0.44	1.00	2.4
4.	15°-20°	-	-	-	-	1.00	1.0
5.	TOTAL	69.29	11.91	5.30	6.04	7.86	100.

The above table reveals that there is a significant association between the slope and cultivable lands. As the slope increases, ploughing, becomes difficult and expensiv The areas, which are unfit for agricultural use due to excessive rainfall or steep slopes are under grass and forests. Though at present, irrigation facilities are increasing rapidly in the region but the potential of irrigation are also limited. Flat surfaces and gently

sloping lands offer maximum scope for the construction of canals, digging wells etc.

4. Ruggedness Number And Land Use:-

The ruggedness number in the study area, ranges from 0 to 0.004. The total area has been categorized in 4 classes with an interval of .001. Such as 0 to .001, .001 - .002, .002-.003 and .003 to .004.

The maximum area of the region (81.59%) has less than .001 ruggedness number. Out of which 64.28% area alone is devoted to the cultivable lands. And the remaining 8.03; 3.00; 4.02; and 2.26% areas are lying under wastelands, scrubs and pastures, barrens and forests respectively.

11.25% area lies in the ruggedity number ranging from .001 to .002. 4.10% area is available for cultivation and remaining 2.72% area concentrates under wastes, 2.11% under scrubs, 1.36% under barrens and .96% area under the forests respectively.

6.08% area of the total is being occupied by the ruggedness number ranging from .002 to .003. The cultivable lands, here are rapidly decreasing as the ruggedity number increases. Only 1.21% area is under cultivation, while 3.60% area is devoted to the forests. Negligible area is available for pastures and grazing lands.

1.00% of the entire area has the highest ruggedity of the region, ranging from .003 to .004 and is covered by the dense and protected forests.

TABLE 5A - IV

RUGGEDNESS NO AND LAND - USE

(Area in % to total)

S. No.	Ruggedness No.	Cultivable Lands	Wastes	Scrubs	Barrens	Forests	Total
1.	0-.001	64.28	8.03	3.00	4.02	2.26	81.59
2.	.001-.002	4.10	2.72	2.11	1.36	0.96	11.25
3.	.002-.003	1.21	0.86	0.19	0.22	3.60	6.08
4.	.003-.004	-	-	-	-	1.00	1.00
5.	TOTAL	7.82	5.60	5.30	11.61	69.59	100.00

The above table depicts a clear picture about the relationship between geomorphic parameter - ruggedness number and the pattern of distribution of land-use. The lesser the number of ruggedness, the higher is the extension of cultivable lands. 64.28% area of the entire region is available for cultivation below .001 ruggedness number. Ruggedness Number above .002 imposes serious limitations to the extension of agricultural land and offers minimum opportunities for the cultivation of crops. The ruggedness number below .001 is the most significant for theagricultural lands.

5. Dissection Index vs. Land-use:-

Dissection Index is one of the most dominant factor of geomorphological parameters, which represents the terrain characteristics of a land unit.

In the study area dissection index ranges from 0 to 80%, and thus, we have categorised all the frequent values into 4 suitable classes with an interval of 20%. Such as 0 to 20%, 20 to 40%, 40 to 60% and above 60%.

The area below 20% of dissection is calculated to be having the highest percentage of the total geographical area of the region. 69.30% of the area is lying below 20% of dissection index. Out of it 61.83% area lies under cultivation and the remaining 3.09, 3.88 and .50 areas have been devoted to the various other categories like wastelands, scrubs, and forests respectively.

Besides, dissection index, ranging from 20 to 40% occupies 20.82% area of the total region. Cultivable land covers only 6.84% while the wastes are covering the maximum area that is near about 7.48% of the total region as a whole. The remaining area .13%, 4.37% and 2.00% of the region is devoted to the other land use categories like - scrubs and pastures, barrens and forests, respectively. 40 to 60% of dissection index occupies 10.09% area of the total geographical area of the region. The area under cultivation is only 1.94% and the forests are covering the highest area of this group, nearly 4.70%

of the total.

Where the dissection index is highest none of the area is available for cultivation. Only .62% area of the total region is covered with forests.

TABLE 5A - V

DISSECTION INDEX AND LAND-USE

S. No.	Dissection Index	Cultivable land	Wastes	Scrubs	Barrens	Forests	To ta
1.	0-20%	61.83	3.09	3.88	-	0.50	69.30
2.	20%-40%	6.84	7.48	0.13	4.37	2.00	20.82
3.	40%-60%	1.94	1.02	1.24	1.19	4.70	10.09
4.	60%	-	-	-	-	0.62	9.62
5.	TOTAL	70.61	11.59	5.25	5.56	7.82	100.00

The above table reveals that there is an inverse relationship between dissection index and agricultural land. As the dissection index increases, the land under cultivation decreases. Thus, the area having 40% of dissection index, offers minimum opportunities, for bringing the land under cultivation, hence it goes rapidly down instead the area under forests increases.

6. Drainage Density Vs. Land-Use:-

The results of the study show that drainage plays an inverse role on the agricultural land. It may be because of the denudational characteristics of the Mewati drainage, as only ephemeral streams are available in the region. These streams only appear (with water)

during rainy season.

The drainage in the entire region has a density, ranging from 0 to .4 mile per square mile and is divided into 4 categories with 0.1 mile of interval. The total area lying below .1 is measured at 72.38%, out of it 55.82% lies under cultivation and 5.21% lies under wastes, 1.54% under scrubs, 5.31% under barrens and 4.50% under forests.

11.33% area lies in the category where the drainage density ranges from .1 to .2 mile. Area under cultivation is only 6.66% and wastes and forests are covering respectively 1.78% and 1.71% area of the total region.

6.36% of the area has the drainage density between .2 to .3 out of which 2.46% is available for cultivation and 2.40% under wastes, while the remaining 1.25 and .24% goes under the category of barrens & forests.

The highest drainage density occupies 10.50% area of the region. Out of which 4.24% area is lying under cultivation and the rest 3.00%, .80% and 3% goes to wastes, pastures and the forests, respectively.

TABLE 5A - VI

DRAINAGE DENSITY AND LAND-USE

(Area in % to total region)

S. No.	Drainage Density	Cultivable lands	wastes	Scrubs	Barrens	Forests	Total
1.	0-.1	55.82	5.21	1.54	5.31	4.50	72.58
2.	.1-.2	6.66	1.00	1.71	0.18	1.78	11.33
3.	.2-.3	2.46	2.40	1.25	0.01	0.24	6.36
4.	.3-.4	4.24	3.00	0.80	-	1.46	10.50
5.	TOTAL	69.18	11.61	5.30	5.50	7.98	100.00

The table reveals that drainage density is inversely related to the agricultural use of land. The vast agricultural fields are found in the areas, where drainage is found negligible. The eastern floodplains and intermontane lowlands (Abras & Bhay(ana) are the two examples to support the above statement.

7. Stream Frequency and landuse:

Stream frequencies in the region ranges from 0 to 8 per sq. mile and has been divided into 4 categories with an interval of 2 streams, such as 0-2, 2-4, 4-6 & 6-8.

The results obtained clearly portrays that maximum land for cultivation is available, whereby the stream frequency is less than 2. The Mewat streams are of ephemeral type and causes great hazards and havocs during rainy season. Much of the land suitable for agriculture is being swept out by these streams.

Where 67.67% area is concentrated the stream frequency is below 2. And this covers the largest percentage of the entire region. Out of this 46.84% area has been devoted to the agricultural lands and the rest 6.11% to the wastes, 2.00% to the scrubs, 3.50% to barrens and 3.62% to the forests.

31.80% area is lying, where the stream frequencies are occuring between 2 to 4. The area available for

cultivation is only 16.21% of the region. The remaining area concentrates of which 8% under wastes, 2.39% under scrubs and 2% and 3.20% under barrens and forests respectively.

7.03% area lies, in the frequency occuring 4 to 6. Cultivable land is only 1.51%. The remaining 1.20 and 2.41% goes to forests and wastes, respectively. In the highest frequency, only a very few areas are available under forests and barrens.

TABLE 5A - VII

STREAM FREQUENCY AND LAND-USE

S. No.	Stream frequency	Culti vables	Wastes	Scrubs	Barrens	Forests	Total
1.	0-2	46.34	6.11	2.00	3.50	3.62	61.67
2.	2-4	16.21	8.00	2.39	2.00	3.20	31.80
3.	4-6	1.51	2.41	0.91	-	1.20	7.03
4.	6-8	0.22	0.49	-	-	-	0.71
5.	TOTAL	64.28	17.01	5.30	5.50	8.02	100.00

The above table reveals how far the high frequencies of ephemeral streams in Mewat region offers severe limitations to the cultivation in the region.

8. Rainfall Intensity vs. Land-Use:-

Rainfall intensity by and large, remains equal through overall the region. It is because as the area of study is smaller and climatically is a part of Indo-Gangetic divide. The intensity of rainfall ranges from

7.0 cm to 8.5 cm with an interval of only .5 cm.

Results obtained show that 40.55% area of the region lies where the intensity is below 7 cm. 33.89% of the total region is lying under cultivation, while of the remaining area, 5% goes under the wastelands, 2.00% to the scrubs, 1.50% to barrens and 3.16% to the forests.

24.65% area is lying, whereby the rainfall intensity is occuring between 7 to 7.5. Here the availability of cultivable land is only 14.21% of the region.

26.90% of the area lies where the intensity of rainfall is below 8 cm. 12.93% area goes to the agricultural fields and the remaining 4.30, 6.00, 1.00, 2.67% goes to the wastes, scrubs, barrens and forests respectively.

Finally, 8.82% area comes under the maximum intensity of rainfall (8.5 cm). Nearly 95% area of the 8.82% area lies under cultivation. This area includes eastern most tehsils of Mewat like, Deeg, Kaman, Hattin and Punhana.

TABLE 5A - VIII

RAINFALL INTENSITY

S. No.	Rainfall Intensity	Cultivable lands	Wastes	Scrubs	Barrens	Forests	Total
1.	7 cm	33.89	5.00	2.00	1.50	3.16	40.55
2.	7.0-7.5	14.21	2.37	3.47	3.00	1.66	24.65
3.	7.5-8.0	12.93	4.30	6.00	1.00	2.67	26.90
4.	8.0-8.5	8.25	-	0.14	-	0.43	8.82
5.	TOTAL	69.28	11.61	11.61	5.50	7.82	100.00

The above tables shows that rainfall does not have any strong impact on the extension of agricultural lands. Though it is very significant in the eastern most blocks of Mewat, whereby the maximum area of particular tehsil lies under the maximum intensity of rainfall. Otherwise, in case of the entire western uplands and relatively in the region as a whole, cultivable lands are increasing with the decreasing pattern of rainfall. It is because of the reason that almost all small patches of agricultural fields of Mewat, now have their own irrigation sources such as tube wells, wells and the persian wheels etc.

Part B

Quantitative Analysis

Spatial variations in the land use to some extent can be attributed to the variations in the physiographic environment. The purpose of this study is to know the impact of geomorphological parameters on the land of the region, using simple bi-variate correlation technique. It is observed that geomorphic factors offer maximum suitability for the land under different uses. For instance, absolute relief below 750' offer maximum land for cultivation, whereas the absolute relief above 1500' impose serious limitations to the cultivation of crops. In the same way slopes below 5 offer maximum suitabilities for the cultivable lands, while the slopes above 10 impose very serious limitations for bringing the land under cultivation.

Methodology

To study the correlation between geomorphic parameters and the land use, an initial hypothesis was formulated that land-use is significantly related to the geomorphic factors like - Absolute Relief, Relative Relief, Slope, Ruggedness number, Dissection Index and Drainage Densities. To test this hypothesis, analysis was done at maso-level. For this purpose 12 tehsils and blocks were selected, which exactly fall in the area under study. Land-use data for individual tehsils were collected from the tehsil headquarters as well as

the maps drawn.

Data Base

Four topographic sheets of the area on quarter inch scale have been studied and the broad and distinct patterns indicated by the help of contours and drainage lines were made out in sequence. For each such geomorphic parameter, a location map has been prepared. At the same time a map for the broad land use categories has also been prepared, which would be representing the site for such a group of land-use. Finally, the data (compiled) for bi-variate analysis has been computerized. Hence, to finalize the study, correlations between dependent and independent variables with their 't' test (significant test) have been worked out.

Objective

The main purpose of the present study is to know the impact of geomorphic parameters on the land-use of the region. But due to the shortage of time and the limited facilities of computer, the multiple regression analysis between one dependent and 8 independent variables could not have been worked out. Therefore, only simple bi-variate analysis has been taken into consideration.

Choice of the Variables

For any statistical analysis two variables are needed at least - one dependent and another independent. Our total

variables are 13, out of which 8 are independent and five are dependent. For independent variables, we have chosen only those variables which are strongly associated with the land-use variables. But it should be kept in mind that the same variables may or may not necessarily be applicable to the other areas of study. Such independent and dependent variables are as follows:

Independent Variables (X)

1. Absolute Relief (X_1)
2. Relative Relief (X_2)
3. Slope (X_3)
4. Ruggedness Number (X_4)
5. Dissection Index (X_5)
6. Drainage Density (X_6)
7. Stream Frequency (X_7)
8. Rainfall Intensity (X_8)

Dependent Variables (Y)

1. Area Under Forests (Y_1)
2. Barren Lands (Y_2)
3. Scurbs and Pastures (Y_3)
4. Waste lands (Y_4)
5. Arable Lands (Y_5)

The principles of expression of these variables for 1448 observations of the region as a whole into numerical values have been elaborated. The strong positive correlation coefficient was found out between Y_1 and the all independent variables.

Besides, strong but negative correlation coefficient was found out between Y_5 and X_1, X_3 .... and X_8. In case of Y_2, the significant correlation has been observed with the variable X_4, X_5, X_6 and X_7. Y_3 co-varies with X_1 to ... X_8 respectively, but insignificantly.

Significance of the Study

The computed values of correlation coefficients reveal the association between geomorphic parameters and each of the land use categories. With the help of these bi-variate associations, we are now able to know that how far the geomorphic parameters govern the distribution of land under any kind of use. This association between geomorphic factors and the land-use can not be explained mathematically without finding the correlation coefficients. Hence, with the help of coefficient values, the degree of control of the geomorphic parameters on land use can be discussed. The determination and acceptance of research hypothesis is performed on the basis of 'r' values according to their level of significance which is tested by 'students t' test.

Correlation Analysis for the Region as a Whole

5B-I Area Under Forests (Y_1) Vs. Geomorphic Parameters (X_1 ..... X_8)

The table 5B-I shows that there is a direct and strong positive correlation between area under forests and all the geomorphic parameters except for relative relief. That is, when 't' test was calculated to prove our hypothesis, it was

observed that relative relief of the entire region was not supporting the growth of forests. In addition, rainfall intensity was inversely affecting the areas under forests. And that is why, the correlation with rainfall is found in negative (-.313).

Table 5B-I Correlation Analysis for the Area Under Forests and Geomorphic Parameters

Geomorphic Parameters	'r' value	t_t value	t_c values	level	Result
1. Absolute Relief	.467	2.576	20.09	.01	Significant
2. Relative Relief	.031	2.576	1.180	.01	Insignificant
3. Slope	.482	2.576	20.933	.01	Significant
4. Ruggedness No.	.372	2.576	15.252	.01	-do-
5. Dissection Index	.412	2.576	17.205	.01	-do-
6. Drainage Density	.280	2.576	11.098	.01	-do-
7. Stream Frequency	.376	2.576	15.441	.01	-do-
8. Rainfall Intensity	-.313	2.576	12.544	.01	-do-

The above table clearly portrays that the growth of forests is very much supported by the slope, ruggedness number and absolute relief of the area. The results obtained are proving that with increasing relief, ruggedity and slope, the area under forests is also increasing. The results are strongly significant at .01 level of significance. With rainfall

intensity, the case is inverse. It is because rainfall inversely supports the growth of forests in the area of study, as mostly forests are of dry deciduous e.g. dhak etc. Next, the rainfall remain, more or less the same throuhout the region.

5B-II Barren Lands (Y_2) Vs. Geomorphic Parameters (X_1 .... X_8)

Three geomorphic parameters play a dominant role in bringing the land under barrens. These are the ruggedness number, dissection index and drainage density. The obtained correlation coefficients values show that the area under barrens increases, with the increase in ruggedity (.084); dissection (.070) and drainage (.121). The coefficients of correlations were then tested at 0.01 level of significance. And thus, the relationship between above three factors and barren lands was found highly significant. The intensity of dissection by the ephemeral streams in the region has contributed significantly to the increase in terrain areas.

Table 5B-II Geomorphic Parameters Vs. Barren Lands

Geomorphic Parameters	'r' values	t_t values	t_c values	Level	Results
1. Absolute Relief	-.003	2.576	1.14	.01	Insignificant
2. Relative Relief	-.004	2.576	0.15	.01	-do-
3. Slope	.036	2.576	1.47	.01	-do-

4.	Ruggedness No.	.084	2.576	3.21	.01	Significant
5.	Dissection Index	.070	2.576	2.67	.01	-do-
6.	Drainage Density	.121	2.576	4.64	.01	-do-
7.	Stream Frequency	.059	2.576	2.25	.01	Insignifi-cant
8.	Rainfall Intensity	.037	2.576	1.41	.01	-do-

Now the scurbs and pastures (Y_3) and waste lands (Y_4) of the region do not have any significant correlations with any one of the geomorphic parameters we have studied. Following may be some of the reasons for being so.

1. Scurbs and wastes are more dynamic than those of the barrens and forests. That is, the modern technology is more applicable on the above two categories of land use than those of the forests and barrens. So many plans on land campaign are being launched in the area. So the above two types of land i.e. wastes and scurbs can simply be brought under cultivation and which holds true in the area.
2. The scurbs and pastures are lying mostly on the flat rolling plains. Hence, the existence of these lands depend upon the will of farmers whether he leaves his land for wastes and grazing or utilizes it for the cultivation. His know-how and technology will also be the co-supporting factors.

3. Role of Haryana Land Reclamation and Development Corporation (HLRDC) is playing a dominant role in converting the waste lands into cultivable lands. According to a branch Manager, (HLRDC, Nuh) nearly 1 lakh hectares of land was brought under level of cultivation and this land was converted from the wastes and grazing lands.

5B-V Cultivable lands (Y_5) Vs. Geomorphic Parameters ($X_1 \ldots X_8$)

The cultivable lands of the region are directly and negatively related with the slope (-.402) and absolute relief (-.350) of the region. Cultivable lands are also related (an inverse relation) with the ruggedness number (-.330); dissection index (-.368); drainage density (-.286); and stream frequencies (-.344). The results are tested at .01 level of significance and are found highly significant. Rainfall intensity alone has a positive correlation with the cultivable lands of the region.

Table 5B-V Geomorphic Parameters Vs. Cultivable lands

Geomorphic Parameters	'r' values	t_t values	t_c values	Level	Results
1. Absolute Relief	-.350	2.576	14.21	.01	Significant
2. Relative Relief	-.011	2.576	0.418	.01	Insignificant
3. Slope	-.402	2.576	16.70	.01	Significant
4. Ruggedness No.	-.330	2.576	13.30	.01	-do-

5. Dissection Index	-.368	2.576	15.05	.01	Significant
6. Drainage Density	-.286	2.576	11.35	.01	-do-
7. Stream Frequency	-.344	2.576	13.94	.01	-do-
8. Rainfall Intensity	.225	2.576	8.82	.01	-do-

The above table clearly portrays that the growth of agricultural lands of the region are directly and positively supported by the geomorphic factors, though the relative relief and rainfall intensity being an exception.

Tehsil-wise Analysis

Alwar Tehsil

1. Forests Vs. Geomorphic Parameters

Forests are strongly related to all geomorphic parameters, except relative relief and rainfall intensity. The coefficient of correlation values found are 0.392 (Absolute Relief); 0.453 (slope); 0.439 (Ruggedness No.); 0.471 (Dissection Index); 0.286 (Drainage Density); 0.348 (Stream Frequency); and -0.060 (Rainfall intensity). All correlation values are tested on students 't' test at 0.01 level of significance, and are found to be highly significant, which supports the fact that high relief lands or the high sloping lands are ideal for bringing the land under forests. If we throw a cursory glance on the western hills of Alwar and the central range of 'Kala Pahar' (Aravalli), we will find that forests

are occupying only those areas where drainage is high, ruggedity is high, dissection is high and frequency of streams is also high.

Table 5B-III Geomorphic Parameters Vs. Area Under Forests - Alwar

Geomorphic Parameters	'r' value	t_t value	t_c value	Level	Results
1. Absolute Relief	.392	2.576	6.678	.01	Significant
2. Relative Relief	-.036	2.576	0.565	.01	Insignificant
3. Slope	0.453	2.576	8.205	.01	Significant
4. Ruggedness No,	.439	2.576	7.660	.01	-do-
5. Dissection Index	.471	2.576	8.370	.01	-do-
6. Drainage Density	.286	2.576	4.580	.01	-do-
7. Stream Frequency	.348	2.576	5.820	.01	-do-
8. Rainfall Intensity	-.060	2.576	0.943	.01	Insignificant

2. Barrens Vs. Geomorphic Parameters

The barren lands of Alwar are insignificantly related with all the geomorphic parameters. It may be because of the unstability of barren lands.

3. Scurbs and Pastures Vs. Geomorphic Parameters

Absolute relief, slope, dissection index, stream frequency and rainfall intensity have been found as the supporting

factors in the growth of pastures and grazing lands in Alwar. Mostly the scurbs in Alwar are found on the hill slopes and that is why it has a direct relationship with the topographical factors including one climatic factor also, that is, rainfall intensity.

Table 5B-IV Geomorphic Parameters Vs. Scurbs and Pastures

Geomorphic Parameters	'r' value	t_t value	t_c value	Level	Results
1. Absolute Relief	.185	2.576	2.950	.01	Significant
2. Relative Relief	-.003	2.576	0.047	.01	Insignificant
3. Slope	.172	2.576	2.738	.01	Significant
4. Ruggedness No.	.114	2.576	1.799	.01	Insignificant
5. Dissection Index	.212	2.576	15.320	.01	Significant
6. Drainage Density	.040	2.576	0.640	.01	Insignificant
7. Stream Frequency	.205	2.576	3.285	.01	Significant
8. Rainfall Intensity	.124	2.576	3.240	.01	Significant

4. Waste Lands Vs. Geomorphic Parameters

Waste lands of Alwar are inversely related with absolute relief (-.066), meaning thereby that the wastes come into growth with the decrease in absolute relief. Actually, waste lands of Alwar are located in the southernmost part around

Malakhera, where River Barah (Ruparel) waterlogs the surrounding areas and leaves behind white patches of saline soils.

Table 5B-V Geomorphic Parameters Vs. Waste lands
Alwar Tehsil

Geomorphic Parameters	'r' value	t_t value	t_c value	Level	Results
1. Absolute Relief	-.066	2.576	2.895	.01	Significant
2. Relative Relief	-.024	2.576	0.376	.01	Insignifi-cant
3. Slope	.008	2.576	.125	.01	-do-
4. Ruggedness No.	-.099	2.576	1.560	.01	-do-
5. Dissection Index	-.065	2.576	1.025	.01	-do-
6. Drainage Density	-.086	2.576	1.350	.01	-do-
7. Stream Frequency	-.105	2.576	1.655	.01	-do-
8. Rainfall Intensity	-.140	2.576	2.217	.01	-do-

5. Cultivable Lands Vs. Geomorphic Parameters

Cultivable lands in Alwar are significantly related with four geomorphic parameters, namely, absolute relief (-.163); ruggedness number (-.231); dissection index (-.291); and stream frequency (-.178). Proving our hypothesis that the geomorphic factors have an inverse relation with area under cultivation, 't' test was calculated. Thus the result found was satisfactorily significant at 0.01 level of significance.

Table 5B-VI Geomorphic Parameters Vs. Cultivable lands - Alwar

Geomorphic Parameters	'r' value	t_t value	t_c value	Level	Results
1. Absolute Relief	-.163	2.576	2.591	.01	Significant
2. Relative Relief	.083	2.576	0.991	.01	Insignificant
3. Slope	-.261	2.576	1.306	.01	-do-
4. Ruggedness No.	-.231	2.576	3.720	.01	Significant
5. Dissection Index	-.291	2.576	4.670	.01	-do-
6. Drainage Density	-.160	2.576	2.541	.01	Insignificant
7. Stream Frequency	-.178	2.576	2.836	.01	Significant
8. Rainfall Intensity	.003	2.576	0.047	.01	Insignificant

Deeg Tehsil

1. Area Under Forests Vs. Geomorphic Parameters

The results obtained show that forest covered areas of Deeg are positively related to the relative relief of the region. First of all, Deeg is scarcely occupied by natural forests. Only a marginal area in the south along Bharatpur boundary is wealthy in forests. Hence, there is no question of association between landform units and the forests. In fact, correlation is there but that is not significant at .01 level of significance. Since, the entire area of Deeg is

a flat plain, which is one of the nearest part of eastern Jamuna floodplains, so neither the forests nor the rugged landforms are available in this tehsil. The 'r' value with relative relief was obtained as .262 which is significant at .01 level.

Table 5B-VII Geomorphic Parameters Vs. Area Under Forests - Deeg

Geomorphic Parameters	'r' value	t_t value	t_c value	Level	Results
1. Absolute Relief	-.035	2.576	0.400	.01	Insignificant
2. Relative Relief	.262	2.576	3.100	.01	Significant
3. Slope	-.064	2.576	0.770	.01	Insignificant
4. Ruggedness No.	-.046	2.576	0.527	.01	-do-
5. Dissection Inxed	-.037	2.576	0.423	.01	-do-
6. Drainage Density	-.049	2.576	0.561	.01	-do-
7. Stream Frequency	-.104	2.576	1.197	.01	-do-
8. Rainfall Intensity	-.039	2.576	0.447	.01	-do-

2. Barrens Vs. Geomorphic Parameters

Barren lands of Deeg does not have any significant correlation with any one of the geomorphic parameters. It may be because of the absolute relief is below 500' in the entire area of the tehsil.

Table 5B-VIII Geomorphic Parameters Vs. Barren Lands Deeg Tehsil

Geomorphic Parameters	'r' value	t_t value	t_c value	Level	Results
1. Absolute Relief	-.043	2.576	1.100	.01	Insignificant
2. Relative Relief	-.046	2.576	1.121	.01	-do-
3. Slope	-.078	2.576	1.084	.01	-do-
4. Ruggedness No.	.144	2.576	2.251	.01	-do-
5. Dissection Index	-.019	2.576	0.471	.01	-do-
6. Drainage Density	.182	2.576	2.421	.01	-do-
7. Stream Frequency	.134	2.576	2.122	.01	-do-
8. Rainfall Intensity	.093	2.576	1.090	.01	-do-

3. Scurbs and Pastures Vs. Geomorphic Parameters

Except relative relief and rainfall intensity, pastures of Deeg are highly correlated with the absolute relief (.414), slope (.848); ruggedness number (.541); dissection index (.458), drainage density (.248) and stream frequency (.424) of regions. The pastures in Deeg are located on or around the hills of Goverdhan. The highest correlation coefficient was found with the slope (.848). Actually slope everywhere in the region has been noted as the dominant factor in providing the site for the better land-use of the region.

Table 5B-IX Pastures Vs. Geomorphic Parameters

Geomorphic Parameters	'r' value	t_t value	t_c value	Level	Results
1. Absolute Relief	0.414	2.576	5.205	.01	Significant
2. Relative Relief	0.162	2.576	1.897	.01	Insignifi-cant
3. Slope	0.848	2.576	18.310	.01	Significant
4. Ruggedness No.	0.541	2.576	7.360	.01	-do-
5. Dissection Index	0.458	2.576	5.897	.01	-do-
6. Drainage Density	0.248	2.576	2.930	.01	-do-
7. Stream Frequency	0.424	2.576	5.358	.01	-do-
8. Rainfall Intensity	0.157	2.576	1.819	.01	Insignifi-cant

4. Waste lands Vs. Geomorphic Parameters

Drainage density is the only factor which supports the extension of wastes in Deeg. Although the drainage density is very shallow here in the tehsil, but it creates the problem of salinity and alkalinity in the tehsil. The relation is tested at .01 level and has been found significant.

5. Cultivable Lands Vs. Geomorphic Parameters

The cultivable lands in Deeg are inversely supported by the two factors - drainage density and rainfall intensity, whereby the correlation coefficients are -.277 with the

drainage density and -.360 with rainfall intensity. Both the values are highly significant at .01 level of 't' significance.

Table 5B-X Geomorphic Parameters Vs. Cultivable lands

Geomorphic Parameters	'r' value	t_t value	t_c value	Level	Results
1. Absolute Relief	-.066	2.576	0.757	.01	Insignificant
2. Relative Relief	-.161	2.576	1.867	.01	-do-
3. Slope	-.148	2.576	1.716	.01	-do-
4. Ruggedness No.	-.216	2.576	2.532	.01	-do-
5. Dissection Index	-.095	2.576	1.992	.01	-do-
6. Drainage Density	-.277	2.576	3.299	.01	Significant
7. Stream Frequency	-.156	2.576	2.089	.01	Insignificant
8. Rainfall Intensity	-.360	2.576	4.416	.01	Significant

3. Ferozepur Jhirka Tehsil

1. Forests Vs. Geomorphic Parameters

There is no significant correlation between area under forests and the geomorphic parameters in Ferozepur Jhirka tehsil. Actually this tehsil has a very few resources of forests, though the potentials are high. Whatever the forests are available they are located around Jindan Ka Ala in the valley of Jhir.

Table 5B-XI Geomorphic Parameters Vs. Area Under Forests - Ferozepur Jhirka

Geomorphic Parameters	'r' value	t_t value	t_c value	Level	Results
1. Absolute Relief	.146	2.576	1.928	.01	Insignificant
2. Relative Relief	.147	2.576	1.927	.01	-do-
3. Slope	.042	2.576	0.472	.01	-do-
4. Ruggedness Number	.077	2.576	0.462	.01	-do-
5. Dissection Index	.177	2.576	0.184	.01	-do-
6. Drainage Density	.040	2.576	0.470	.01	-do-
7. Stream Density	.002	2.576	0.098	.01	-do-
8. Rainfall Intensity	.047	2.576	0.428	.01	-do-

2. Barren Lands Vs. Geomorphic Parameters

Barrens are directly associated with the absolute relief (.350), slope (.325), and dissection index (.287) of the region. The association is highly significant at .01 level of 't' test. Actually all barren lands of this tehsil are located either on the top of the hills or in the eastern sloping lands. The Baloj Ka Khola is totally occupied by this type of 'usar lands'.

Table 5B-XII Geomorphic Parameters Vs. Barren Lands

Geomorphic Parameters	'r' value	t_t value	t_c value	Level	Results
1. Absolute Relief	.350	2.576	3.846	.01	Significant

2. Relative Relief	.209	2.576	2.200	.01	Insignificant
3. Slope	.325	2.576	3.538	.01	Significant
4. Ruggedness No.	.220	2.576	2.316	.01	Insignificant
5. Dissection Index	.287	2.576	3.084	.01	Significant
6. Drainage Density	.153	2.576	1.594	.01	Insignificant
7. Stream Frequency	.102	2.576	1.055	.01	-do-
8. Rainfall Intensity	-.209	2.576	-2.200	.01	-do-

3. Pastures and Scurbs Vs. Geomorphic Parameters

The correlation values, which we have obtained clearly show that there is correlation between pastures and scurbs but this association is not significant at .01 level of 't' test. It is because the grazings are most probably located in the flat plains, where cultivation practices are done. Sometimes fallow lands are also used for the grazing of the animal herds, in the tehsil.

Table 5B-XIII Scurbs Vs. Geomorphic Parameters

Geomorphic Parameters	'r' value	t_t value	t_c value	Level	Results
1. Absolute Relief	.191	2.576	2.141	.01	Insignificant
2. Relative Relief	.058	2.576	1.037	.01	-do-
3. Slope	.126	2.576	1.192	.01	-do-
4. Ruggedness No.	.069	2.576	1.048	.01	-do-

5. Dissection Index	.063	2.576	1.053	.01	Insignificant
6. Drainage Density	.155	2.576	2.044	.01	-do-
7. Stream Frequency	.034	2.576	1.011	.01	-do-
8. Rainfall Intensity	-.159	2.576	2.051	.01	-do-

4. Waste lands Vs. Geomorphic Parameters

Waste lands of Ferozepur Jhirka tehsil are supported by the absolute relief (.267); relative relief (.350); slope (.319); dissection index (.297); and rainfall intensity (.392). The association was found significant at .01 level 't' test.

Table 5B-XIV Geomorphic Parameters Vs. Waste Lands of Ferozepur Jhirka Tehsil

Geomorphic Parameters	'r' value	t_t value	t_c value	Level	Results
1. Absolute Relief	.267	2.576	2.848	.01	Significant
2. Relative Relief	.350	2.576	3.845	.01	-do-
3. Slope	.319	2.576	3.465	.01	-do-
4. Ruggedness No.	.102	2.576	1.062	.01	Insignificant
5. Dissection Index	.297	2.576	3.202	.01	Significant
6. Drainage Density	.227	2.576	2.399	.01	-do-
7. Stream Frequency	.392	2.576	4.387	.01	-do-
8. Rainfall Intensity	-.073	2.576	0.753	.01	Insignificant

5. Cultivable Lands Vs. Geomorphic Parameters

Cultivable lands are everywhere correlated with the geomorphic parameters, except the rainfall intensity, where the correlation was found insignificant at .01 level of 't' test. The results obtained are highly significant and the inverse relationship is worth of explanation as it proves our basic hypothesis regarding the present study. The correlation values were -.543 (Absolute relief); -.471 (relative relief); -.0533 (slope); -.278 (ruggedness number); -.480 (dissection index); -.361 (drainage density); -.401 (stream frequency) and -.236 with rainfall intensity.

Table 5B-XV Cultivable lands Vs. Geomorphic Parameters

Geomorphic Parameters	'r' value	t_t value	t_c value	Level	Results
1. Absolute Relief	-.543	2.576	6.650	.01	Significant
2. Relative Relief	-.471	2.576	6.221	.01	-do-
3. Slope	-.533	2.576	6.486	.01	-do-
4. Ruggedness No.	-.278	2.576	2.979	.01	-do-
5. Dissection Index	-.480	2.576	5.633	.01	-do-
6. Drainage Density	-.361	2.576	3.986	.01	-do-
7. Stream Frequency	-.401	2.576	4.506	.01	-do-
8. Rainfall Intensity	-.236	2.576	2.500	.01	Insignificant

Hattin Tehsil

Geomorphologically, Hattin is situated in the eastern low lands of Jamuna catchment area. Except for some of the isolated sand-dunes, the area is quite plain and is rich in canal irrigation.

The results obtained show that there is no significant correlation at all between the geomorphic factors and the land use categories except for drainage density. Only barren lands are positively associated with the drainage density, whereby the 'r' value (.329) obtained is significant at .01 level of 't' test. Waste lands are related at .01 level of significance. The 'r' value obtained is -.360, which proves a significant correlation but an inverse (negative) between wastes and drainage density of the tehsil.

Besides, cultivable lands are also found to have an inverse relation with the drainage density of the tehsil. The coefficient of correlation obtained is -.591 which is strongly significant at .01 level. Thus the drainage in the tehsil plays a dominant role in the extension and growth of agricultural lands. Nearly 92.30% of the area of this tehsil is well drained by the Gurgaon canal (the link of Agra big canal).

Table 5B-XVI Cultivable lands Vs. Geomorphic Parameters

Geomorphic Parameters	'r' value	t_t value	t_c value	Level	Results
1. Absolute Relief	.074	2.576	1.141	.01	

2. Relative Relief	.000	2.576	0.000	.01
3. Slope	.259	2.576	2.410	.01
4. Ruggedness No.	.063	2.576	1.210	.01
5. Dissection Index	.082	2.576	1.051	.01
6. Drainage Density	-.591	2.576	15.341	.01
7. Stream Frequency	-.142	2.576	2.114	.01
8. Rainfall Intensity	.022	2.576	0.549	.01

Kaman Tehsil

Area Under Forests Vs. Geomorphic Parameters

In case of area under forests, absolute relief and slope are the dominant factors, which control the growth of area under forests. The correlation coefficient between absolute relief and area under forests is obtained as (.586) while the correlation between slope and forests is obtained as (.425). Both the values are highly significant at .01 level of significance (t).

Table 5B-XVII Area Under Forests Vs. Geomorphic Parameters

S.No.	Geomorphic Parameters	Results
1.	Absolute Relief	Significant
2.	Relative Relief	Insignificant
3.	Slope	Significant
4.	Ruggedness Number	Insignificant

S.No.	Geomorphic Parameters		Results
5.	Dissection Index	-.047	Insignificant
6.	Drainage Density	-.104	Insignificant
7.	Stream Frequency	-.097	Insignificant
8.	Rainfall Intensity	-.014	Insignificant

2. Barren Lands Vs. Geomorphic Parameters

There is no significant correlation between barren lands and geomorphic parameters in Kaman tehsil. The results obtained are as follows.

Table 5B-XVIII Barren Lands Vs. Geomorphic Parameters. Barrens of Kaman tehsil have an inverse and negative correlation with the geomorphic parameters. The following table clearly portrays the fact that the barrens are insignificantly correlated with the slope, relief and drainage characteristics.

Table 5B-XIX Geomorphic Parameters Vs. Barren lands

S.No.	Geomorphic Parameters	'r' value	Results
1.	Absolute Relief	-.073	Insignificant
2.	Relative Relief	-.040	Insignificant
3.	Slope	-.148	Insignificant
4.	Ruggedness number	-.050	Insignificant
5.	Dissection Index	-.040	Insignificant

6.	Drainage Density	-.089	Insignificant
7.	Stream Frequency	-.082	Insignificant
8.	Rainfall Intensity	-.177	Insignificant

3. Scurbs and Pastures Vs. Geomorphic Parameters

Scurbs are negatively and significantly related with the slope of the region. The highest correlation was found only with slope (.271). It is significant at .02 level of significance. The rest of the geomorphic factors have the relation as follows.

Table 5B-XX Scurbs and Pastures Vs. Geomorphic Parameters

S.No.	Geomorphic Parameters	'r' values	Results
1.	Absolute Relief	-.132	Insignificant
2.	Relative Relief	-.074	Insignificant
3.	Slope	-.271	Insignificant
4.	Ruggedness Number	-.091	Insignificant
5.	Dissection Index	-.074	Insignificant
6.	Drainage Density	-.098	Insignificant
7.	Stream Frequency	-.056	Insignificant
8.	Rainfall Intensity	-.158	Insignificant

4. Waste lands Vs. Geomorphic Parameters

S.No.	Geomorphic Parameters	'r' value	Results
1.	Absolute Relief	-.231	Significant

2.	Relative Relief	-.129	Insignificant
3.	Slope	-.245	Significant
4.	Ruggedness Number	-.133	Insignificant
5.	Dissection Index	-.129	Insignificant
6.	Drainage Density	-.105	Insignificant
7.	Stream Frequency	-.263	Significant
8.	Rainfall Intensity	-.088	Significant

The above table clearly portrays that the pastures of Kaman tehsil are significantly related with absolute relief, slope and stream frequency in the area. Actually it is well known that in the region as a whole, the availability of wastes, most probably is found either on the point bars of rivers or on the water logged areas. But in case of Kaman streams are inversely influencing the waste lands. It may be because of the non-availability of streams or that the area is falling in the flood plain zone of Jamuna river.

5. Cultivable lands Vs. Geomorphic Parameters

Table 5B-XXII Cultivable lands Vs. Geomorphic Parameters

S.No.	Geomorphic Parameters	'r' value	Results
1.	Absolute Relief	.011	Insignificant
2.	Relative Relief	.188	Insignificant

3.	Slope	.176	Insignificant
4.	Ruggedness Number	.209	Insignificant
5.	Dissection index	.188	Insignificant
6.	Drainage Density	.223	Insignificant
7.	Stream Frequency	.372	Significant
8.	Rainfall Intensity	.119	Insignificant

The above table reveals that the cultivable lands of Kaman are positively related with the stream frequencies of the tehsil. The greater the stream frequency, more is the area which comes under cultivation.

Kishangarh Tehsil

1. Area Under Forests Vs. Geomorphic Parameters

Forests are highly related with the slope, drainage density, stream frequency and rainfall intensity of the tehsil. With slope the coefficient of correlation was found .309, which is significant at .01 level of 't' test. The correlation value with drainage is obtained as .238, which is also significant at .01 't' test level. The r value with stream frequency is obtained .260 and it is significant at the aforesaid 't' level. Finally with rainfall the 'r' value obtained is .338. This is highly significant. Thus, the discussed 4 geomorphic parameters have a direct positive correlation with the forests of Kishangarh.

Table 5B-XXIII Area Under Forests Vs. Geomorphic Parameters

S.No.	Geomorphic Parameters	'r' value	Results
1.	Absolute Relief	-.109	Insignificant
2.	Relative Relief	.173	Insignificant
3.	Slope	.309	Significant
4.	Ruggedness Number	.199	Insignificant
5.	Dissection Index	.093	Insignificant
6.	Drainage Density	.238	Significant
7.	Stream Frequency	.260	Significant
8.	Rainfall Intensity	.338	Significant

Kishangarh falls in the dry arid to semi-arid type of climate. The rainfall intensity is very low. The forest lands are directly dependent on relief characteristics, drainage and the intensity of rainfall.

2. Barren Lands Vs. Geomorphic Parameters

Barrens are insignificantly associated with all the geomorphic parameters, as the following table reveals.

Table 5B-XXIV Barren lands Vs. Geomorphic Parameters

S.No.	Geomorphic Parameters	'r' value	Results
1.	Absolute Relief	-.083	Insignificant
2.	Relative Relief	-.018	Insignificant

3.	Slope	-.169	Insignificant
4.	Ruggedness Number	.086	Insignificant
5.	Dissection Index	-.051	Insignificant
6.	Drainage Density	.121	Insignificant
7.	Stream Frequency	.162	Insignificant
8.	Rainfall Intensity	-.060	Insignificant

The above results are insignificant due to the spatial variation viz. the highlands of Kishangarh tehsil are totally occupied by the forested areas. The availability of barrens is only limited in the waterlogging areas of Dhamukhar Naddi around Titarka Bolni villages.

3. Scurbs Vs. Geomorphic Parameters

Scurbs in Kishangarh are significantly associated with the drainage density and the rainfall intensity, whereby the correlation values are -.221, -.265 respectively. This relationship is inverse and negative, which means where drainage and rainfall is high the area under scurbs decreases. Because high rainfall and drainage help in bringing the land under cultivation.

Table 5B-XXV Scurbs Vs. Geomorphic Parameters

S.No.	Geomorphic Parameters	'r' value	Results
1.	Absolute Relief	.039	Insignificant

2.	Relative Relief	.032	Insignificant
3.	Slope	.047	Insignificant
4.	Ruggedness Number	-.076	Insignificant
5.	Dissection Index	.060	Insignificant
6.	Drainage Density	-.221	Significant
7.	Stream Frequency	-.104	Significant
8.	Rainfall Intensity	-.265	Significant

4. Waste lands Vs. Geomorphic Parameters

There is no significant association between wastes of Kishangarh and the geomorphic attributes. Actually the waste lands are negligible in the tehsil. Following is the table in which the results obtained are shown.

Table 5B-XXVI Wastes Vs. Geomorphic Parameters

S.No.	Geomorphic Parameters	'r' value	Results
1.	Absolute Relief	.132	Insignificant
2.	Relative Relief	-.018	Insignificant
3.	Slope	.065	Insignificant
4.	Ruggedness No.	-.155	Insignificant
5.	Dissection Index	-.050	Insignificant
6.	Drainage Density	-.102	Insignificant
7.	Stream Frequency	-.159	Insignificant
8.	Rainfall Intensity	.163	Insignificant

5. Cultivable lands Vs. Geomorphic Parameters

In case of cultivable lands, slope is a dominant and supporting factor, has a direct hold on the growth of agricultural lands. The results obtained are -.370 (with slope) and .300 (with the stream frequencies). Both the 'r' values are significantly related at .01 level of t test. Kishangarh particularly is the source of myriad of small rivulets (which are ephemeral in nature) existing in the region of Mewat. The big Landoha mainstream, which sometimes called as "sorrow for Mewat" also originates from the high hills of Kishangarh tehsil. It causes much damages with its inundation capacities in its path.

Table 5B-XXVII Cultivable lands Vs. Geomorphic Parameters

S.No.	Geomorphic Parameters	'r' value	Results
1.	Absolute Relief	-.240	Insignificant
2.	Relative Relief	-.258	Insignificant
3.	Slope	-.370	Significant
4.	Ruggedness Number	-.142	Insignificant
5.	Dissection Index	-.110	Insignificant
6.	Drainage Density	-.096	Insignificant
7.	Stream Frequency	-.300	Significant
8.	Rainfall Intensity	-.248	Significant

Nagar Tehsil

1. Area Under Forests Vs. Geomorphic Parameters

Four geomorphic factors supports the growth of forests in the tehsil. These are absolute relief (.398), relative relief (.398), dissection index (.396) and stream frequency (.343).

Table 5B-XXVIII Forests Vs. Geomorphic Parameters

S.No.	Geomorphic Parameters	'r' value	Results
1.	Absolute Relief	.398	Significant
2.	Relative Relief	.398	Significant
3.	Slope	.191	Insignificant
4.	Ruggedness Number	.114	Insignificant
5.	Dissection Index	.396	Significant
6.	Drainage Density	.194	Insignificant
7.	Stream Frequency	.343	Significant
8.	Rainfall Intensity	-.146	Insignificant

2. Barren lands Vs. Geomorphic Parameters

The barrens and scurbs and the pastures are not having any correlation with the geomorphic parameters. In both the cases values obtained are 0-0, which may be a computer mistake or it is because the relief values and the area under barrens, both were nil in the area of tehsil.

3. Cultivable lands Vs. Geomorphic Parameters

The cultivable lands of the tehsil have an inverse correlation with the ruggedness number (-.270) and dissection index (-.218). The impact of both these variables is significant at .01 level as 't' test was worked out. The following table gives an idea of the same.

Table 5B-XXIX Cultivable lands Vs. Geomorphic Parameters

S.No.	Geomorphic Parameters	'r' value	Results
1.	Absolute Relief	-.206	Insignificant
2.	Relative Relief	-.206	Insignificant
3.	Slope	-.164	Insignificant
4.	Ruggedness Number	-.270	Significant
5.	Dissection Index	-.218	Significant
6.	Drainage Density	-.075	Insignificant
7.	Stream Frequency	-.070	Insignificant
8.	Rainfall Intensity	-.135	Insignificant

Nuh Tehsil

1. Area Under Forests Vs. Geomorphic Parameters

The forests are nil at present in Nuh tehsil. Hence the correlation is also nil.

2. Barren lands Vs. Geomorphic Parameters

Barrens are associated with three geomorphic parameters namely (i) dissection index (.211), (ii) stream frequencies

(.289), (iii) drainage density (.239). Actually barrens of Nuh are considered as those lands which are occupying the tops of the Kala Pahar hills, where by if modern technology be applied, certainly these top hill lands may be brought into cultivation. Even, some Meo people of low lying villages (e.g. Notaki, Ghaghas, Kotla and Mohammadpur Meoli etc.) during rainy season grow their kharif crops here on the top lands, which have been included in the barren lands. Besides, artifactial resources of forests aan well be developed in these barren soils of Nuh, as it provides better potentialities for plant growth.

Table 5B-XXX Barren Lands Vs. Geomorphic Parameters

S.No.	Geomorphic Parameters	'r' value	Results
1.	Absolute Relief	.152	Insignificant
2.	Relative Relief	.171	Insignificant
3.	Slope	.062	Insignificant
4.	Ruggedness Number	.195	Insignificant
5.	Dissection Index	.211	Insignificant
6.	Drainage Density	.289	Insignificant
7.	Stream Frequency	.239	Insignificant
8.	Rainfall Intensity	-.078	Insignificant

3. Scurbs Vs. Geomorphic Parameters

There is no correlation between scurbs and the geomorphic

parameters in Nuh. Actually, there is no scope and space for the scurbs in Nuh. The increasing population in seeking food for the sustenance have ploughed all the grazing lands etc. turning them into cultivable lands.

Table 5B-XXXI Scurbs Vs. Geomorphic Parameters

S.No.	Geomorphic Parameters	'r' value	Results
1.	Absolute Relief	-.029	Insignificant
2.	Relative Relief	-.013	Insignificant
3.	Slope	.068	Insignificant
4.	Ruggedness Number	.002	Insignificant
5.	Dissection Index	-.022	Insignificant
6.	Drainage Density	-.047	Insignificant
7.	Stream Frequency	-.029	Insignificant
8.	Rainfall Intensity	-.069	Insignificant

4. Wastes Vs. Geomorphic Parameters

The waste lands of Nuh have zero correlation with the geomorphic parameters. Wastes include the water logged areas of Nuh, whereby white patches of alkaline and saline soils are seen. These wastes are becoming permanent day by day. The results obtained are totally zero.

5. Cultivable lands Vs. Geomorphic Parameters

Except for drainage density and rainfall intensity, the cultivable lands of Nuh are highly related with the rest

of geomorphic attributes.

Table 5B-XXXII Cultivable lands Vs. Geomorphic Parameters

Geomorphic Parameters	'r' value	t_t value	t_c value	Level	Result
1. Absolute Relief	-.276	2.576	3.687	.01	Significant
2. Relative Relief	-.393	2.576	5.480	.01	-do-
3. Slope	-.274	2.576	3.622	.01	-do-
4. Ruggedness No.	-.399	2.576	5.556	.01	-do-
5. Dissection Index	-.329	2.576	4.174	.01	-do-
6. Drainage Density	-.185	2.576	2.418	.01	Insignificant
7. Stream Frequency	-.265	2.576	3.530	.01	Significant
8. Rainfall Intensity	.106	2.576	1.361	.01	Insignificant

The above table reveals that the agricultural lands of Nuh are being negatively supported by absolute relief with r = .276; relative relief with r = -.393, slope with r = -.274; ruggedness number with r = -.399; dissection Index with r = .329 and stream frequencies with r = .265.

Pahari Block

Though the correlation values have been obtained in finding out the association between geomorphic attributes and the land use in Pahari, but all the r values are found insignificant, when they were tested on .01 level of significance. The 'r' values are being given in the following table

as follows.

Table 5B-XXXIII Land Use Vs. Geomorphic Parameters

Geomorphic Parameters	'r' values for different land use				
	Forests	Barrens	Scurbs	Wastes	Agrl. lands
1. Absolute Relief	-.015	0.00	-.029	.139	-.121
Relative Relief	-.015	0.00	-.029	.139	-.121
3. Slope	-.045	0.00	.071	.218	-.234
4. Ruggedness Number	-.044	0.00	-.087	.236	-.087
5. Dissection Index	-.015	0.00	-.029	.139	-.121
6. Drainage Density	-.058	0.00	-.116	.096	-.031
7. Stream Frequency	-.021	0.00	-.042	.049	-.025
8. Rainfall Intensity	.160	0.00	-.211	-.081	.132

Punhana Block

In case of forests, scurbs and barrens, the correlation is nil in Phnhana block. Actually, none of the above three categories of land-use are available in this tehsil nor the geomorphic inequality is so high. Hence, the correlation is zero. The waste lands have an association with the slope of the area. Whatever the slope is available in the tehsil supports the wastes of the block. Higher, the slope, greater will be the wastes in the block. These wastes are around Khanpur Ghati and Utawar-Kot villages. This is a unique characteristic of this block, where the waste lands are

distributed on high sloping areas, in contrast to the other areas of the region, where waste lands are negatively correlated with the slope. This is attributed mainly to the saline patches formed by excessive waterlogging. Very few patches are sandy which are left as waste lands.

Table 5B-XXXIV Waste lands Vs. Geomorphic Parameters

S.No.	Geomorphic Parameters	'r' value	Results
1.	Absolute Relief	.265	Insignificant
2.	Relative Relief	.000	Insignificant
3.	Slope	.445	Significant
4.	Ruggedness Number	.265	Insignificant
5.	Dissection Index	0000	Insignificant
6.	Drainage Density	.130	Insignificant
7.	Stream Frequency	-.029	Insignificant
8.	Rainfall Intensity	.043	Insignificant

Cultivable lands Vs. Geomorphic Parameters

The cultivable lands of Punhana are also inversely supported by the slope of the area.

Table 5B-XXXV Cultivable lands Vs. Geomorphic Parameters

S.No.	Geomorphic Parameters	'r' value	Results
1.	Absolute Relief	-.265	Insignificant
2.	Relative Relief	.000	Insignificant

3.	Slope	-.445	Significant
4.	Ruggedness Number	-.265	Significant
5.	Dissection Index	.000	Significant
6.	Drainage Density	-.130	Significant
7.	Stream Frequency	-.029	Significant
8.	Rainfall Intensity	-.043	Significant

Ramgarh Tehsil

Forests Vs. Geomorphic Parameters

Geomorphic parameters play a dominant role in the land use of Ramgarh tehsil. The forests depend directly upon the relief and drainage characteristics. They are associated with absolute relief (.224); relative relief (.258); slope (.369); ruggedness number (.452); dissection index (.399); drainage density (.474) and rainfall intensity (-.315) with high value of 't' significance. The results obtained in the table clearly portrays the positivity of forests governed by the geomorphic attributes. With rainfall intensity, this correlation is negative. It is because of the aridity in the tehsil, which enjoys the arid to semi-arid type of climate.

Table 5B-XXXVI Forests Vs. Geomorphic Parameters

S.No.	Geomorphic Parameters	'r' value	t_t value	t_c value	Level	Results
1.	Absolute Relief	.224	2.576	3.176	.01	Significant

2.	Relative Relief	.258	2.576	3.699	.01	Significant
3.	Slope	.369	2.576	5.486	.01	-do-
4.	Ruggedness Number	.452	2.576	7.002	.01	-do-
5.	Dissection Index	.399	2.576	5.988	.01	-do-
6.	Drainage Density	.446	2.576	6.886	.01	-do-
7.	Stream Frequency	.474	2.576	7.459	.01	-do-
8.	Rainfall Intensity	-.315	2.576	4.586	.01	-do-

Barren Lands Vs. Geomorphic Parameters

Barrens are negatively related with all geomorphic parameters. But the barrens are very scarce in the tehsil as the data speaks. Hence the correlation is also insignificant.

Table 5B-XXXVII Barren lands Vs. Geomorphic Parameters

S.No.	Geomorphic Parameters	'r' value	Results
1.	Absolute Relief	-.112	Insignificant
2.	Relative Relief	-.063	Insignificant
3.	Slope	-.020	Insignificant
4.	Ruggedness Number	-.032	Insignificant
5.	Dissection Index	-.048	Insignificant
6.	Drainage Density	-.102	Insignificant
7.	Stream Frequency	-.097	Insignificant
8.	Rainfall Intensity	-.084	Insignificant

3. Scurbs Vs. Geomorphic Parameters

Scurbs and pastures also have an inverse and insignificant correlation with the geomorphic parameters.

Table 5B-XXXVII Scurbs Vs. Geomorphic Parameters

S.No.	Geomorphic Parameters	'r' value	Results
1.	Absolute Relief	.102	Insignificant
2.	Relative Relief	-.012	Insignificant
3.	Slope	.030	Insignificant
4.	Ruggedness Number	-.068	Insignificant
5.	Dissection Index	-.004	Insignificant
6.	Drainage Density	-.053	Insignificant
7.	Stream Frequency	-.012	Insignificant
8.	Rainfall Intensity	.010	Insignificant

4. Waste lands Vs. Geomorphic Parameters

There is close correlation between wastes and geomorphic parameters, but it is insignificant at .01 level of 't' test.

Table 5B-XXXVIII Wastes Vs. Geomorphic Parameters

S.No.	Geomorphic Parameters	'r' value	Results
1.	Absolute Relief	.134	Insignificant
2.	Relative Relief	.185	Insignificant
3.	Slope	.088	Insignificant
4.	Ruggedness Number	.095	Insignificant

5.	Dissection Index	.103	Insignificant
6.	Drainage Density	-.067	Insignificant
7.	Stream Frequency	.079	Insignificant
8.	Rainfall Intensity	-.100	Insignificant

5. Cultivable lands Vs. Geomorphic Parameters

Cultivable lands in Ramgarh are inversely related to all geomorphic attributes. The correlation matrix with their 't' test values is provided here in the following table.

Table 5B-XXXIX Cultivable Wastes Vs. Geomorphic Parameters

Geomorphic Parameters	'r' value	t_t value	t_c value	Level	Results
1. Absolute Relief	-.257	2.576	3.654	.01	-
2. Relative Relief	-.353	2.576	5.243	.01	-
3. Slope	-.348	2.576	5.130	.01	-
4. Ruggedness No.	-.382	2.576	5.712	.01	-
5. Dissection Index	-.364	2.576	5.400	.01	-
6. Drainage Density	-.286	2.576	4.125	.01	-
7. Stream Frequency	-.415	2.576	6.304	.01	-
8. Rainfall Intensity	-.395	2.576	5.942	.01	-

Tiiara Tehsil

1. Area Under Forests Vs. Geomorphic Parameters

The correlation values in the table shows that there is correlation between area under forests and the geomorphic values, but it is not significant at .01 level of 't' test.

Table 5B-LX Geomorphic Parameters Vs. Area Under Forests

S.No.	Geomorphic Parameters	'r' value	Results
1.	Absolute Relief	.099	Insignificant
2.	Relative Relief	.091	Insignificant
3.	Slope	.131	Insignificant
4.	Ruggedness Number	.077	Insignificant
5.	Dissection Index	-.010	Insignificant
6.	Drainage Density	.145	Insignificant
7.	Stream Frequency	.109	Insignificant
8.	Rainfall Intensity	.044	Insignificant

2. Barren lands Vs. Geomorphic Parameters

Barren lands are negatively related with absolute relief. The correlation is inversely significant at .01 level of 't' test.

Table 5B-LXI Barren lands Vs. Geomorphic Parameters

S.No.	Geomorphic Parameters	'r' value	Results
1.	Absolute Relief	-.237	Significant

2.	Relative Relief	.015	Insignificant
3.	Slope	-.044	Insignificant
4.	Ruggedness Number	-.021	Insignificant
5.	Dissection Index	-.110	Insignificant
6.	Drainage Density	-.067	Insignificant
7.	Stream Frequency	-.083	Insignificant
8.	Rainfall Intensity	.131	Insignificant

3. Scurbs Vs. Geomorphic Parameters

There is no significant correlation between geomorphic parameters and the prevailing pastures in Tijara Roondh. Actually, the Roondh of Tijara alone provide the grazing lands for the tehsil.

Table 5B-LXII Scurbs Vs. Geomorphic Parameters

S.No.	Geomorphic Parameters	'r' value	Results
1.	Absolute Relief	.112	Insignificant
2.	Relative Relief	.123	Insignificant
3.	Slope	.084	Insignificant
4.	Ruggedness Number	.144	Insignificant
5.	Dissection Index	.110	Insignificant
6.	Drainage Density	-.021	Insignificant
7.	Stream Frequency	-.067	Insignificant
8.	Rainfall Intensity	.122	Insignificant

4. Wastelands Vs. Geomorphic Parameters:

Wastes in Tijara have a direct relation with drainage density and stream frequency of the area. The waste lands here include the water logged areas, where the salinal-alkalinal soils are found in white colour. These lands in the locality are known as the Kallar bhoom or 'Khar'. These types of patches in Tijara are located at the upper banks (point bars) of the river streams.

The other supporting factors are Relative Relief (r . 227) and slope (r = .200).

TABLE LXIII

WASTELANDS VS. GEOMORPHIC PARAMETERS

S.No.	Geomorphic Parameters	'r' value	t_e value	t_o value	Level	Results
1.	Absolute Relief	.186	2.576	2.206	0.01	Insignificance
2.	Relative Relief	.227	"	2.718	"	Significance
3.	Slope	.200	"	1.166	"	Insignificance
4.	Ruggedness No.	.176	"	2.085	"	"
5.	Dissection Index	.153	"	1.805	"	"
6.	Drainage Density	.227	"	2.718	"	Significant
7.	Stream Frequency	.428	"	5.522	"	"
8.	Rainfall Intensity	.008	"	0.939	"	Insignificance

5. Cultivable lands Vs. Geomorphic Parameters
TIJARA TEHSIL:

Cultivable lands are inversely related with relative relief (r=.337), slope (r=.25); ruggedness number (-.257); stream frequency (-.265) and rainfall intensity (r=-.217).

TABLE LXIV

cultivable lands Vs. Geomorphic Regions

S.No.	Geomorphic Parameters	'r' Value	t_t Value	Level	Relation
1.	Absolute Relief	-.083	2.576	0.01	Insignificant
2.	Relative Relief	-.337	"	"	Significant
3.	Slope	-.250	"	"	"
4.	Ruggedness number	-.257	"	"	"
5.	Dissection Index	-.156	"	"	Insignificant
6.	Drainage Density	-.172	"	"	"
7.	Stream Frequency	-.265	"	"	Significant
8.	Rainfall Intensity	-.217	"	"	"

CONCLUDING REMARKS:

On the whole, from previous quantitative analysis. its broadly inferred that all these geomorphic parameters except the climatic parameter exercise a remarkable role in controlling the spatial variations of land use patterns in Mewat. For example these parameters have the highest correlation in Alwar, Ferozepur Jhirka, Nuh, Kishangarh, Ramgarh and Tijara. Secondly the land use patterns are seem to be entirely controlled by the altitudinal

differences in relief. The waste lands are those areas where waterlogging provides some white patches of salinal alka-linal soil called the 'Kharlands' or the 'Kaller Bhum'. The barrens are those areas/those dissection index and ruggedness number seem to be high. The forests are distributed mainly on hill tops or the sloping lands. The flat rolling plains or the flood plains are totally occupied by the agricultural lands, the high values of geomorphic parameters impose severe limitations to bring the land under cultivation. Pastures and scrubs mainly depend upon the will of farmers or the planning by government. Hence the physical parameters have less affect on the scrub and grass lands.

Part - C

GEOMORPHIC UNITS AND LANDUSE
A CASE STUDY OF TIJARA TEHSIL

A detailed Physiographic Vs Landuse analysis is attempted here based on the availability of 1:50,000 map of the area under study and also the field report made available by soil survey unit I.A.R.I.

Tijara tehsil occupies NW's part of Mewat region between 28 47' N to 28 14'N to 76 43'E to 76 58'E with a geomorphic variations of Aravalli ranges in the SE to peidmont zone in the centre followed by aeolian plains in the west. This tehsil represents the varied geomorphic entities of the region and has attracted a wide range of specialists after the havoc of 1977 Sahibi floods. Pedologists have specially contributed to the Genesis & tararomical ordering of the soils of the region. Though the detailed soil groups were available for this area, but this was partly used in the schematic analysis of the region.

Procedure:

Procedure of geomorphological mapping consists of the following stages:

1. Preparation of accurate relief base map of the area under study.
2. Mapping of geomorphological units and micro-topography.

Previously no geomorphological work has been done on this area. The present study may thus in its own

way be a step forward in evaluating morphological units, from the geomorphological point of view.

Geomorphology:

Topographic map analysis aided considerably in identifying various geomorphological units in the area of study. The units identified have thus been demarcated in figures accompanying the profile. The legend of these figures is self explanatory.

Various geomorphological units, with their brief description and evaluation of materials is outlined below:

REPORT ON TIJARA

Physiography, Relief and Drainage:

Hills:

They are covered by very shallow and shallow gravely sandy loam, soils of yellowish brown colour. Rock out crops are common to the extent of 60 to 70%. Scattered scrubs are visible on these lands described under Roopbas hill series (table No.).

Foothills:

Foothill slopes of this area display shallow to medium ravines having very deep coarse texural soils of dark yellowish brown to dark brown colour. They are waste lands, and used for grazing lands.

Plains:

Plains cover major parts of the water-shed with characteristics, nearly level to very gently sloping

plain, with very deep marginally fine loamy soils of dark yellowish brown colour.

Basinal:

Pale brown colour on water-sheds. In Bamantheri and Tijara Tehsils, these plains are found. Soils are of salinal and non-salinal characteristics. Average height of the area is 320^{m}. The maximum height is 400^{m} and the minimum is 240^{m}.

Geology:

The main rock type of the surveyed area belongs to Delhi system. The rock types met within the surveyed area are of Alwar series, mainly composed of quartzites and mica schists.

These rocky projections arrests the wind blown sand in the form of ridges and dunes in the SW part of the surveyed area, and its other geomorphic forms.

Climate:

This area enjoys the arid to semi-arid monsoon type of climate with an annual average rainfall of 715 mm, distributed mainly between January to September. The rainfall statistics for 7 yearm (1973-1979) has been reported hereby for Tijara station. Maximum rainfall (1193 mm) occured in 1977, and the minimum (246.6 m/m) occured in 1974.

Soil Erosion:

The intensity of erosion is severe to very severe in the eastern part of the surveyed area, especially in the hill region. It displays a ravinous dissected and undulating landscape. Due to bad topography and lack of any soil conservation, such land yields more silt to the reservoir.

The remaining area which is almost plain, suffers from slight to moderate erosion.

Table No.

(Physiography & Soils)

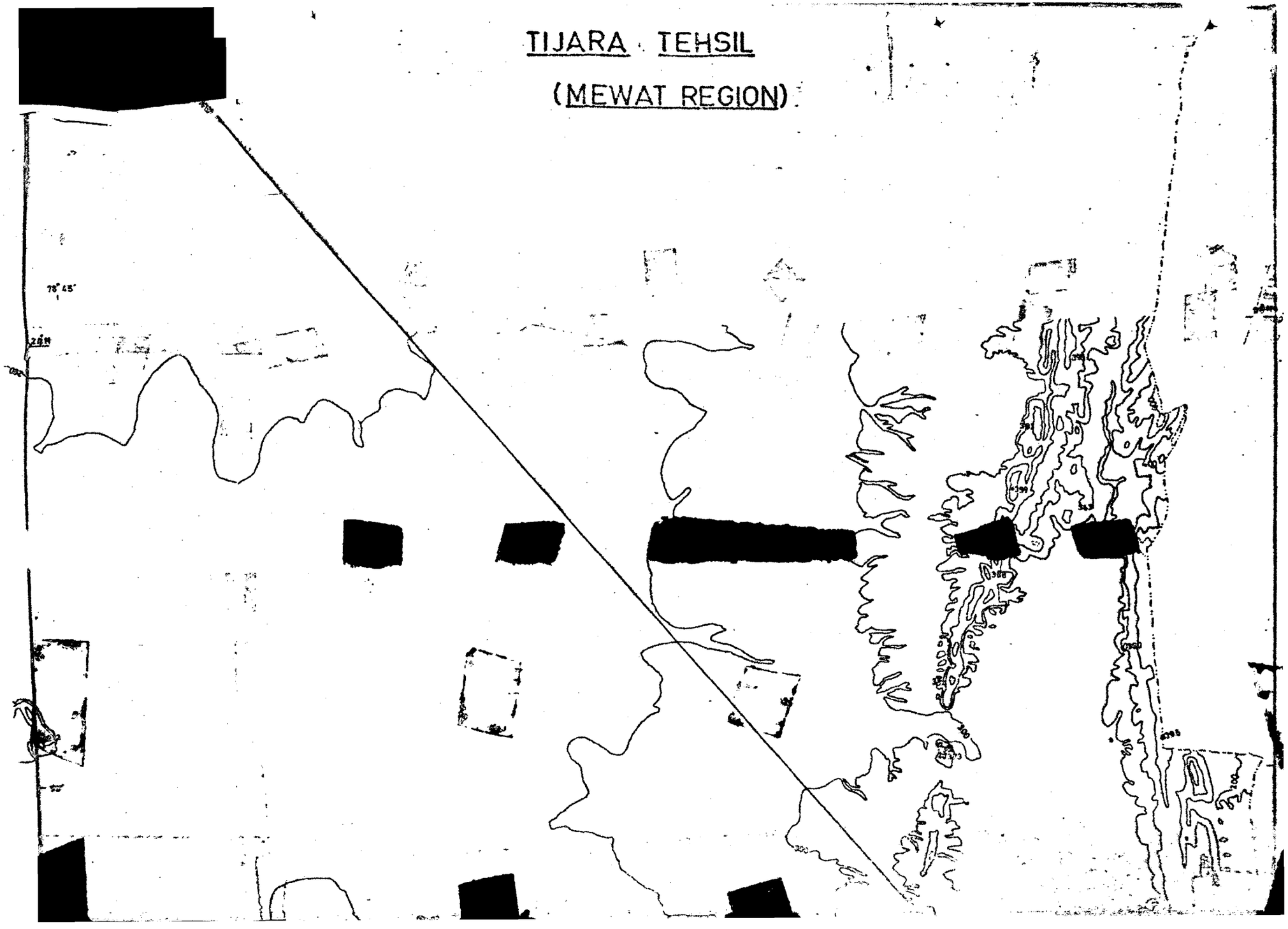
S. No.	Soil Series	Parent Material	Physiographic position and slope Range	Thickness Around	Texture Surface
1.	Allahpur Meo.	Alluvium	Undulating Landscape Slope 1 - 10%	100 cm.	Loamy sand to sandy loam
2.	Baliabas	"	Plain land slope 1-3%	100 cm.	Loamy & sandy loam
3.	Bawan theri	"	Below Band tank 1-3%	100 cm.	Loamy sand
4.	Luhadera	Aeolian Deposits	Stabilized dunes, 3-10% (Slope) Ravinous soils	100 cm.	sand
5.	Roondh Tijara	Aeolian	Stabilized dunes slope 3-10%	100 cm.	sand
6.	Tijara	Alluvium	Alluvial deposit Slope 1-3%	100 cm.	Clayey loam

DESCRIPTION OF PHYSIOGRAPHY AND LANDUSE IN TIJARA TEHSIL

The cross section along NW.SE direction in Tijara of Mewat region projects the area along 25 Kms. distance. The profile is of a gently sloping nature from SE-NW. In S.E. the undulations predominate, slowly levelling down to a flat monotonous flood plain in the east. In SE, the Hills & hillocks (C) (fig.) with 33% slope stand out at 440 meters of height. These hills are characterised by sparse scrubs and grasslands. At a lower height of 360 mts. these hills give way to Ravineland (H) with 5-15% slope, once again studded with scrubs & grasses. Till a distance of 3 1/2 kms. the same alternate arrangement of hills with ravinelands is observed, which ultimately give way to Foothill landscape (G) with 3-10% slope at a height of 300 mts. This physiographic unit has an intermixture of cultivation is over 70-80% of the area and scrubs & grasses are on 30.20% area. Fourthly, this G unit merges with Alluvial plains ( ) with 1-5% slope & 0.3% respectively, which are mainly cultivated lands. This continuous stretch of alluvial plain for need by Aslimpur & Bamantheri stream with 0-3% slope is broken by the appearence of recent bars and broad river beds with 1-5% slope which are uncultivated patches of land. From the cross section and

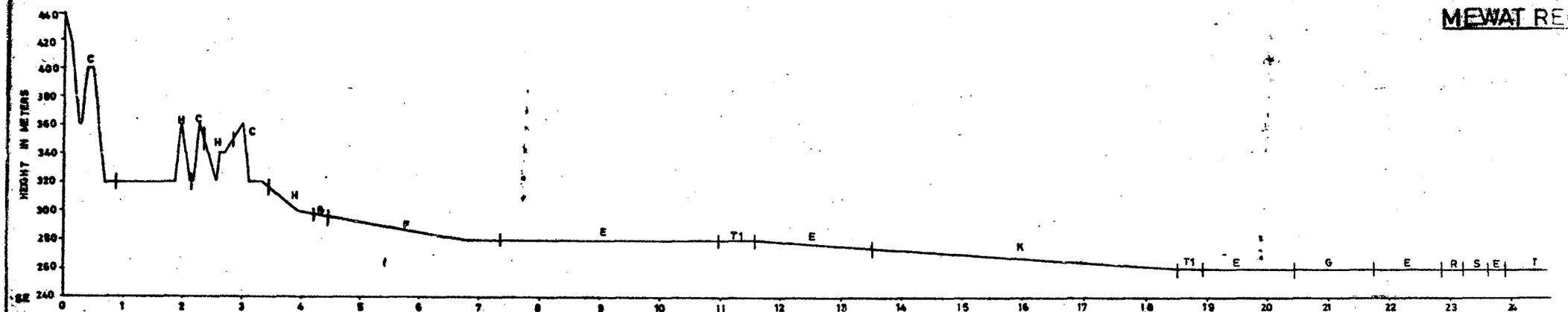
TIJARA TEHSIL

(MEWAT REGION)



CROSSSECTION ALONG 'NW-SE' DIRECTION IN TIJARA TEHSIL

MEWAT REGION



INDEX:

UNIT No.	PHYSIOGRAPHIC REGIONS WITH SLOPE VALUES,	LAND USE.
C.	HILLS & HILLOCKS WITH >33% SLOPE	SPARSE SCRUBS AND GRASSLANDS
G	FOOTHILL LANDSCAPE WITH 3-10% SLOPE	70-90% CULTIVATION AND 30-20% SCRUBS & GRASSES
H	RAVINES LAND WITH 5-15% SLOPE	MOSTLY SCRUBS & GRASSES OCCASIONAL CULTIVATION ON >20%
E	ALLUVIAL PLAINS WITH 0-3% SLOPE	CULTIVATED LANDS
F	ALLUVIAL PLAINS WITH 1-5% SLOPE	CULTIVATED LANDS
K	AEOLIAN ALLUVIAL PLAINS WITH SCATTERED SAND DUNES, SLOPE 0 3%	CULTIVATED LANDS
R	FLOODPLAINS INTERDUNE VALLEYS & BASINAL LANDS, SLOPE 1-3%	CULTIVATED LANDS
S	FLOODPLAINS WITH 1-3% SLOPE	80-90% WASTELANDS 20-10% UNDER CULTIVATION
T	POINT BARS WITH 1-3% SLOPE	CULTIVATED LANDS
T1	RECENT BARS AND BROAD RIVER BEDS WITH 1-5% SLOPE	UNCULTIVATED LANDS

SCALE:

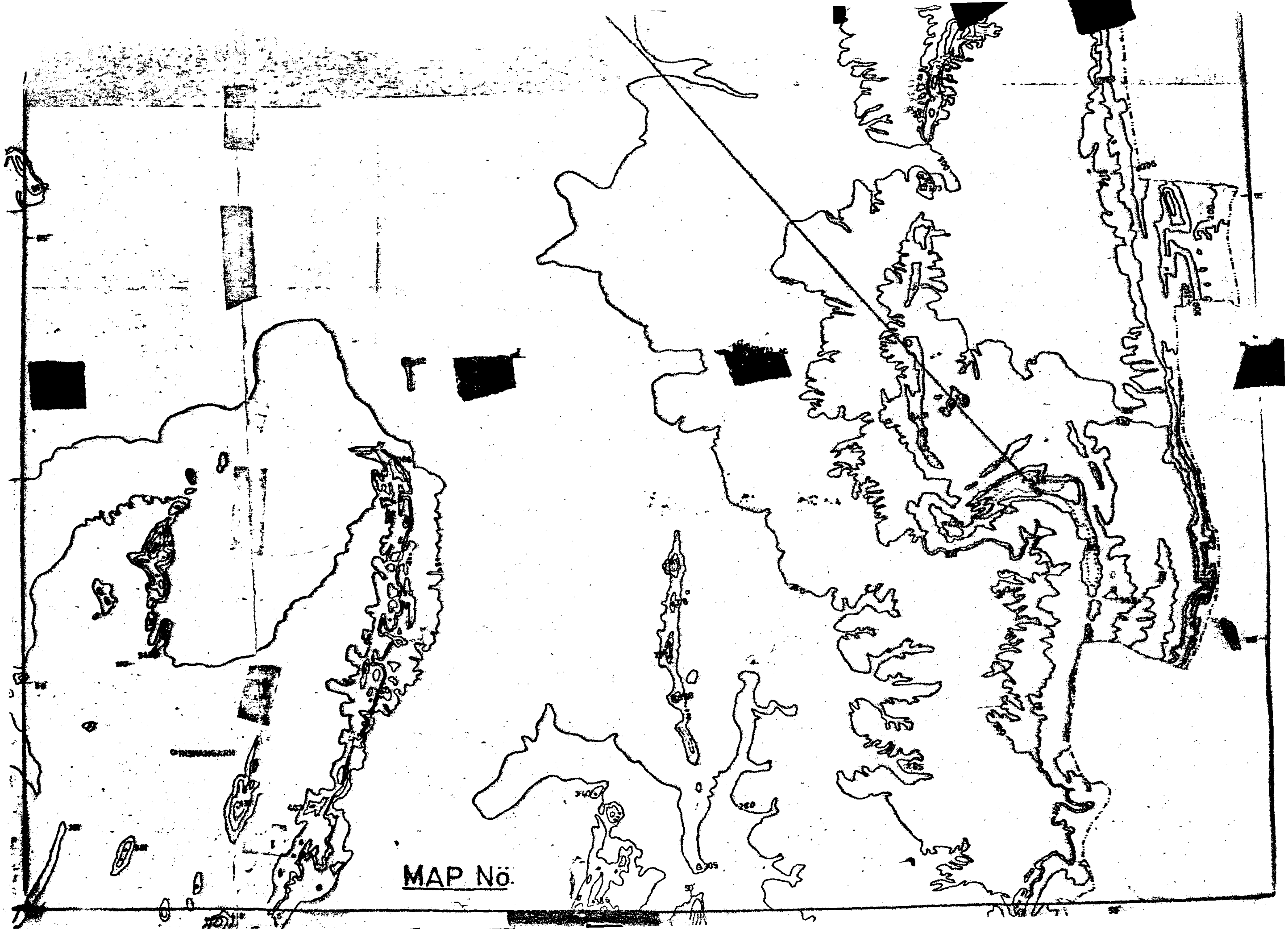
1 0 1 2 3 KILOMETERS

VERTICAL EXAGGERATION 25 TIMES.

FOR DETAILS REFER TO TABLE No.

CE:- COMPILED FROM 'SOIL SURVEY UNIT' I.A.R.I PUSA ROAD, NEW DELHI.

Fig. No



MAP Nö.

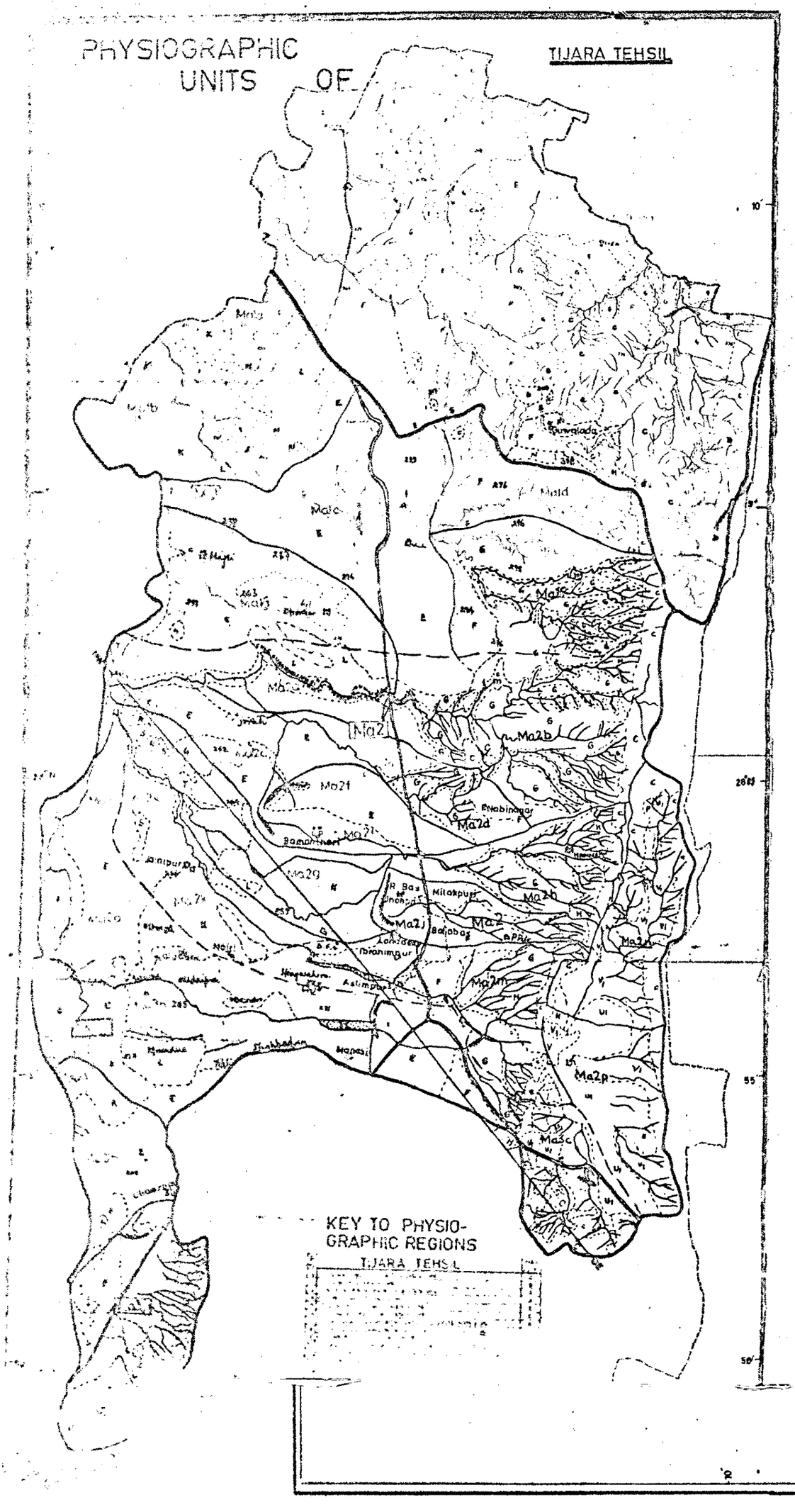
TIJARA TEHSIL, MEWAT REGION

S.No.	Unit	Physiography	Land-Use	Soils	Erosion
1.	C	Hills & hillocks with 33% of slope	Sparse Scrubs & Grass lands	Very shallow to shallow, Course loamy (dark yellowish soils) nearly 30 to 35% rockout-crops	Slight to moderate silt and hill erosion
2.	G	Foothill landscape with 3-10% slopes	70-80% cultivation and 30-20% scrubs and grass	Very deep, Course to fine loamy soils, light yellow brown to dark brown	Very severe sheet and sheet gully erosion
3.	H	Ravines land, 5-15% slope	Mostly Scrubs and grasses occassional cultivation (20%)	Very deep course loamy soils	Very severe sheet and gully stream bank erosion
4.	E	Alluvial Plains with 0 to 3% slopes	Cultivated lands	Very deep, Course loamy yellow brown to dark brown soils	Slight sheet erosion
5.	F	Alluvial Plains with 1-5% slopes	Cultivated lands	Very deep Course loamy yellow brown to dark brown	Moderate sheet erosion

6.	K	Aeolian Alluvial plains with scattered dunes slope 0-3%	Cultivated lands	Very dip sandy, dark yellowish brown to browny shallow	Slight wind and water erosion
7.	R	Floodplains, Inter dune valleys and basinal lands slope 1-3%	Cultivated lands	Very deep, fine loamy yellowish brown to dark yellowish brown	None to slight erosion, Moderate flood hazards
8.	S	Floodplains 1-3%	Wastelands 10-20% under cultivation	Saline soils, very deep, fine loamy saline soils	Slight erosion, moderate flood hazards
9.	T	Point Bars Slope 1-3%	Cultivated lands	Very deep to Course loamy soils	Slight erosion Severe flood hazards
10.	T1	Recent Bars and Broad river beds Slope 1 to 5%	Un-cultivated lands	Very deep sandy soils	Slight erosion severe flood hazards

the table it is clearly evidenced that a broad patch of aeolian plain with scattered sandduneS & slope 0-3% (K) stretches for a distance of approximately 5 Kms.On this arid plain too, the cultivation is made possible with the help of irrigation facilities. Apart from this it is also being evidenced that underground water potential increases in the area as this area is nearer to water table because of the proximity to main Sahibi river. Bars & broad river beds (T_1) once again juxtapose between K & E respectively. In the last stretch of 3 kms., flood plains valleys and basinal lands with 1-3% slope. Point Bars (T) are also evidenced where the cultivation is the main activity. Surprisingly over flood plains (S), only 20-10% is put under cultivation and the rest of the area is occupied with wastelands. This may be due to the irregularities within this area which are left without cultivation due to lack of irrigational facilities. But this area needs to be explored further before making any proper analysis.

On the whole, it is concluded that the detailed cross section in Tijara tehsil provides an account of morphoric units associated with landuse. Such profiles are increasingly important to assess the terrain & to evaluate the further possible development in the region.


PHYSIOGRAPHIC UNITS OF
TIJARA TEHSIL
Ma2
Ma2b
Ma2d
Ma2j
Ma2h
Ma2p
Ma3c
KEY TO PHYSIO-GRAPHIC REGIONS
TIJARA TEHSIL

CHAPTER - VI

CHAPTER - VI

SUMMARY & CONCLUSION

The past decade has witnessed an increasing change in the mode of land system studies in geomorphology. The geomorphological studies related to our topic of research "Geomorphology and land-use." can be considered into three stages, such as:-

1. Morphology and land systems in which mapping of geomorphological units have been done.
2. Correlation Analysis and
3. General distribution of land-use in a region.

Geomorphological mapping has been chosen as a tool for analysing the topographic features of a region.

The recent mapping techniques which were initiated by CSIRO, CRD in Australia have made a significant contributions to the emergence of Geomorphology as an applied discipline. This impetus initiated by these Organizations have been followed up widely to assess the potentialities of terrain and evaluate it for furter development. The Geomorphic processes with their wide ranging degrees of variations give rise to diversities over the landscape of which landuse is one of the foremost activity which seems to be guided by the geomorphic parameters. In this case study an initial attempt has been made to assess the role of geomorphic parameters on the landuse of the region.

The very early researchers stressed their work on studying the landform units after analysing the maps and their field surveys. It is well known fact that the natural biota is controlled by natural environment. For this it becomes essential to analyse terrain and associated land-use to draw and to infer the conclusions regarding the close association between the geomorphology and land-use.

In 1978 Subramanyam of I.I.T. Bombay made out certain geomorphic units after chosing certain geologic, pedalogic, vegetational, hydrological and land-use aspects in and around Sagar. On the basis of these mapology he drew several profiles to illustrate the land units.

This study is also very close to the above mentioned study as we have also prepared several maps of geomorphic parameters and then, we have drawn the profiles, which gave us the vertical and horizontal dimension of the region.

Very few persons shave studied the relationship between geomorphology and land-use. An initial hypothesis was formulated by us that land-use of a region is highly related to the geomorphological parameters of the area or to say in simple words that land use of Mewat Region has a significant relationship with its geomorphology. Henceforth, to test this hypothesis, analysis was done using statistical tools like correlation coefficient of

Karl Pearson and the 't' test of Confidence. Thus, the results obtained through this analysis was very significant.

Briefly on the basis of our correlate results, it can be emphasized that no part of the region is free from the impact of geomorphic factors, such as relief, slope, dissection, drainage, stream frequency and ruggedness of the region. In fact, it can be overwhelmingly stated that geomorphic factors play a predominant role on the spatial variation of land-use of any region.

In the first Chapter of our study, we have introduced the area selected for our present study. The study area is representative of a section of India, which offers a multitude of natural landscape, and biotic phenomena. The interdependence of these two features is clearly evidenced in the study area and it was the main aim of this study as to facus the attention on the impact of natural landscape on the land-use.

The Mewat region has a geographical extension between 27 15' N.Lat. - 28 30'N Lat. and 76 30' East long - 77 30' E long. The area covers partly the states Haryana, Rajasthan and a part of western U.P.

Here, it should be kept in mind that the delimitation of Mewat Region is entirely based upon the concentration of Meo-villages. Though, the Sohna block of Gurgaon district and Goberdhan of Mathura in NE & SE of Mewat

respectively also form a part and parcel of the region, but it is to be stated here that only 150 sq. miles of the total Gurgaon area is restricted to Mewat region. In a similar way 25 square miles of Mathura district falls under the range of Mewat Region. Due to lack of availability of statistical data it was not possible to include these two blocks for the analysis of our present study. But this fact did not deter us to draw the overall conclusion regarding the pattern of our study.

Geologically, the whole region is made up of the Delhi system of rocks. The chief geological formation occuring in the region, is the famour belt of Aravalli range, traversing from SW to NE. It comprises of two series namely Alwar & RAjabgarh series. The total area of the region was calculated as 1450 square miles.

Physiographically, the region has been divided into two broad regions, which come under three strips of Mewat. The highlands of Mewat are the western rugged areas which include Tijara, Kishangarh, Ramgarh and Alwar tehsils. And the lowlands of Mewat consist of two strips viz. 'Abrez'and'Bhayana'. Consisting of Deeg, Hattin, Kaman, Punhana and Pahari blocks Bassai Landhe tehsils. The drainage is characterised by ^ rivers flowing in a W-S direction. The climate is arid to semi-arid depicted by Thornthwaite's -100 to -33.3 moisture index

In the second chapter we have selected a few of several other geomorphic parameters, keeping in view their possible impact on the land use of the region.

In the present study, the following 8 parameters were chosen which reliably govern the land-use distribution in the region:-

1. Absolute Relief 2. Relative Relief 3. Slope 4. Ruggedness number 5. Dissection Index 6. Drainage Density 7. Stream Frequency & 8. Rainfall Intensity.

The above mentioned parameters were calculated on the basis of morphometric methods. For all, the 1/4" toposheet maps have been used, and to delineate contours and drainage lines. For each and every parameter, the maps have been drawn, which would be representing the site for such a parameter.

Absolute Relief has been chosen as the first parameter, which expresses an actual, maximum local relief in a region above mean sea level. On the basis of absolute relief, the area was categorized in 4 sections, and the results then, showed that most part of the region (55.55%) occurs below 750' of local relief a very little area (7% of the region) only lies above 1000' and this much area totally lies in the tops of western hills of Alwar and Kishangarh.

The second parameter i.e. relative relief has been calculated differentiating between the highest and lowest points in a grid square. In the present area of study, the values of relative relief range from 0 to 1200' with an interval of 300'. The highest relative relief was also in Alwar tehsil.

Briefly apeaking, it was concluded that all the parameters except of rainfall intensity were observed to be high in the western hills and the central hills followed by dissected piedmont zone. The rest of the areas were quite gently sloping and were poor in drainage also. The rainfall intensity was absolutely inverse than the of the pattern of other parameters. This picture is very clear from the superimposed profiles drawn.

In the Chapter III, on the basis of parametric studies and the profiles drawn along 6 cross-sections, various geomorphic regions have been identified. Actually, the study of geomorphic parameters provides an insight into the delimitation process based on certain basic geomorphic attributes. The landscape approach which classifies the land into various land systems uses geomorphic units as its fundamental basis with simple form, relief, soil, climate and drainage regime with maximum homogeneity.

The criterion which we have adopted here to classify the area into certain geomorphic units very closely follows the previous landscape approaches. Only in three points, it differs from those of the previous studies. For instance (1) we have chosen comparatively more geomorphic parameters for classifying the land into several geomorphic regions. (2) we have drawn the serial and superimposed profiles for each of

the geomorphic parameters along 6 cross-sections ('AB, 'BC', 'CD', 'DE' & 'EF).

The regions made (by the help of these superimposed profiles of 8 parameters) were then, tallied with the contour net in the region, as the superimposition of all profiles gives a broad frame in which 7 geomorphic units have been identified in such a way that by incorporating the corresponding soil, vegetation, climate and land use data, these may be regarded as the present geomorphic map. The consideration of geomorphic regions has been done on meso level because the region is most probably a part of Indo-Gangetic divide and the Sahibi Catchment. The central Aravalli Range or "Kala Pahar" seperates both the plains as it becomes a barrier between Jamuna floodplains and Sahibi aeolian plains. The entire region on the basis of relief structure, slope elevation, ruggendity, dissection and drainage characteristics is divided into two broad regions and 7 sub-regions. The two broad regions are (1) Ridges & Valleys occupying 55.55% area of the total region. (2) Plains studded with hillocks, which occupies 44.45% area of the region. The western Aravalli Ranges makes western boundary of Mewat. This is the highest range which occupies the heighest altitude and that is why the top of the hills and their footslopes are mostly covered with dense forests. Slopes here are steep to very steep at some places, but moderately to steep

slopes are available at everywhere. The rocks here comprises of hard sandstone, which geologically belongs to the Alwar series of Delhi system. Ruggedness is high but dissection comparatively is low as the stream frequency is not so high. Central Aravalli range (The Kala Pahar) of Mewat is the most important geomorphic unit of the region, as it is an important water shed divide, which contributes the rainfall water to the region through a myriad of small ephemeral rivulets, originating from the tops of the hills. This range starts from Noganwa village in south and extends upto Bhundsi village in north. The footslopes of this range are very rugged and dissected, hence it is called dissected piedmont zone; which runs parallel to this region. Intermontane midlands and low lands are very rich from agricultural point of view. Soils are very fertile. The eastern Jamuna flood plains are very much affected by the rainfall and prevailing irrigation facilities. It is quite a flat plain, which is structured by pleistocence recent alluviums. The western aeolian plains are totally falling with in the Sahibi catchment.

Mewat Region, on the whole offers a wide scope for further delimitation of geomorphic units, though the seven units which are broadly recognized from the geomorphic analysis provide a base with which the land use was broadly correlated in our 5th chapter of study.

In the Chapter IV, an attempt has been made, first to define land-use, its purpose and scope and then 5 broad land-use groups have been chosen for the study as they represent the natural utilization of the land then the rest of the categories. The general distribution of land-use has been shown through maps and tables. It is apparent from this distribution that most of the area is lying under cultivation. (Nearly 74.20% of the total area). The remaining 25.80% area is devoted to the other uses of land, such as 2.85% under forests, 6.14% under barrens, 6.22% under landput to non-agricultural use; .95 under permanent pastures and grazing lands. 1.39% under cultivable wastes and 8.27% area is left for fallow lands during the year 1980-81.

It has been found that the forests are always found on the high hills and pastures and barrens in the foot hills. The waste lands and cultivable lands are distributed the lowlying areas.

The highest area of the cultivable lands (32.33% of the region) lies in the Jamuna flood plains. The highest area under forests is available in three tehils - Alwar, Ramgarh and Kishangarh. Henceforth, the study reveals that the land-use patterns under different geomorphic units vary according to physical potentialities, whereas hills and high lands are not suitable for cultivation. Besides, the western aeolian plains and the central lowlying saline buried plains have comparatively less potentialities for agriculture.

In the 5th Chapter, the first part deals with the qualitative analysis of geomorphology and land-use and the second part deals with the quantitive analysis, in which statistical tools have been applied. Bi-variate correlation analysis for individual tehsils and for the region as a whole have been worked out between five dependent land-use variables and 8 independent parametric values. The results obtained were very much satisfactory. The forests, pastures and barrens were highly and positively correlated with the relief and drainage characteristics of the region. The waste lands and cultivable lands are negatively but significantly related with the geomorphic parameters but drainage density, stream frequency are positively related with wastelands. Density and stream frequency in the form of drainage characteristics show a negative correlation with cultivable lands. This is explained by the nature of streams which are ephemeral and increase the dissection and ruggedity during rainy season by gully erosion. Henceforth, these two drainage characteristics are positively correlated with dissection index and ruggedness number. Apart from this, as the area falls in the backward zone of India, the technology has not made a rapid progress whereby the freshlands, which lie as wastelands at present are not being brought into cultivation. So, the hypothesis, relating the drainage characteristics with wastelands and cultivable lands holds good in the study area.

Besides, the climate being uniform through out the region, no positive correlation between cultivable lands and rainfall intensity could have been obtained except for two tehsils namely Deeg and Hattin. The utilization of water of these two tehils is efficient because the rainwater is diverted to the fields through canals and their sub-channels for the cultivation purposes, whereas no other areas, the water is not utilized in the same manner, thereby leading to the concentration of wastelands.

The problem of wastelands is immense and needs to be tackled before proper measures are implied in the region. The wastelands are highly correlated with high dissection index. This means the possible reclamation might be possible only through a proper management of drainage lines. If this is done, then more amount of agricultural land can be brought under cultivation which will be an input into the living of Meo Community. But, for a more precise analysis the geomorphic mapping needs to be carried at a detailed level to assess the role of geomorphic variables on the landuse.

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APPENDIX

TABLE NO. DISTRIBUTION OF LAND UNDER DIFFERENT CATEGORIES OF GEOMORPHIC PARAMETERS, MEWAT REGION, 1980 - 1981

(Area in Percentages, relatively to the total area of the region)

Tahsil/ Block	Absolute Relief				Relative Relief			
	750	750-1000	1000-1500	1500-2000	0-300	300-600	600-900	900-1200
Alwar	6.00	0.35	3.00	3.00	6.90	0.25	1.00	4.20
Deeg	6.50	0.00	0.00	0.00	6.50	0.00	0.00	0.00
Ferozepur (J)	8.68	0.20	2.00	0.00	8.00	2.88	0.00	0.00
Hattin	5.34	0.00	0.00	0.00	5.34	0.00	0.00	0.00
Kaman	4.73	0.20	0.00	4.73	0.00	0.00	0.00	0.00
Kishangarh	0.00	0.00	8.82	1.18	8.00	1.00	1.00	1.00
Nagar	4.00	0.26	2.00	0.00	5.20	1.06	0.00	0.00
Nuh	8.00	1.01	5.00	0.00	12.00	2.00	0.01	0.00
Pahari	4.00	0.24	0.84	0.00	4.80	0.28	0.00	0.00
Punhana	4.74	1.00	0.88	0.00	6.62	0.00	0.00	0.00
Ramgarh	3.74	1.00	4.98	0.00	7.16	2.24	0.34	0.00
Tijara	0.00	0.00	8.49	0.00	7.00	1.00	0.49	0.00

TABLE NO. CONT'D...

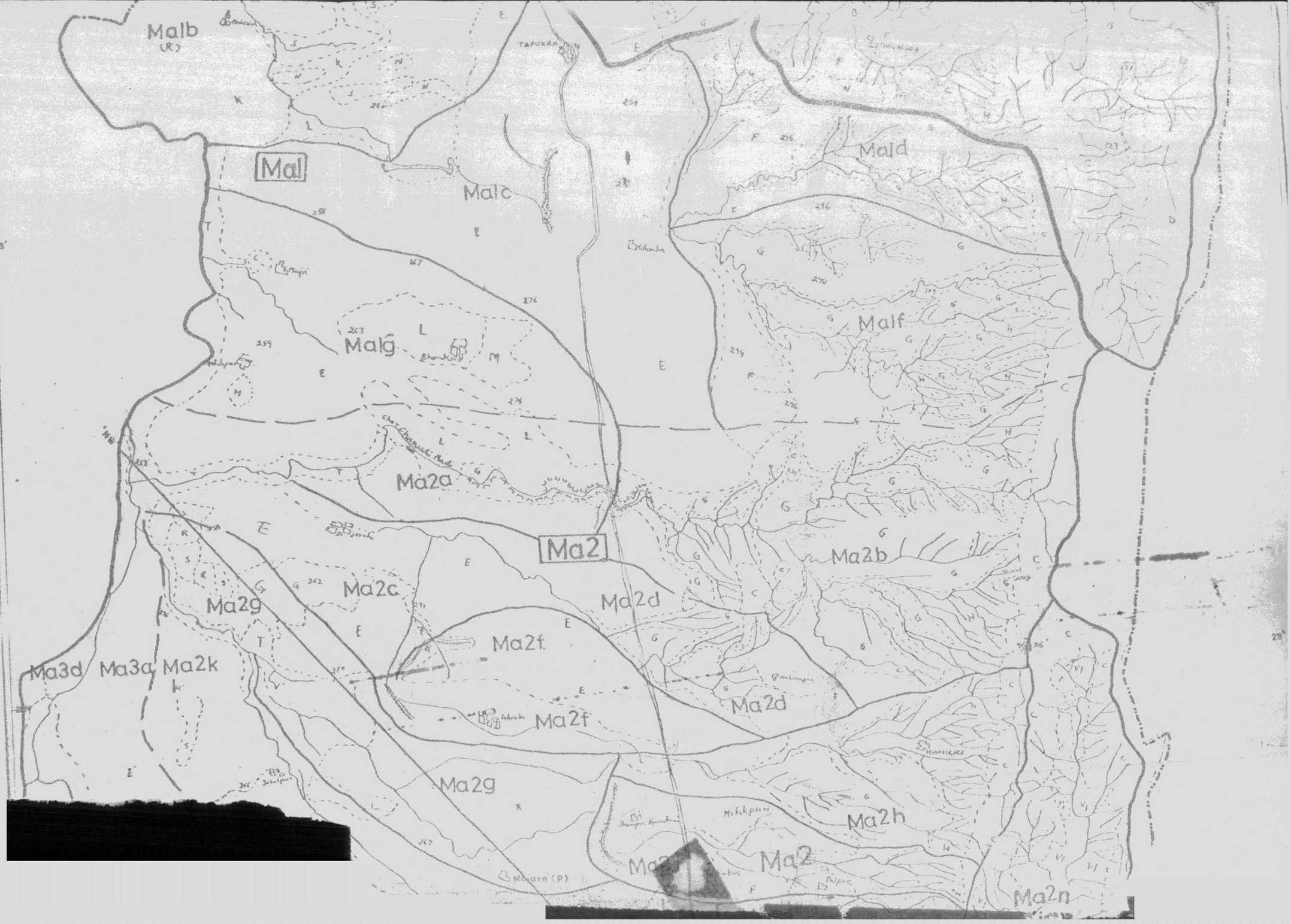
Tehsil/ Block	Slope in Degree				Ruggedness Number			
	0-5	5-10	10-15	15-20	0-.001	.001-.002	.002-.003	.003-.004
Alwar	7.60	1.95	2.35	0.45	7.30	1.02	2.98	1.05
Deeg	6.50	0.00	0.00	0.00	6.30	0.02	0.18	0.00
Ferozepur (J)	7.12	2.90	0.86	0.00	9.47	0.82	0.59	0.00
Hattin	5.34	0.00	0.00	0.00	5.34	0.00	0.00	0.00
Kaman	4.73	0.00	0.00	0.00	4.53	0.20	0.00	0.00
Kishangarh	6.60	3.00	0.40	0.00	8.00	2.00	0.00	0.00
Nagar	6.26	0.00	0.00	0.00	6.24	0.02	0.00	0.00
Nuh	10.90	2.91	0.20	0.00	11.80	1.80	0.41	0.00
Pahari	4.50	0.59	0.00	0.00	5.08	0.00	0.00	0.00
Punhana	6.62	0.00	0.00	0.00	6.62	0.00	0.00	0.00
Rangarh	8.10	0.84	0.80	0.00	8.00	1.24	0.50	0.00
Tijara	7.89	1.30	0.30	0.00	7.09	1.40	0.00	0.00

TABLE NO. CONT'D...

Tehsil/ Block	Dissection Index				Drainage Density			
	0.0-20%	20-40%	40-60%	60%	0-0.1	0.1-0.2	0.2-0.3	0.3-0.4
Alwar	7.19	5.16	0.00	0.00	4.95	0.00	5.33	2.27
Deeg	6.00	0.50	0.00	0.00	6.00	0.50	0.00	0.00
Ferozepur (J)	6.38	3.60	0.90	0.00	8.18	2.48	0.20	0.02
Hattin	5.34	0.00	0.00	0.00	5.34	0.00	0.00	0.00
Kaman	4.00	0.73	0.00	0.00	4.73	0.00	0.00	0.00
Kishangarh	3.78	3.75	2.47	0.00	8.50	1.41	0.00	0.00
Nagar	4.85	0.80	0.61	0.00	6.00	0.26	0.00	0.00
Nuh	7.92	5.55	0.29	0.25	12.00	1.00	1.01	0.00
Pahari	4.10	0.60	0.38	0.00	5.00	0.08	0.00	0.00
Punhana	6.60	0.02	0.00	0.00	6.62	0.00	0.00	0.00
Rewgarh	4.90	4.10	0.74	0.00	8.00	0.00	0.00	1.74
Tijara	4.19	4.30	0.00	0.00	0.10	4.00	0.39	4.00

TABLE NO. CONT'D...

Tehsil/ Block	Stream Frequency				Rainfall Intensity			
	0-2	2-4	4-5	6 - 8	7.0	7.5	8.0	8.5
Alwar	7.00	4.50	0.20	0.65	10.00	0.00	0.00	0.00
Deeg	6.50	0.00	0.00	0.00	0.00	0.00	1.50	5.00
Ferozepur (J)	8.99	1.53	0.06	0.30	5.88	0.00	5.00	0.00
Hattin	5.34	0.00	0.00	0.00	0.00	0.00	0.00	5.37
Kaman	4.73	0.00	0.00	0.00	2.00	0.00	2.73	0.00
Kishongarh	9.00	1.00	0.00	0.00	0.50	7.80	2.50	0.00
Nagar	6.00	0.17	0.09	0.00	2.26	0.00	3.00	0.26
Nuh	11.00	2.15	0.86	0.00	8.00	0.00	6.00	0.00
Pahari	4.00	0.60	0.78	0.00	5.00	0.00	0.00	0.00
Punhana	6.62	0.00	0.00	0.00	0.00	0.00	3.00	3.62
Rangarh	4.70	4.71	0.15	0.18	4.00	0.00	5.74	0.00
Tijara	4.00	3.79	0.70	0.00	3.00	3.00	2.49	0.00


Malb
(R)
Mal
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Ma2
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Ma2f
Ma3d
Ma3a
Ma2k
Ma2h
Ma2n
Mikkpuri
Mavara (P)


Ma2k
Ma3a
Ma3b
Ma3
Ma3h
Ma3j
Ma2p
Ma3c
KEY TO PHYSIO-GRAPHIC REGIONS
TIJARA TEHSIL
S. NO. | PHYS. UNIT
1 HILLS AND HILLOCKS WITH > 33% SLOPE C
2 HILLS WITH > 33% SLOPE D
3 FOOTHILL LANDSCAPE WITH 3-10% SLOPE G
4 RAVINES LAND 5-15% SLOPE H
5 ALLUVIAL PLAINS WITH 0-3% SLOPE E
6 ALLUVIAL PLAINS WITH 1-5% SLOPE E
7 AEO ALLUVIAL PLAINS WITH SCATTERED DUNES SOPE 0-3% K
8 AEO ALLUVIAL PLAINS WITH FREQUENT DUNES SLOPE 1-3% L
9 AEOLIAN ALLUVIAL PLAINS WITH SLOPE 1-10 % M
10 AEO ALLUVIAL PLAINS WITH STABILIZED & ISO SAND DUNES SLOPE 3-10% N
11 AEO ALLUVIAL PLAINS WITH ISO & STABILIZED DUNES SLOPE 3-10 % P
12 SANDHONIS WITH SLOPE 15% P1
13 FLOODPLAINS INTERDUNE VALLEYS & BASINAL LANDS SLOPE 1-3 % R
14 FLOODPLAINS WITH SLOPE 1-3% S
15 INTERMONTANE VALLEYS WITH UNDULATING PLAINS SLOPE 1-5% U1
16 VALLEY UNDULATING PLAINS WITH SLOPE 3-10% V
17 INTERMONTANE VALLEYS WITH 3-10% SLOPE V1
18 POINT BARS WITH SLOPE 1-3% T
19 RECENT BARS AND BROAD RIVER BEDS SLOPE 1-5% T1
20 OLD BARS WITH SHALLOW RIVER BEDS SLOPE 1-10 % T2
Abbreviations:
AEO = AEOLIAN
ISO = ISOLATED
WATERSHED BOUNDARY
SUB-WATERSHED BOUNDARY
SOIL UNIT BOUNDARY
DISTRICT AND STATE BOUNDARY
SCALE:
KMS.
COMPILED FROM 'SOIL SURVEY UNIT,' IARI PUSA ROAD NEW DELHI
MAP No.
D.Mohd.

TABLE NO. BROAD LAND-USE GROUPS (DISTRIBUTION) UNDER DIFFERENT GEOMORPHIC PARAMETRIC VALUES (PERCENTAGE AREA, RELATIVELY TO THE TOTAL AREA OF THE TEHSIL), 1980-81

Tehsil/ Block	Absolute Relief	Area under forests	Barren Uncultivated lands	Scrubs and Pastures	Waste lands	Arable Cultivated lands
Alwar	750	4.30	2.00	0.00	0.00	27.66
	750-1000	10.33	0.00	3.00	2.85	13.70
	1000-1500	2.00	2.00	4.00	9.00	0.00
	1500-2000	20.16	0.00	0.00	0.00	0.00
Deeg	750	3.62	6.80	5.94	2.65	81.00
	750-1000	0.00	0.00	0.00	0.00	0.00
	1000-1500	0.00	0.00	0.00	0.00	0.00
	1500-2000	0.00	0.00	0.00	0.00	0.00
Ferozepur (J)	750	0.00	11.00	0.00	10.00	48.00
	750-1000	2.03	12.00	0.00	12.00	5.00
	1000-1500	0.00	0.00	0.00	0.00	0.00
	1500-2000	0.00	0.00	0.00	0.00	0.00
Hattin	750	0.00	0.00	2.00	5.60	32.40
	750-1000	0.00	0.00	0.00	0.00	0.00
	1000-1500	0.00	0.00	0.00	0.00	0.00
	1500-2000	0.00	0.00	0.00	0.00	0.00
Kaman	750	0.00	0.00	10.00	10.80	77.70
	750-1000	0.00	0.00	0.00	1.50	0.00
	1000-1500	0.00	0.00	0.00	0.00	0.00
	1500-2000	0.00	0.00	0.00	0.00	0.00

TABLE NO. CONT'D...

Tehsil/ Block	Absolute Relief	Area under forests	Barren Uncultivated lands	Scrubs and Pastures	Waste land	Arable Cultivated lands
Kishangarh	750	0.00	0.00	0.00	0.00	0.00
	750-1000	16.00	2.75	14.00	0.00	61.25
	1000-1500	4.75	0.00	1.25	0.00	0.00
	1500-2000	0.00	0.00	0.00	0.00	0.00
II.	Relative Relief					
Alwar	0-300	10.80	4.10	3.00	9.00	30.70
	300-600	0.00	0.00	0.00	0.00	0.00
	600-900	0.00	0.00	4.00	0.00	0.00
	900-1200	36.40	0.00	0.00	2.00	0.00
Dausa	0-300	3.62	6.80	5.94	2.65	81.00
	300-600	0.00	0.00	0.00	0.00	0.00
	600-900	0.00	0.00	0.00	0.00	0.00
	900-1200	0.00	0.00	0.00	0.00	0.00
Ferozepur (J)	0-300	0.00	11.00	0.00	16.00	52.00
	300-600	2.03	12.00	0.00	8.00	1.00
	600-900	0.00	0.00	0.00	0.00	0.00
	900-1200	0.00	0.00	0.00	0.00	0.00
Hattin	0-300	0.00	0.00	2.00	5.60	92.40
	300-600	0.00	0.00	0.00	0.00	0.00
	600-900	0.00	0.00	0.00	0.00	0.00
	900-1200	0.00	0.00	0.00	0.00	0.00

TABLE NO. CONT'D...

Tehsil/ Block	Relative Relief	Area under forests	Barren Uncultivated lands	Scrubs and Pastures	Waste land	Arable Cultivated lands
Kaman	0-300	0.00	0.00	10.00	10.80	77.70
	300-600	0.00	0.00	0.00	1.50	0.00
	600-900	0.00	0.00	0.00	0.00	0.00
	900-1200	0.00	0.00	0.00	0.00	0.00
Kishangarh	0-300	10.75	1.50	9.00	0.00	41.00
	300-600	4.00	1.25	3.00	0.00	21.50
	600-900	6.00	0.00	2.00	0.00	0.00
	900-1200	0.00	0.00	0.00	0.00	0.00
III.	Slope Modified					
Alwar	0-5	20.79	0.00	2.00	11.85	27.66
	5-10	13.10	2.00	4.10	0.00	0.00
	10-15	8.40	2.00	0.00	0.00	0.00
	15-20	16.50	0.00	0.00	0.00	0.00
Deeg	0-5	3.62	6.80	5.94	2.65	81.00
	5-10	0.00	0.00	0.00	0.00	0.00
	10-15	0.00	0.00	0.00	0.00	0.00
	15-20	0.00	0.00	0.00	0.00	0.00
Ferozepur (J)	0-5	0.00	11.30	0.00	10.20	83.00
	5-10	0.00	10.00	0.00	11.80	0.00
	10-15	2.03	1.70	0.00	0.00	0.00
	15-20	0.00	0.00	0.00	0.00	0.00

TABLE NO. CONT'D...

Tehsil/ Block	Slope Modified	Area under forests	Barren Uncultivated lands	Scrubs and Pastures	Waste land	Arable Cultivated lands
Hattin	0-5	0.00	0.00	2.00	5.60	92.40
	5-10	0.00	0.00	0.00	0.00	0.00
	10-15	0.00	0.00	0.00	0.00	0.00
	15-20	0.00	0.00	0.00	0.00	0.00
Kaman	0-5	0.00	0.00	10.00	10.80	77.70
	5-10	0.00	0.00	0.00	1.50	0.00
	10-15	0.00	0.00	0.00	0.00	0.00
	15-20	0.00	0.00	0.00	0.00	0.00
Kishangarh	0-5	11.00	2.75	6.00	0.00	56.25
	5-10	8.00	0.00	8.25	0.00	5.00
	10-15	0.00	0.00	0.00	0.00	0.00
	15-20	1.75	0.00	1.00	0.00	0.00
IV.	Ruggedness Index					
Alwar	0-.001	9.80	4.00	0.00	8.00	21.64
	.001-.002	0.00	0.00	0.00	1.20	18.72
	.002-.003	1.20	0.00	7.00	0.00	0.00
	.003-.004	25.80	0.00	0.00	2.65	1.00
Deeg	0-.001	3.62	6.80	5.94	2.65	81.00
	.001-.002	0.00	0.00	0.00	0.00	0.00
	.002-.003	0.00	0.00	0.00	0.00	0.00
	.003-.004	0.00	0.00	0.00	0.00	0.00

TABLE NO. CONT'D...

Tehsil/ Block	Ruggedness No.	Area under forests	Barren Uncultivated lands	Scrubs and Pastures	Waste land	Arable Cultivated lands
Faroza-pur (J)	0-.001	0.00	5.00	0.00	4.00	53.00
	.001-.002	2.00	9.00	0.00	16.00	0.00
	.002-.003	0.00	7.00	0.00	2.00	0.00
	.003-.004	0.00	2.00	0.00	0.00	0.00
Nattin	0-.001	0.00	0.00	2.00	5.60	92.40
	.001-.002	0.00	0.00	0.00	0.00	0.00
	.002-.003	0.00	0.00	0.00	0.00	0.00
	.003-.004	0.00	0.00	0.00	0.00	0.00
Kaman	0-.001	0.00	0.00	10.00	10.80	77.70
	.001-.002	0.00	0.00	0.00	1.50	0.00
	.002-.003	0.00	0.00	0.00	0.00	0.00
	.003-.004	0.00	0.00	0.00	0.00	0.00
Kishan-garh	0-.001	11.05	2.75	10.00	0.00	54.75
	.001-.002	0.00	0.00	0.00	0.00	2.50
	.002-.003	9.70	0.00	5.25	0.00	4.00
	.003-.004	0.00	0.00	0.00	0.00	0.00
V.	Dissection Index					
Alwar	0-20%	4.80	0.00	1.00	6.45	22.66
	20-40%	24.00	4.00	2.00	5.40	15.70
	40-60%	4.00	0.00	4.00	0.00	3.00
	60-80%	4.00	0.00	0.00	0.00	0.00

TABLE NO. CONT'D...

Tehsil/ Block	Dissection Index	Area under forests	Barren Uncultivated lands	Scrubs and Pastures	Waste land	Arable Cultivated lands
Daag	0-20%	3.62	6.80	5.94	2.00	77.00
	20-40%	0.00	0.00	0.00	0.75	4.00
	40-60%	0.00	0.00	0.00	0.00	0.00
	60-80%	0.00	0.00	0.00	0.00	0.00
Ferozepur (J)	0-20%	0.00	0.00	0.00	2.00	49.00
	20-40%	2.03	16.00	0.00	20.00	1.00
	40-60%	0.00	7.00	0.00	0.00	3.00
	60-80%	0.00	0.00	0.00	0.00	0.00
Hattin	0-20%	0.00	0.00	2.00	5.60	92.40
	20-40%	0.00	0.00	0.00	0.00	0.00
	40-60%	0.00	0.00	0.00	0.00	0.00
	60-80%	0.00	0.00	0.00	0.00	0.00
Kamon	0-20%	0.00	0.00	10.00	10.80	60.00
	20-40%	0.00	0.00	0.00	1.50	17.00
	40-60%	0.00	0.00	0.00	0.00	0.00
	60-80%	0.00	0.00	0.00	0.00	0.00
Kishangarh	0-20%	1.00	2.00	3.00	0.00	41.75
	20-40%	3.75	0.75	12.25	0.00	17. 50
	40-60%	14.00	0.00	0.00	0.00	2.00
	60-80%	0.00	0.00	0.00	0.00	0.00

TABLE NO. CONT'D...

Tehsil/ Block	Drainage Density	Area under forests	Barren Uncultivated lands	Scrubs and Pastures	Waste land	Arable Cultivated lands
Alwar	0-0.1	18.80	1.00	0.00	0.00	20.00
	0.1-0.2	0.00	0.00	2.00	0.00	0.00
	0.2-0.3	10.00	3.00	0.00	11.85	21.36
	0.3-0.4	8.00	0.00	5.00	0.00	0.00
Daeg	0-0.1	3.62	6.00	5.94	2.65	81.00
	0.1-0.2	0.00	0.00	0.00	0.00	0.00
	0.3-0.3	0.00	0.00	0.00	0.00	0.00
	0.3-0.4	0.00	0.00	0.00	0.00	0.00
Fazaz-pur (J)	0-0.1	2.00	23.00	0.00	14.00	44.50
	0.1-0.2	0.00	0.00	0.00	8.00	8.50
	0.2-0.3	0.00	0.00	0.00	0.00	0.00
	0.3-0.4	0.00	0.00	0.00	0.00	0.00
Hattin	0-0.1	0.00	0.00	2.00	5.60	92.40
	0.1-0.2	0.00	0.00	0.00	0.00	0.00
	0.2-0.3	0.00	0.00	0.00	0.00	0.00
	0.3-0.4	0.00	0.00	0.00	0.00	0.00
Kaman	0-0.1	0.00	0.00	10.00	10.80	77.70
	0.1-0.2	0.00	0.00	0.00	1.50	0.00
	0.2-0.3	0.00	0.00	0.00	0.00	0.00
	0.3-0.4	0.00	0.00	0.00	0.00	0.00

TABLE NO. CONT'D...

Tehsil/ Block	Drainage Density	Area under forests	Barren Uncultivated lands	Scrubs and Pastures	Waste lands	Arable Cultivated lands
Kishangarh	0-0.1	0.00	0.00	0.00	0.00	61.25
	0.1-0.2	18.75	2.75	15.25	0.00	0.00
	0.2-0.3	0.00	0.00	0.00	0.00	0.00
	0.3-0.4	2.00	0.00	0.00	0.00	0.00
VII.	Stream Frequency					
Alwar	0-2	20.68	0.00	7.00	5.00	28.00
	2-4	16.11	1.50	0.00	6.10	13.36
	4-6	0.00	2.50	0.00	0.50	0.00
	6-8	0.00	0.25	0.00	0.25	0.00
Deeg	0-2	3.62	6.80	5.94	2.65	78.00
	2-4	0.00	0.00	0.00	0.00	2.00
	4-6	0.00	0.00	0.00	0.00	1.00
	6-8	0.00	0.00	0.00	0.00	0.00
Farozepur (J)	0-2	0.00	1.50	0.00	22.00	50.00
	2-4	2.00	19.50	0.00	0.00	0.00
	4-6	0.00	0.50	0.00	0.00	4.50
	6-8	0.00	1.50	0.00	0.00	1.50
Nattin	0-2	0.00	0.00	2.00	3.60	92.40
	2-4	0.00	0.00	0.00	0.00	0.00
	4-6	0.00	0.00	0.00	0.00	0.00
	6-8	0.00	0.00	0.00	0.00	0.00

TABLE NO. CONT'D...

Tehsil/ Block	Stream Frequency	Area under forests	Barren Uncultivated lands	Scrubs and Pastures	Waste lands	Arable Cultivated lands
Kaman	0-2	0.00	0.00	10.00	12.30	77.70
	2-4	0.00	0.00	0.00	0.00	0.00
	4-6	0.00	0.00	0.00	0.00	0.00
	6-8	0.00	0.00	0.00	0.00	0.00
Kishangarh	0-2	15.75	2.75	14.00	0.00	55.00
	2-4	5.00	0.00	1.25	0.00	8.25
	4-6	0.00	0.00	0.00	0.00	0.00
	6-8	0.00	0.00	0.00	0.00	0.00
VIII.	Rainfall Density					
Alwar	7.0	31.79	0.00	0.00	11.85	34.00
	7.5	0.00	0.00	0.00	0.00	0.00
	8.0	5.00	4.00	7.00	0.00	7.36
	8.5	0.00	0.00	0.00	0.00	0.00
Deeg	7.0	0.00	0.00	8.00	0.00	0.00
	7.5	0.00	0.00	0.00	0.00	0.00
	8.0	0.00	0.00	0.00	2.65	21.00
	8.5	3.62	6.80	5.94	0.00	60.00
Ferozepur (J)	7.0	1.00	13.00	0.00	11.00	27.00
	7.5	0.00	0.00	0.00	0.00	0.00
	8.0	1.00	12.00	0.00	11.00	26.00
	8.5	0.00	0.00	0.00	0.00	0.00

TABLE NO. CONT'D...

Tehsil/ Block	Rainfall Density	Area under forests	Barren Uncultivated lands	Scurbs and Pastures	Waste lands	Arable Cultivated lands
Hattin	7.0	0.00	0.00	0.00	0.00	0.00
	7.5	0.00	0.00	0.00	0.00	0.00
	8.0	0.00	0.00	2.00	5.60	40.00
	8.5	0.00	0.00	0.00	0.00	52.40
Kaman	7.0	0.00	0.00	0.00	6.00	30.70
	7.5	0.00	0.00	0.00	0.00	0.00
	8.0	0.00	0.00	10.00	6.30	40.00
	8.5	0.00	0.00	0.00	0.00	0.00
Kishangarh	7.0	0.00	0.00	0.00	0.00	6.25
	7.5	12.00	0.00	4.00	0.00	55.00
	8.0	8.75	2.75	11.25	0.00	0.00
	8.5	0.00	0.00	0.00	0.00	0.00
I.	Absolute Relief					
Nagar	750	0.00	0.00	0.00	5.50	66.30
	750-1000	0.00	0.00	0.00	4.20	24.00
	1000-1500	0.00	0.00	0.00	0.00	0.00
	1500-2000	0.00	0.00	0.00	0.00	0.00
Nuh	740	0.00	0.00	0.00	0.00	54.75
	750-1000	0.00	13.20	13.25	0.00	18.80
	1000-1500	0.00	0.00	0.00	0.00	0.00
	1500-2000	0.00	0.00	0.00	0.00	0.00

TABLE NO. CONT'D...

Tehsil/ Block	Absolute Relief	Area under forests	Barren Uncultivated lands	Scrubs and Pastures	Waste lands	Arable Cultivated lands
Paheri	750	0.00	0.00	0.00	13.00	78.40
	750-1000	0.00	0.00	0.00	6.60	0.00
	1000-1500	0.00	0.00	0.00	0.00	0.00
	1500-2000	0.00	0.00	0.00	0.00	0.00
Punhana	750	0.00	0.00	0.00	29.70	70.30
	750-1000	0.00	0.00	0.00	0.00	0.00
	1000-1500	0.00	0.00	0.00	0.00	0.00
	1500-2000	0.00	0.00	0.00	0.00	0.00
Ramgarh	750	7.50	0.00	0.00	2.80	33.75
	750-1000	5.50	0.00	0.00	5.25	43.70
	1000-1500	1.50	0.00	0.00	0.00	0.00
	1500-2000	0.00	0.00	0.00	0.00	0.00
Tijarah	750	0.00	0.00	0.00	0.00	0.00
	750-1000	2.50	1.00	20.00	20.00	57.00
	1000-1500	0.00	0.00	0.00	0.00	0.00
	1500-2000	0.00	0.00	0.00	0.00	0.00
II.	Relative Relief					
Nagar	0-300	0.00	0.00	0.00	7.30	90.10
	300-600	0.00	0.00	0.00	2.60	0.00
	600-900	0.00	0.00	0.00	0.00	0.00
	900-1200	0.00	0.00	0.00	0.00	0.00

TABLE NO. CONT'D...

Tehsil/ Block	Relative Relief	Area under forests	Barren Uncultivated lands	Scurbs and Pastures	Waste lands	Arable Cultivated lands
Nuh	0-300	0.00	0.00	20.15	13.00	66.85
	300-600	0.00	0.00	0.00	0.00	0.00
	600-900	0.00	0.00	0.00	0.00	0.00
	900-1200	0.00	0.00	0.00	0.00	0.00
Pahari	0-300	0.00	0.00	0.00	13.00	71.66
	300-600	0.00	0.00	0.00	10.60	4.84
	600-900	0.00	0.00	0.00	0.00	0.00
	900-1200	0.00	0.00	0.00	0.00	0.00
Punhana	0-300	0.00	0.00	0.00	29.70	70.30
	300-600	0.00	0.00	0.00	0.00	0.00
	600-900	0.00	0.00	0.00	0.00	0.00
	900-1200	0.00	0.00	0.00	0.00	0.00
Ramgarh	0-300	9.45	0.00	0.00	2.40	64.29
	300-600	6.66	0.00	0.00	5.00	6.20
	600-900	0.00	0.00	0.00	0.00	0.00
	900-1200	0.00	0.00	0.00	0.00	0.00
Tijarah	0-300	2.50	1.00	18.00	13.00	56.50
	300-600	0.00	0.00	2.00	7.00	0.80
	600-900	0.00	0.00	0.00	0.00	0.00
	900-1200	0.00	0.00	0.00	0.00	0.00

TABLE NO. CONT'D...

Tehsil/ Block	Slope in degrees	Area under forests	Barren Uncultivated lands	Scrubs and Pastures	Waste lands	Arable Cultivated lands
Nagar	0-5	0.00	8.00	0.00	5.30	66.50
	5-10	0.00	0.00	0.00	4.20	24.00
	10-15	0.00	0.00	0.00	0.00	0.00
	15-20	0.00	0.00	0.00	0.00	0.00
Nuh	0-5	0.00	5.60	9.75	0.00	73.55
	5-10	0.00	6.60	3.00	0.00	0.00
	10-15	0.00	1.00	0.00	0.00	0.00
	15-20	0.00	0.00	0.00	0.00	0.00
Paharí	0-5	0.00	0.00	0.00	13.00	78.40
	5-10	0.00	0.00	0.00	8.60	0.00
	10-15	0.00	0.00	0.00	0.00	0.00
	15-20	0.00	0.00	0.00	0.00	0.00
Punhana	0-5	0.00	0.00	0.00	29.70	70.30
	5-10	0.00	0.00	0.00	0.00	0.00
	10-15	0.00	0.00	0.00	0.00	0.00
	15-20	0.00	0.00	0.00	0.00	0.00
Ramgarh	5-10	1.00	0.00	0.00	15.75	8.00
	0-5	13.50	0.00	0.00	3.00	49.00
	10-15	0.00	0.00	0.00	1.25	0.00
	15-20	0.00	0.00	0.00	0.00	0.00

TABLE NO. CONTINUED

Tehsil/ Block	Slope in degrees	Area under forests	Barren Uncultivated lands	Scurbs and Pastures	Waste lands	Arable Cultivated lands
Tijarah	0-5	2.50	1.00	9.00	13.50	54.00
	5-10	0.00	0.00	11.00	6.50	3.00
	10-15	0.00	0.00	0.00	0.00	0.00
	15-20	0.00	0.00	0.00	0.00	0.00
IV.	Ruggedness Number					
Nagar	0-.001	0.00	0.00	0.00	9.50	88.00
	.001-.002	0.00	0.00	0.00	0.00	0.00
	.002-.003	0.00	0.00	0.00	0.00	0.00
	.003-.004	0.00	0.00	0.00	0.00	0.00
Nuh	0-.001	0.00	0.00	4.00	0.00	69.00
	.001-.002	0.00	3.00	3.00	0.00	5.55
	.002-.003	0.00	9.20	4.00	0.00	0.00
	.003-.004	0.00	1.00	2.25	0.00	0.00
Paheri	0-.001	0.00	0.00	0.00	8.00	73.00
	.001-.002	0.00	0.00	0.00	11.00	5.40
	.002-.003	0.00	0.00	0.00	2.00	0.00
	.003-.004	0.00	0.00	0.00	0.00	0.00
Punhana	0-.001	0.00	0.00	0.00	29.20	69.30
	.001-.002	0.00	0.00	0.00	0.00	0.00
	.002-.003	0.00	0.00	0.00	1.50	0.00
	.003-.004	0.00	0.00	0.00	0.00	0.00

TABLE NO. CONT'D...

Tehsil/ Block	Ruggedness No.	Area under forests	Barren Uncultivated lands	Scrubs and Pastures	Waste lands	Arable Cultivated lands
Ramgarh	0-.001	3.00	0.00	0.00	2.00	71.29
	.001-.002	0.70	0.00	0.00	3.00	5.16
	.002-.003	3.00	0.00	0.00	3.05	0.00
	.003-.004	7.80	0.00	0.00	0.00	0.00
Tijarah	0-.001	0.00	0.00	10.00	9.00	7.00
	.001-.002	2.50	1.00	0.00	4.00	50.00
	.002-.003	0.00	0.00	10.00	4.00	0.00
	.003-.004	0.00	0.00	0.00	3.00	0.00
V.	Dissection Index					
Nagar	0-20%	0.00	0.00	0.00	5.60	86.00
	20-40%	0.00	0.00	0.00	0.00	0.00
	40-60%	0.00	0.00	0.00	3.90	5.00
	60%	0.00	0.00	0.00	0.00	0.00
Nuh	0-20%	0.00	11.00	9.25	0.00	54.56
	20-40%	0.00	2.20	3.00	0.00	15.70
	40-60%	0.00	0.00	0.00	0.00	2.31
	60%	0.00	0.00	1.00	0.00	0.00
Pahari	0-20%	0.00	0.00	0.00	21.00	66.40
	20-40%	0.00	0.00	0.00	0.00	6.00
	40-60%	0.00	0.00	0.00	0.00	6.09
	60%	0.00	0.00	0.00	0.00	0.00

TABLE NO. CONT'D...

Tehsil/ Block	Dissection Index	Area under forests	Barren Uncultivated lands	Scrubs and Pastures	Waste lands	Arable Cultivated lands
Punhana	0-20%	0.00	0.00	0.00	25.94	69.30
	20-40%	0.00	0.00	0.00	4.76	0.00
	40-60%	0.00	0.00	0.00	0.00	0.00
	60%	0.00	0.00	0.00	0.00	0.00
Ramgarh	0-20%	3.00	0.00	0.00	1.00	55.45
	20-40%	9.00	0.00	0.00	7.05	19.20
	40-60%	2.50	0.00	0.00	0.00	1.80
	60%	0.00	0.00	0.00	0.00	0.00
Tijarah	0-20%	0.00	0.00	0.00	4.00	47.00
	20-40%	2.50	1.00	20.00	16.00	10.00
	40-60%	0.00	0.00	0.00	0.00	0.00
	60%	0.00	0.00	0.00	0.00	0.00
VI.	Drainage Density					
Nagar	0-0.1	0.00	0.00	0.00	4.00	91.00
	.1 -0.2	0.00	0.00	0.00	5.50	0.00
	0.2-0.3	0.00	0.00	0.00	0.00	0.00
	0.3-0.4	0.00	0.00	0.00	0.00	0.00
Nuh	0-0.1	0.00	9.25	4.00	0.00	63.55
	0.1-0.2	0.00	4.00	1.25	0.00	10.00
	0.2-.03	0.00	0.00	8.00	0.00	0.00
	0.3-0.4	0.00	0.00	0.00	0.00	0.00

TABLE NO. CONT'D...

Tehsil/ Block	Drainage Density	Area under forests	Barren Uncultivated lands	Scurbs and Pastures	Waste lands	Arable Cultivated lands
Pahari	0.0-0.1	0.00	0.00	0.00	21.00	78.40
	0.1-0.2	0.00	0.00	0.00	0.00	0.00
	0.2-0.3	0.00	0.00	0.00	0.00	0.00
	0.3-0.4	0.00	0.00	0.00	0.00	0.00
Punhana	0.0-0.1	0.00	0.00	0.00	30.00	69.20
	0.1-0.2	0.00	0.00	0.00	0.00	0.00
	0.2-0.3	0.00	0.00	0.00	0.00	0.00
	0.3-0.4	0.00	0.00	0.00	0.00	0.00
Rangarh	0.0-0.1	12.00	0.00	0.00	1.05	69.45
	0.1-0.2	0.00	0.00	0.00	0.00	0.00
	0.2-0.3	0.00	0.00	0.00	0.00	0.00
	0.3-0.4	2.50	0.00	0.00	7.00	7.00
Tijarah	0.0-0.1	0.00	0.00	6.00	2.25	20.00
	0.1-0.2	0.00	0.00	0.00	0.00	18.00
	0.2-0.3	0.00	0.00	7.00	0.00	7.00
	0.3-0.4	0.00	0.00	7.00	17.35	12.00
	Stream Frequency					
Nagar	0-2	0.00	0.00	0.00	9.50	84.00
	2-4	0.00	0.00	0.00	0.00	5.00
	4-6	0.00	0.00	0.00	0.00	2.00
	6-8	0.00	0.00	0.00	0.00	0.00

TABLE NO. CONT'D...

Tehsil/ Block	Stream Frequency	Area under forests	Barren Uncultivated lands	Scrubs and Pastures	Waste lands	Arable Cultivated lands
Nuh	0-2	0.00	0.00	3.50	0.00	74.00
	2-4	0.00	12.00	8.25	0.00	0.00
	4-6	0.00	1.50	1.25	0.00	0.00
	6-8	0.00	0.00	0.00	0.00	0.00
Pahari	0-2	0.00	0.00	0.00	11.60	71.40
	2-4	0.00	0.00	0.00	0.00	3.00
	4-6	0.00	0.00	0.00	0.00	2.00
	6-8	0.00	0.00	0.00	0.00	0.00
Punhana	0-2	0.00	0.00	0.00	29.70	70.30
	2-4	0.00	0.00	0.00	0.00	0.00
	4-6	0.00	0.00	0.00	0.00	0.00
	6-8	0.00	0.00	0.00	0.00	0.00
Ramgarh	0-2	3.50	0.00	0.00	6.00	30.00
	2-4	4.00	0.00	0.00	2.08	47.45
	4-6	2.00	0.00	0.00	0.00	0.00
	6-8	5.00	0.00	0.00	0.00	0.00
Tijara	0-2	1.00	0.00	7.00	0.00	0.00
	2-4	1.50	1.00	6.00	17.00	0.00
	4-6	0.00	0.00	7.00	3.00	0.00
	6-8	0.00	0.00	0.00	0.00	0.00

TABLE NO. CONT'D...

Tehsil/ Block	Rainfall Intensity	Area under forests	Barren Uncultivated lands	Scrubs and Pastures	Waste lands	Arable Cultivated lands
Nagar	7.0	0.00	0.00	0.00	9.50	0.00
	7.5	0.00	0.00	0.00	0.00	30.00
	8.0	0.00	0.00	0.00	0.00	48.25
	8.5	0.00	0.00	0.00	0.00	12.50
Nuh	7.0	0.00	0.00	0.00	0.00	0.00
	7.5	0.00	0.00	4.50	0.00	37.50
	8.0	0.00	0.00	9.00	0.00	36.00
	8.5	0.00	0.00	0.00	0.00	0.00
Pahari	7.0	0.00	0.00	0.00	10.00	71.00
	7.5	0.00	0.00	0.00	1.60	7.40
	8.0	0.00	0.00	0.00	0.00	0.00
	8.5	0.00	0.00	0.00	0.00	0.00
Punhana	7.0	0.00	0.00	0.00	0.00	0.00
	7.5	0.00	0.00	0.00	0.00	10.30
	8.0	0.00	0.00	0.00	20.00	60.00
	8.5	0.00	0.00	0.00	9.70	0.00
Rangarh	7.0	0.00	0.00	0.00	2.05	37.00
	7.5	0.00	0.00	0.00	0.00	0.00
	8.0	0.00	0.00	0.00	6.00	40.45
	8.5	0.00	0.00	0.00	6.00	0.00

TABLE NO. CONT'D...

Tehsil/ Block	Rainfall Intensity	Area under forests	Barren Uncultivated lands	Scrubs and Pastures	Waste lands	Arable Cultivated lands
Tijarah	7.0	0.00	0.00	0.00	0.00	52.00
	7.5	2.50	1.00	15.00	12.00	5.00
	8.0	0.00	0.00	5.00	8.00	0.00
	8.5	0.00	0.00	0.00	0.00	0.00

```
** NO. OF OBSERVATIONS **    999
** NUMBER OF VARIABLES ***  13

SET NO.      1
 ** NO. OF OBSERVATIONS **    248
 ** NUMBER OF VARIABLES ***  13
 ** MEANS **
  1156.250   493.952      6.270      .051     14.125      .109      .378     7.087      .508      .026      .020      .091
     .292
 ** STD.DEVIATIONS **
  5247.609 69797.500     87.492     1.195   276.285     3.200     6.824    10.506     7.784     2.424     1.975     4.383
    7.110
  **    CORRELATION MATRIX    **
   1  1.000
   2   .032     1.000
   3   .859     .031     1.000
   4   .685     .003     .646     1.000
   5   .875     .011     .863     .707     1.000
   6   .468    -.003     .393     .434     .430     1.000
   7   .436     .121     .515     .446     .512     .363     1.000
   8  -.086    -.010    -.068    -.028    -.014    -.046    -.019     1.000
   9   .392     .036     .459     .439     .471     .286     .348    -.060     1.000
  10  -.006    -.012    -.050    -.044    -.013     .091    -.043    -.022    -.167     1.000
  11   .185    -.003     .172     .114     .212     .040     .205     .124    -.100    -.027     1.000
  12  -.066     .024     .009    -.099    -.065     .086    -.109    -.140    -.277    -.059    -.052     1.000

  13  -.163     .063     .261    -.231    -.291     .150    -.178     .003    -.512    -.109     .104    -.187
     1.000

                    DEEP
        (T50,I2,T6,F4.0,F5.0,F3.0,F4.2,F3.0,8F3.1,1X)
 ** NO. OF OBSERVATIONS **    999
 ** NUMBER OF VARIABLES ***  13

SET NO.      2
 ** NO. OF OBSERVATIONS **    133
 ** NUMBER OF VARIABLES ***  13
 ** MEANS **
  753.759     9.398      .256      .009      .361      .031      .096     8.026      .075      .106      .028      .045
     .734
 ** STD.DEVIATIONS **
  350.[illegible]   822.041    13.088      .319    31.823      .724     2.406     6.493     3.041     3.538     1.630     2.394
    5.084
  **    CORRELATION MATRIX    **
    1  1.000
    2   .417     1.000
    3   .625     .249     1.000
    4   .423     .165     .521     1.000
    5   .991     .413     .643     .490     1.000
    6   .235     .061     .269     .262     .244     1.000
    7   .367     .129     .531     .377     .409     .365     1.000
    8   .104     .111     .190     .116     .110     .105     .267     1.000
    9  -.035     .262    -.064    -.046    -.037    -.049    -.104    -.039     1.000
   10  -.043    -.046    -.078     .144    -.019     .182     .134     .093    -.099     1.000
   11   .414     .162     .848     .541     .458     .[illegible]     .424     .157    -.053    -.064     1.000
   12  -.027    -.029    -.049    -.043    -.028     .355    -.048     .183    -.062    -.079    -.040     1.000

   13  -.066     .161     .149     .216     .095     .277    -.156     .360     .153    -.581    -.222     .365
     1.000

                    F P JHIRKA
        (T50,I2,T6,F4.0,F5.0,F3.0,F4.2,F3.0,8F3.1,1X)
 ** NO. OF OBSERVATIONS **    999
 ** NUMBER OF VARIABLES ***  13

SET NO.      3
 ** NO. OF OBSERVATIONS **    108
 ** NUMBER OF VARIABLES ***  13
 ** MEANS **
  817.130    62.500     2.870      .016     6.019      .[illegible]      .191     7.843      .005      .130      .051      .245
     .546
 ** STD.DEVIATIONS **
```

```
1255.313  1280.869    27.133      .309    107.916     1.821          3.365      .498     3.269     2.114     4.387
   5.076
 **   CORRELATION MATRIX   **
   1  1.000
   2   .729     1.000
   3   .798      .709     1.000
   4   .610      .442      .600     1.000
   5   .883      .692      .756      .579     1.000
   6   .568      .488      .720      .574      .606     1.000
   7   .603      .529      .692      .540      .668      .674     1.000
   8  -.233      .276     -.303     -.219     -.265      .233      .283     1.000
   9   .146      .147      .042      .077      .177      .040      .002      .047     1.000
  10   .350      .209      .325      .220      .287      .153      .102      .209      .114     1.000
  11   .191      .058      .126      .069      .063      .155      .034     -.159     -.024      .005     1.000
  12   .267     -.350      .319      .102      .297      .227      .392      .073     -.056     -.240     -.145     1.000

  13   .543     -.471     -.533     -.278     -.480     -.361      .401      .236     -.108     -.446      .280      .616
       1.000
                          HATTIN
          (T50,I2,T6,F4.0,F5.0,F3.0,F4.2,F3.0,8F3.1,1X)
 ** NO. OF OBSERVATIONS **    999
 ** NUMBER OF VARIABLES ***  13

SET NO.      4
 ** NO. OF OBSERVATIONS **     76
 ** NUMBER OF VARIABLES ***  13
 ** MEANS **
  759.66F     0.000     1.092      .004     1.118      .025      .039     8.171     0.000      .020      .033     0.000
     .908
 ** STD.DEVIATIONS **
  424.38C     0.000     8.146      .075    43.358      .403      .884     4.156     0.000      .849     1.291     0.000
    2.203
 **   CORRELATION MATRIX   **
   1  1.000
   2  0.000     0.000
   3  -.237     0.000     1.000
   4   .837     0.000     -.098     1.000
   5   .973     0.000     -.206      .806     1.000
   6   .329     0.000     -.266      .288      .308     1.000
   7   .921     0.000     -.191      .796      .891      .239     1.000
   8  -.356     0.000      .083     -.324     -.330      .045     -.453     1.000
   9  0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
  10  -.041     0.000      .237      .102     -.046      .329     -.079     -.073     0.000     1.000
  11   .045     0.000      .164      .094     -.050      .360     -.086      .173     0.000     -.045     1.000
  12  0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000

  13   .674     0.000      .259      .063      .082     -.591      .142      .022     0.000      .327     -.534     0.000
       1.000
                          KAMAN
          (T50,I2,T6,F4.0,F5.0,F3.0,F4.2,F3.0,8F3.1,1X)
 ** NO. OF OBSERVATIONS **    999
 ** NUMBER OF VARIABLES ***  13

SET NO.      5
 ** NO. OF OBSERVATIONS **     63
 ** NUMBER OF VARIABLES ***  13
 ** MEANS **
  773.81C     7.937      .873      .003      .794      .033      .106     8.262      .065      .048      .119      .302
     .483
 ** STD.DEVIATIONS **
  582.482   347.896    10.440      .119    34.790      .663     2.289     2.632     1.986     1.690     2.315     3.357
    3.959
 **   CORRELATION MATRIX   **
   1  1.000
   2   .558     1.000
   3   .771      .430     1.000
```

```
 4   .576    .985    .480   1.000
 5   .558   1.000    .430    .985   1.000
 6   .324    .686    .270    .656    .686   1.000
 7   .218    .498    .425    .486    .498    .034   1.000
 8  -.419   -.416   -.280   -.414   -.416   -.096   -.014   1.000
 9   .586   -.047    .425    .058    .047    .082    .177   -.058   1.000
10   .073    .040   -.148    .050    .040    .056   -.158   -.106    .091   1.000
11   .132   -.074   -.271    .091    .074    .063    .088    .185   -.159   -.130   1.000
12   .231   -.129   -.245    .133   -.129   -.105    .119   -.252    .083   -.395    .577

13   .011    .168    .176    .209    .188    .223    .372
    1.000
```

KISHANGARH

(T50,I2,T6,F4.0,F5.0,F3.0,F4.2,F3.0,8F3.1,1X)

** NO. OF OBSERVATIONS ** 999
** NUMBER OF VARIABLES *** 13

SET NO. 6
** NO. OF OBSERVATIONS ** 71
** NUMBER OF VARIABLES *** 13
** MEANS **

```
1077.873   204.634     6.676     .073   20.915     .261     .659    7.296     .382     .139     .224     .099
    .146
```

** STD.DEVIATIONS **

```
1194.313  1064.810    22.794     .530  104.305    1.220    3.045    2.606    3.958    2.718    3.195    2.193
   2.828
```

** CORRELATION MATRIX **

```
 1  1.000
 2   .571   1.000
 3   .586    .654   1.000
 4   .243    .309    .107   1.000
 5   .515    .913    .591    .329   1.000
 6  -.077    .129    .126    .224    .188   1.000
 7  -.013    .122    .244    .106    .053    .386   1.000
 8   .158    .299    .300   -.121    .152   -.117   -.018   1.000
 9   .109    .173    .309✓   .199    .093    .238✓   .260✓   .338✓   1.000
10  -.083   -.018   -.169    .086   -.051    .121    .162   -.060    .351   1.000
11   .039    .032    .047   -.076    .060    .221✓   .104    .265   -.393   -.224   1.000
12   .132   -.018    .065   -.155    .050    .102   -.159    .163    .308    .080   -.152   1.000

13  -.240✓   .258✓  -.370✓  -.142   -.110   -.096   -.300✓   .248✓  -.355   -.154   -.228   -.125
    1.000
```

NAGAR

(T50,I2,T6,F4.0,F5.0,F3.0,F4.2,F3.0,8F3.1,1X)

** NO. OF OBSERVATIONS ** 999
** NUMBER OF VARIABLES *** 13

SET NO. 7
** NO. OF OBSERVATIONS ** 137
** NUMBER OF VARIABLES *** 13
** MEANS **

```
 755.474     5.474     .387     .001     .584     .033     .123    7.883     .015    0.000    0.000    .073
    .839
```

** STD.DEVIATIONS **

```
 428.245   428.245   12.021     .050  42.864     .862    2.605    6.175    1.404    0.000    0.000   3.045
   4.297
```

** CORRELATION MATRIX **

```
 1  1.000
 2  1.000   1.000
 3   .721    .721   1.000
 4   .671    .671    .765   1.000
 5   .998    .998    .716    .668   1.000
 6   .272    .272    .169    .056    .300   1.000
 7   .522    .522    .286    .137    .519    .198   1.000
 8  -.156   -.156   -.179    .004   -.154    .005   -.116   1.000
 9   .398    .398    .191    .114    .396    .194    .343    .146   1.000
```

```
 10  0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
 11  0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
 12   .150      .150      .249      .330      .154      .065      .029      .009      .034      0.000     0.000     1.000
 13  -.206     -.206      .184      .270     -.218      .075      .070     -.135     -.278     0.000     0.000     -.442
     1.000

                              NUM
          (T50,I2,T6,F4.0,F5.0,F3.0,F4.2,F3.0,3F3.1,1X)
 ** NO. OF OBSERVATIONS **    999
 ** NUMBER OF VARIABLES ***  13

SET NO.      8
 ** NO. OF OBSERVATIONS **    167
 ** NUMBER OF VARIABLES ***  13
 ** MEANS **
   818.653    38.144     1.539      .018     4.263      .038      .131     7.793     0.000      .034      .527     0.000
      .834
 ** STD.DEVIATIONS **
  1695.574  1265.158    27.230      .559   121.716      .784     3.614     4.650     0.000     2.453     8.279     0.000
     4.404
 **    CORRELATION MATRIX    **
    1  1.000
    2   .662     1.000
    3   .407      .707     1.000
    4   .664      .704      .534     1.000
    5   .665      .765      .191      .715     1.000
    6   .219      .368      .391      .244      .2    1.000
    7   .233      .371      .285      .319      .31    .311     1.000
    8  -.064     -.074      .130     -.034     -.026    -.227     .153     1.000
    9   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   10   .152      .171      -2        .195      .211      .285      239      .078     0.000     1.000
   11  -.029     -.013      .068      .002     -.022     -.04       .029     -.069     0.000     -.025     1.000
   12   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   13  -.276     -.393     -.274      .399     -.326     -.185     -.285      .106     0.000     -.542      .005     0.000
       1.000

                              PATART
          (T50,I2,T6,F4.0,F5.0,F3.0,F4.2,F3.0,3F3.1,1X)
 ** NO. OF OBSERVATIONS **    999
 ** NUMBER OF VARIABLES ***  13

SET NO.      9
 ** NO. OF OBSERVATIONS **     69
 ** NUMBER OF VARIABLES ***  13
 ** MEANS **
   753.623     3.623      .319      .001      .362      .019      .038     7.986      .014     0.000      .051      .442
      .493
 ** STD.DEVIATIONS **
   248.182   248.182     7.140      .027    24.818      .325     1.778     3.238      .993     0.000     1.753     4.033
     4.092
 **    CORRELATION MATRIX    **
    1  1.000
    2  1.000     1.000
    3   .519      .519     1.000
    4   .335      .335      .603     1.000
    5  1.000     1.000      .519      .335     1.000
    6  -.058     -.058     -.006      .057     -.058    1.000
    7   .828      .828      .407      .253      .826     -.085    1.000
    8   .005      .005     -.094      .013      .005     -.410     -.002     1.000
    9  -.015     -.015     -.045     -.044     -.015     -.058     -.021      .160     1.000
   10   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   11  -.029     -.029      .071     -.087      .029     -.116     -.042      .11      .029     0.000     1.000
   12   .139      .139      .218      .136      .139      .098      .046      .81     -.110     0.000     -.193     1.000
   13  -.121     -.121     -.234      .087       21       .031      .025       .2     -.121     0.000      .240     -.480
       1.000
```

PUTHANA

(T50,I2,T6,F4.0,F5.0,F3.0,F4.2,F3.0,8F3.1,1X)

** NO. OF OBSERVATIONS ** 999

** NUMBER OF VARIABLES *** 13

SET NO. 10

** NO. OF OBSERVATIONS ** 45

** NUMBER OF VARIABLES *** 13

** MEANS **

755.556 0.000 1.289 .000 0.000 .024 .024 8.189 0.000 0.000 0.000 .244
.756

** STD.DEVIATIONS **

247.207 0.000 6.873 .020 0.000 .351 .378 3.412 0.000 0.000 0.000 2.983
2.883

** CORRELATION MATRIX **

1	1.000											
2	0.000	0.000										
3	.399	0.000	1.000									
4	1.000	0.000	.399	1.000								
5	0.000	0.000	0.000	0.000	0.000							
6	.218	0.000	-.049	.218	0.000	1.000						
7	.737	0.000	.378	.737	0.000	.249	1.000					
8	.352	0.000	.108	-.352	0.000	.161	-.161	1.000				
9	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000			
10	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
12	.265	0.000	.445	.265	0.000	.130	.029	.043	0.000	0.000	0.000	1.000
13	-.265	0.000	-.445	-.265	0.000	-.130	-.029	-.043	0.000	0.000	0.000	-1.000

1.000

RAMGARH

(T50,I2,T6,F4.0,F5.0,F3.0,F4.2,F3.0,8F3.1,1X)

** NO. OF OBSERVATIONS ** 999

** NUMBER OF VARIABLES *** 13

SET NO. 11

** NO. OF OBSERVATIONS ** 193

** NUMBER OF VARIABLES *** 13

** MEANS **

915.181 100.415 3.067 .029 7.057 .092 .380 7.461 .321 .031 .016 .197
.415

** STD.DEVIATIONS **

2874.312 2427.266 53.461 .743 158.134 1.928 6.881 6.516 6.370 2.305 1.719 5.433
6.844

** CORRELATION MATRIX **

1	1.000											
2	.571	1.000										
3	.758	.563	1.000									
4	.606	.521	.614	1.000								
5	.782	.705	.797	.699	1.000							
6	.427	.378	.557	.470	.561	1.000						
7	.547	.438	.586	.611	.674	.534	1.000					
8	-.320	-.283	-.342	.285	-.224	-.100	-.195	1.000				
9	.224	.258	.369	.452	.399	.446	.474	.315	1.000			
10	.112	-.063	.020	.032	-.048	.102	-.097	-.094	-.097	1.000		
11	.102	.012	.030	.068	-.004	-.053	-.012	.010	.088	-.024	1.000	
12	.134	.165	.088	.095	.103	.067	.079	-.100	.266	.094	-.063	1.000
13	-.257	.353	.348	.382	.364	.286	-.415	.395	.589	-.158	-.106	-.424

1.000

SITARA – [redacted]

(T50,I2,T6,F4.0,F5.0,F3.0,F4.2,F3.0,8F3.1,1X)

** NO. OF OBSERVATIONS ** 999

** NUMBER OF VARIABLES *** 13

SET NO. 12

```
** NO. OF OBSERVATIONS **    138
** NUMBER OF VARIABLES ***   13
** MEANS **
  988.435   117.058     4.775      .069    14.377      .191      .428     7.283      .029      .171      .095      .188
     .504
** STD.DEVIATIONS **
 2807.113  1563.614    34.555      .879   133.695     1.681     4.613     4.299     1.971     3.694     2.947     4.313
    5.530
 **   CORRELATION MATRIX   **
   1  1.000
   2   .489     1.000
   3   .585      .703     1.000
   4   .450      .609      .575     1.000
   5   .468      .697      .484      .513     1.000
   6   .408      .364      .419      .368      .379     1.000
   7   .263      .361      .319      .441      .324      .397     1.000
   8   .113      .275      .271      .222      .280      .103      .018     1.000
   9   .099      .091      .131      .077     -.010      .145      .109      .044     1.000
  10  -.237      .015     -.044     -.021     -.110     -.067     -.083      .131     -.094     1.000
  11   .112      .123      .064      .144      .110     -.021     -.067      .122     -.065      .040     1.000
  12   .186      .227      .200      .176      .153      .227      .428      .008     -.089     -.169     -.194     1.000

  13  -.083     -.337     -.250     -.257     -.156     -.172     -.265     -.217     -.185     -.464     -.379     -.518
      1.000
                          13 MEWAT REGION
          (T50,I2,T6,F4.0,F5.0,F3.0,F4.2,F3.0,8F3.1,1X)
 ** NO. OF OBSERVATIONS **    999
 ** NUMBER OF VARIABLES ***   0

SET NO.     13
 ** NO. OF OBSERVATIONS **   1450
 ** NUMBER OF VARIABLES ***    0
 ** MEANS **
   895.681
 ** STD.DEVIATIONS **
  9090.963
  **   CORRELATION MATRIX   **
    1  1.000
```

(T[illegible],I2,T6,F4.0,F5.0,F3.0,F4.2,F3.0, F3.1,1X)

** NO. OF OBSERVATIONS ** 999
** NUMBER OF VARIABLES *** 13

SET NO. 1
** NO. OF OBSERVATIONS ** 1450
** NUMBER OF VARIABLES *** 13
** MEANS **

895.881	129.954	2.864	.027	6.886	.086	.248	7.650	.163	.060	.102	.136
.560											

** STD.DEVIATIONS **

9090.983	70206.563	147.690	2.108	470.303	5.580	14.781	23.455	13.929	8.335	70.356	12.654
18.552											

** CORRELATION MATRIX **

1	1.000											
2	.089	1.000										
3	.833	.083	1.000									
4	.655	.049	.650	1.000								
5	.805	-.066	.812	.704	1.000							
6	.456	.028	.511	.486	.529	1.000						
7	.497	.096	.564	.517	.578	.507	1.000					
8	-.424	-.055	-.384	-.274	-.311	-.243	-.293	1.000				
9	.467	.031	.482	.372	.412	.280	.376	-.313	1.000			
10	-.003	-.004	.036	.084	.070	.121	.059	-.037	-.116	1.000		
11	-.005	.002	.014	.007	.001	-.008	-.008	-.009	-.022	-.008	1.000	
12	.021	-.006	.054	.011	.032	.049	.067	-.004	-.154	-.091	-.020	1.000
13	-.350	-.011	-.402	-.330	-.368	-.286	-.344	.225	-.461	-.269	-.006	-.449
	1.000											