Deforestation and Land Degradation :

A Case Study of Umran River Basin (Meghalaya)

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Dissertation Submitted In Partial Fulfilment Of The Degree Of Master Of Philosophy (M. Phil.) In Geography

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CERTIFICATE

This is to certify that the dissertation titled "*Deforestation and land degradation: A case study of Umran river basin, Meghalaya*" prepared by Shri Bighnaraj Panda towards partial fulfilment of the degree of Master of Philosophy (M.Phil) is a genuine study to the best of my knowledge and belief. Shri Panda has duly acknowledged study by other scholars at appropriate places. Maps and diagrams have been prepared by him only.

I, therefore, recommend that the dissertation may be placed before examiners for due evaluation.

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I owe an onerous to debt to all of my friends for their support, without which perhaps I could not have dreamt of completing this work.

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Bighnaraj Panda

Date-30.8.93...

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Place-Shillong...

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CHAPTER-I

INTRODUCTION

INTRODUCTION:

The process of modern development has taken a heavy toll on the Earth Ecosystem. The recent Rio Summit i.e. UNCED, 1992 is a clear indication of global concern and the urgency attached to protecting, managing and regulating the earth Ecosystem, so that it remains a sustainable home for not only men, But also for the millons and billions of other plant and animal organisms. The physical environment of men consists of land form, climate, water, soil and natural vegetaton. Natural vegetation plays a significant role in protecting earth ecosystem. Changing social and economic systems have a dramatic effect on forests[1]. Fast growing population can increase the demand of wood. The explosion of education, book publishing, etc. also have created manifold demands on wood. Fuel wood and fodder and grazing too, have exerted excessive pressure on the forest ecosystem in the second half of the tewntieth century. Already a major part of the earth having been colonised, the remaining forest systems are more and more under pressure.

1.2 PROBLEM OF THE STUDY:

Forests disappear naturally as a result of broad climatic changes or catastrophes such as fire and land slides. Most changes of forest areas are the result of human activities. Historical evidences indicate that in Eastern

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1. J.C. Allen and D.F.Branes (1985): "The Causes of Deforestaion in Developing Countries", Annals of American Geographer, Vol.75(2).
N.B. The conversion factor of N from Organic Carbon is 20%.

Mediterranean Region during Roman times millions of hectares of land became desert[2]. In China, vast areas became eroded and abandoned. Deforestation is becoming a major problem in developing countries like ours. The problem which arises concerns mostly the tropical rainforests. Tropical rain forests are identified on the basis of two factors, i.e. location and level of rainfall. It occurs between 20° N/S latitide. The type of vegetation is dominated by tall trees (up to 60m.). It receives heavy rainfall measuring above 1500mm. annually and avarage temperature lies from 25°-30°. This type of forests are characterised by the highest biomass production per unit area, the greatest 'bio-diversity' and therefore, containing the single largest 'gene-pool' of the earth, but in areas of thin nutrient leached soil, the higher biomass production is possible because of the high rate of nutrient cycled from the litter on the floor. This is an extremely delicately balanced ecosystem. Forests have their own history of importance from time immemorial. It plays a vital role in the economy of a counrty. It protects soil erosion, floods, drought, etc. The destrucion of forest area is becoming a world wide problem. Of the 12 per cent of land under forests, tropical rainforest occupy well over half[3]. Most of the tropcal rainforests exist in Latin America, Asia, Africa and some patches of Indian and Pacific Ocean. In Asia, tropical rainforests are found in North-Eastern States, Malabar Coast in India, parts of Indonesia and Phillipines.

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2. FAO 1977-'78 "Soil Consevation in Developing Countires" in Soil Bullitin No. 30.

The North Eastern India is divided into three ecological zones with different physiographic-climatic regions and socio-econimic characteristics; the Himalayan Zone (Arunachal Pradesh, parts of Nagaland, Manipur and Mizoram) has a high rainfall, sharp altitudinal zonation, unconsolidated sedimentary structure and relative thin population. Secondly, the plateau of Meghalaya-Mikir Hills has high rainfall, low Hills and undulating topography and very old sedimentaries, with moderate population densities and thirdly, the valleys of Brahmaputra and Barak, with high rainfall, low flood plains, essentially sub-tropical rainforests, high temperature and humidity with no dry season and high population density. All these three regions have under heavy strain of deforestation.

Deforestation is the major cause for soil erosion. The extent of annual deforestation of rainforest in India is about 8000 to 10,000 sq.km[4]. It makes an ecological imbalance of our country. The main strain of deforestaion is occuring in North-Eastern States because of its faulty land use pattern and cutting of trees for timber and other purposes. It has about 40.94 per cent closed forest[5] cover, but of these forests are secondary vegetation mostly containing the 10 years bamboo scrubs which developed after a shifting cultivation cycle[6]. It is also estimated that about

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3. L Ramakrishnan (1991): "Tropical rainforests and its present crisis", My Forest, Vol. 27
4. Ibid. 2
5. NRSA, 1983.
6. P.S. Ramakrishnan (1983): "Tropical man in Humidtropics of the North-East", Man in India, Vol. 65(1)

5.5 thousand sq.km. of additional forests are cleared every year in the region, 50 per cent of which is primary forests due to slash and burn practices[7]. If these process continues the primary forests will vanish within a short span of time. This practice will disturb not only eclogy of this region but also degrade the soil fertility.

1.3 OBJECTIVES:

The main objective of the study are as follows:

1) To make a critical survey of significant scientific studies on the problem of deforestation and soil erosion in the North-East Region to enable in assessing the magnitude of the problem;

2) To prepare a micro-study of the Umran River Basin in the Ri-Bhoi District on the northern slopes at the Meghalaya plateau, in which a full season soil loss study will be carried out on deforested patches both to assess the volumetric and nutrient losses from the soil; and

3) To finally assess the community's response to the problem of deforestation and soil erosion in the basin area on the basis of a perception-behavioural apporach on a scheduled based interviews.

1.4. RESEARCH QUESTION:

The following research questions are aimed to be in the study:

1) North-East Region has 8 per cent of the geograpnical area of the country and approximately 40.94 per cent of the country is under forests (closed), therefore 1/7th of all

7. op. cit. 6

forest areas of the country. It is thus, important to make a realistic assessment of the scientific studies on the problem of deforestation in the region, more so because, the region contains the largest segment of the tropical forests in the country. What are the major gaps in these studies, needing immediate attention? What could be the main management techniques in arresting both logging and shifting cultivation, being aware of the fact that these are only long term goals?

2) The second set of the questions relate to the actual process of soil erosion in given the micro-ecosystem, the Umran River Basin. The questions are related to: a)What is the quantity of sediment flow under the freshly deforested tracts under different gradient and soil conditions?

b) What is the nature of nutrient status of soil prior to the seasonal rains (in a given season) and what is the total nutrient loss, in specific relation to NPK and Organic Carbon loss from the system?

3) The third set of the question relates to the community response to the problem:

a) How does the community perceive the problem of deforestation and soil loss?

b) Do they perceive the effect of soil loss through annual production loss? Do they have a 'plan of action' to tackle the problem at the community level? Or do they have other alternatives to the growing problem through out migration?

1.5. DATA BASE AND METHODOLOGY:

In the present study, information has been

used from both primary and secondary sources. However, the study is largely based on data from actual field work carried out by the researcher.

1.5.1. Secondary Sources:

Since, the study is the micro-analysis of the problem of deforestation and soil erosion in the Umran Basin, a small river basin in the state of Meghalaya, within the broad zonal characteristics of humid tropics, a number of relevant literature on the subject, both at global as well as the regional context have been evaluated to provide a precise focus on the study. The details of literature survey has been outlined in chapter-II. Apart from the literature a number of secondary information have been obtained fron publications of:

i) Registrar General of Census India: In connection with the village level information on the river basin, on population and other demographic information.

ii) Publication of State Statistical Bureau, Government of Meghalaya.

iii) Published and unpublished information from ICAR, Regional Centre for N-E Region, Barapani.

iv) Published and unpublished reports of GSI, N-E Circle, Shillong.

v) Publications of Indian Meterological Department in connection with climatic information.

vi) Land-Sat Imageries of concerned River Basin through SPOT data of NRSA, Hydrabad, etc.

The deatils of these sources have been given during the text, tables and maps at appropriate places.

1.5.2. Primary Sources:

The study has been designed to evaluate the nature and processes of deforestation and soil erosion in the given river basin, thus, two aspects of the study has been carried out:

i) The process of soil erosion itself for one season, i.e. 1991; and

ii) The perception and response of the village communities to the emerging problem of soil erosion and the consequent land degradation in the river basin.

1.5.2.1. Collection of soil erosion data:

To get information on the nature of the processes of soil erosion the study design in envisaged experiment plots at two sites, one at Iewsir, at an elevation of approximately above 1200 ft. MSL and Umran at the height of above 3500 ft. above MSL. At both the sites, three experimental plots were identified on similar terrain, but at different gradients i.e. $< 15^{o}$ (moderate), 15^{o}-25^{o} (medium) and $>25^{o}$ (high). Under these categories there are two sets of plots measuring 1m.x5m., of area each representing three plots under deforested conditions (hence, forward refered as *open plots*) and three plots under conditions of natural vegetation (hence forward refered to as *covered plots*) In each case initial surface samples upto depth of 15 cm, were taken in the begining of the season, i.e. May/June, which would provide the initial condition of soil in terms of physical and chemical properties, at both the sites. Then, the plots were bounded on all sites and opening kept on the lower slope where a pit was dug and drums of approximate dimension of 3 ft. diameter x 4 ft height were fixed to

Plate No.-1 Surface Soil Sample before monsoon

Plate No.-2 Collection of Soil. Sediments

Plate No.-3 Surface Soil Sample after monsoon

collect the sediments overflow both at the open and the covered plots (Fig.-1) Samples were collected at the interval of 15 days to one month during the rainy season of 1991 from June to September. On each occasion of sediment collection the sediments volume was measured and approximately, a sample of dry weight of 1 kg. soil was kept for the soil analysis particularly to asses the nutrient loss in sediments. At the end of the season during November/December, a further surface sample to the depth of 15 cm. was collected from both the sites and all the plots (both open and covered) were closed. About all the sites and plots details of sites characteristics like topography, vegetation, rainfall climatic condition etc. were collected.

1.5.3. Processing of soil loss information:

At both the sites and all the six plots each open and covered, the dry soil samples were processed for their physical and chemical properties. These include physical properties soil colour and soil texture analysis following standard procedures. For the present study pipettes' method has been used, which is based on Stock's Law. To determine the textural name of the soil, an equilateral triangle has been used. This triangle is known as Textural Triangle. (Fig.2). Soil colour is the most obvious and easily determined of soil characteristics. The Munsell[8] Colour Chart was used for this purpose. The main chemical properties studied were soil pH, Organic Carbon, P and K. Organic Carbon representing the quantum of usuable N in the soil. It may be noticed that the surface sample at the beginning of the season represents the initial condition and at the end of the season represent the altered condition, due

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8. Munsell soil color chart, Munsell color company Inc. Baltimorez, Mary land, 1975.

Fig.-1

SCHEMATIC MAP

CONTROL AND EXPERIMENTAL PLOTS

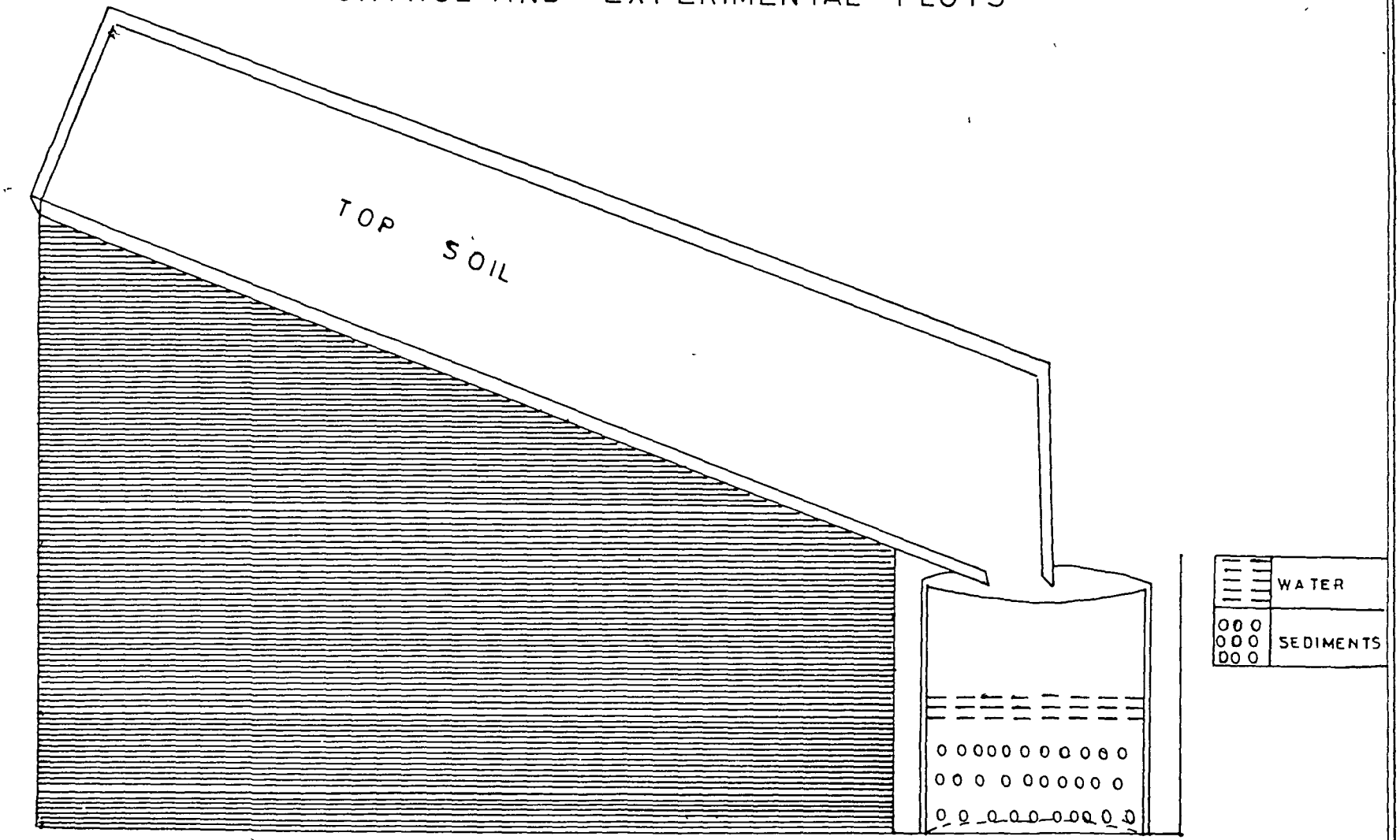
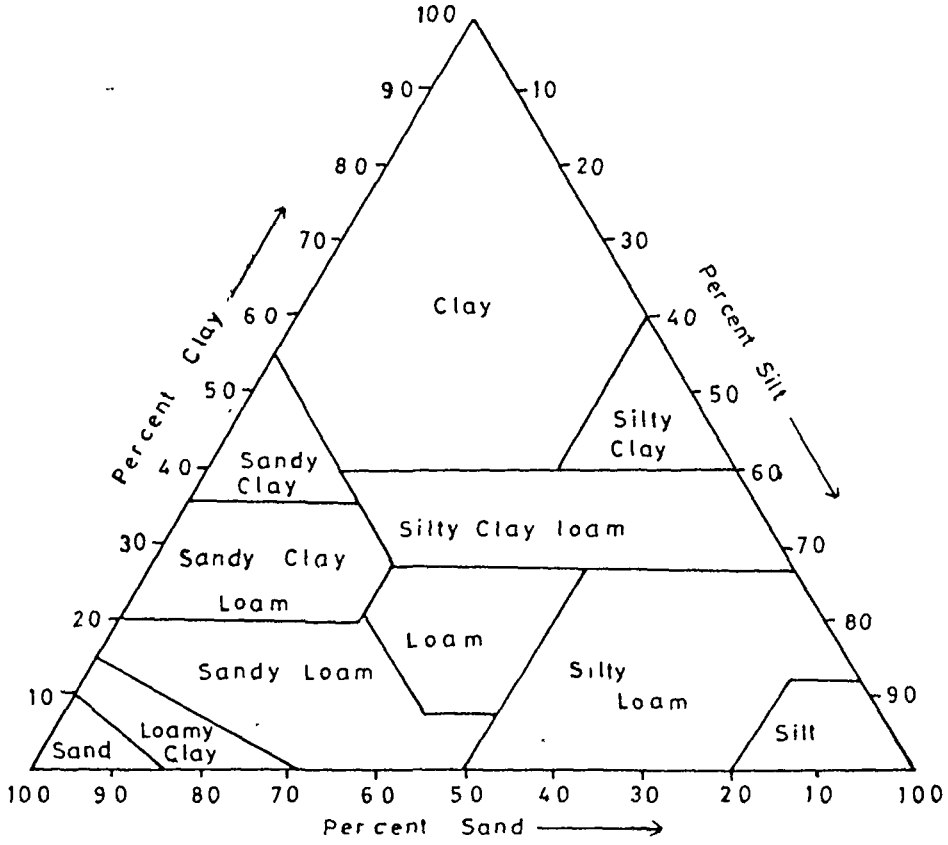


Fig.- 2

TEXTURAL TRIANGLE



to the soil loss both in volume and in terms of nutrients during the corresponding rainy season. The analysis of chemical properties have been done also following standard procedures. It is expected that the volume loss of soil from the initial condition as well as the nutrient loss due to erosion during the rainy season would balance out in terms of terminal condition of the soil. Although it may not exactly match i.e. initial condition - loss due to erosion = the terminal condition. Thre may be some addition of nutrients due to external condition like external nitrite or under growth detritus which start growing after the initial rains, specifically in the open site, it is expected that the loss of nutrients under the deforested condition caused due to fair degree quantified and also the total loss from sample plots. This methods of assessing soil erosion would therefore help in understanding the nature and extent of volume and nutrient loss in soil and also the nature of pH alternation in the soil during the rainy season.

1.5.4. Collection of information relating to the community perception and response to the problem of deforestation and soil erosion:

By and large in most studies refering to deforestation and problem of soil erosion the community perception and response is not taken into account. This is due to the perceptions for most researchers that deforestation and soil erosion which is now endemic in large areas of tropical world has only 'technological solution'. Unfortunetly, understanding in recent days indicates that it is not so, for land management in tropics which has a highly

vulnerable ecology with high density of population also happen to be by and large areas of quasi-peasant, or intensive-peasant agriculture therefore, any attempt towards management of land while requires technical inpurts, needs cooperation and action on the part of local communities who ultimately are the loosers in the process of soil degradation. Keeping this in mind, the study ends at analysing the perception and response of the village community of Iewsir to evaluate *(a)* the nature of the community, *(b)* the levels of their awareness about their environment, their own lives, *(c)* the awareness about the problem of deforestation their own response, *(d)* What they propose to do about the situation. In this light a schedule containing questions about the demography of the village, land holding pattern, the levels of income, the type of occupation and the nature of their awareness and response etc. was framed and all the 22 households in the village were interviewed. It may be pointed that the selection of the village itself was limited by several factors like the selection of the site itself. It is certainly not the best representative situation.

The schedules were subjected to primary and secondary processing and was pivotal in analysing the situation.

1.6 PLAN OF STUDY:

The study has been divided into five chapters:

First chapter deals with introduction, statement of the problem, objectives of the study and brief discussion of the study area and methodology applied for the

present study.

Second chapter deals with the problems of deforestation and its consequences with special reference to North-East India.

Third chapter contains the soil characteristics like colour, texture, nutrient present in the soil before and after the monsoon at two sites in Umran River Basin and the presence of nutrients in the soil. Also this chapter deals with volumetric loss and nutrient loss from soil in different gradients at two sites. The comparison of loss of nutrients, texture and volumetric loss of soil in different plots *(Moderate, Medium and High slopes)* of open and covered sites of Umran and Iewsir have been given.

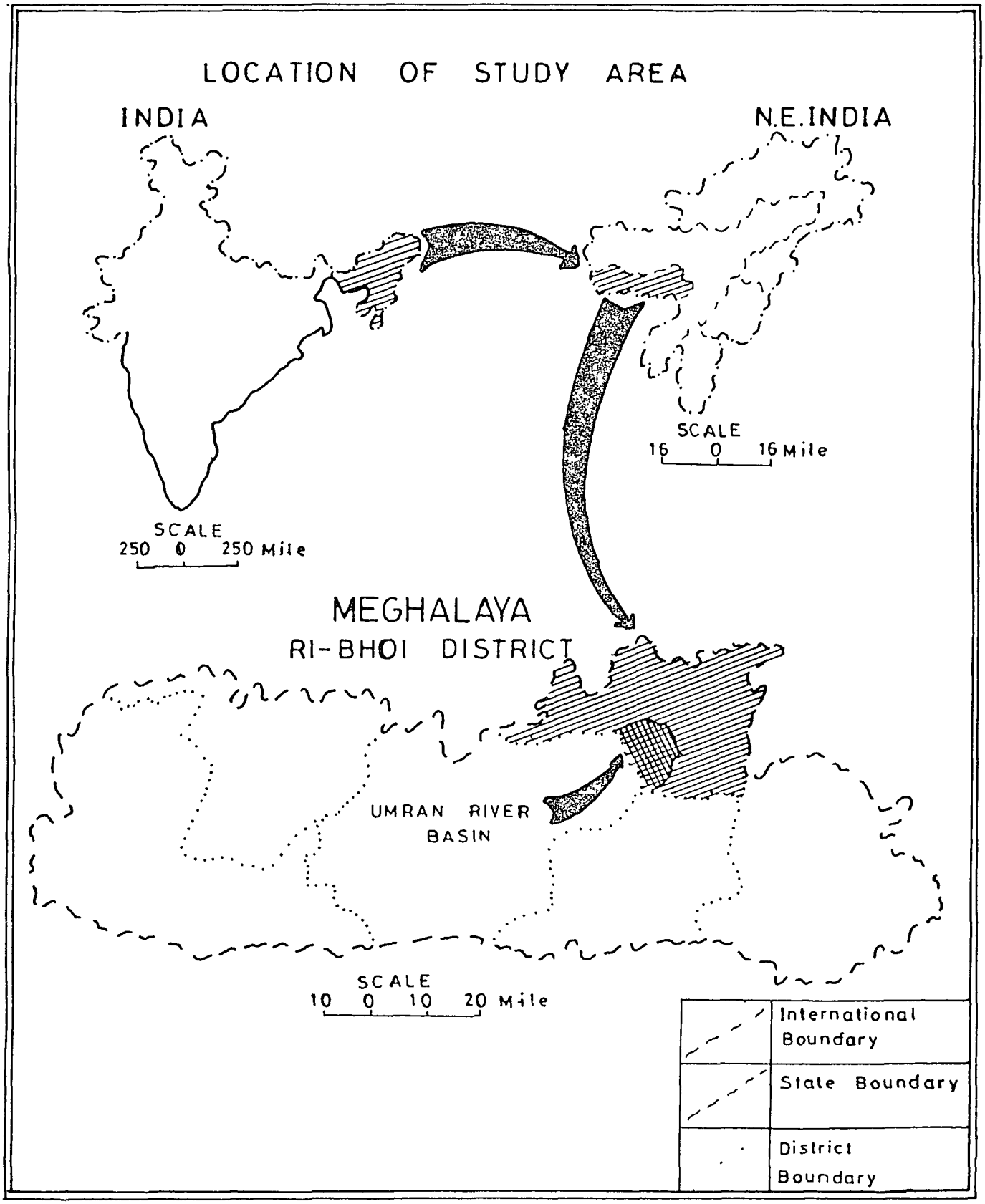
Fourth chapter deals with the demographic characteristics, land holdings, perception and response in regard to environmental degradation of the communities of village Iewsir.

Fifth chapter deals with conclusion, and further planning for the degraded lands to keep the environment stable.

1.7. STUDY AREA:

Meghalaya *the abode of clouds* is situated in the North-Eastern part of India (Fig. 3). Before 1992, the state had five districts. Those are East Khasi Hills, West Khasi Hills, East Garo Hills , West Garo Hills and Jaintia Hills Districts. In the year 1992, East Khasi Hills District and West Garo Hills District were divided into two more districts. Those are Ri-Bhoi District and South Garo Hills District. The area Ri-Bhoi District is about 2378 sq.km.,

Fig. - 3


LOCATION OF STUDY AREA
INDIA
N.E.INDIA
SCALE
250 0 250 Mile
SCALE
16 0 16 Mile
MEGHALAYA
RI-BHOI DISTRICT
UMRAN RIVER
BASIN
SCALE
10 0 10 20 Mile
International Boundary
State Boundary
District Boundary

Nongpoh is the H.Q. of the district. For detail study, a river basin was taken into consideration of Ri-Bhoi District, i.e. Umran River Basin. The river basin covers an area of 298.1 sq. km., approximately.

1.7.1 Location:

The boundaries of Umran River Basin are well demarcated by the water divides. It lies between $25^{o}45'$ N to $25^{o}\ 55'$ N latitude and $91^{o}45'$ E longitude. The basin is bounded by two growing urban areas. Umtasor village limits its western boundary, while the eastern boundary extends a little beyond Mawrang village.

1.7.2. Geology:

The soil of North-East Region have developed under the influence of many types of bed-rocks. Major areas of Khasi Hills have been formed on gnessic rocks[9].

The rocks of Meghalaya belongs to five geological formations. Those are as follows:

i) Archaen-Genssic Complex,

ii) The Lower-Gondwana Rock,

iii) The Sylhet Traps,

iv) The Shillong Group of Rocks

v) The Cretaceous Tertiary Sediments

Table-1.1 shows the geological formation and rock types of Meghalaya. Considering the area covered by the basin, the underlying rocks are mostly Archaen metamorphics. Near Umsning, southern point of the basin, Muscovite and to

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9. G.S.I. (1974): Misc. Publication. No.30. Part-IV,

TABLE-1.1

GEOLOGOCAL FORMATION AND ROCKS OF MEGHALAYA

Geological Types	Group	Formation	Rock Type
Recent	New Alluvium (Thickness not known)	Unclassified	Sand, Silt, Clay
		Unconfirmity	
Pleistocene	Old Alluvium (Thickness not known)	Unclassified	Sand, Clay, Pebbles Gravels, Boulders
		Unconfermity	
Mio-Pleistocene	Dupi Tita Group(1050 km)	Unclasified	Molted Clay,Feldsphathic, sand stone Conglomerate.
		Unconfirmity	
Ologo-Miocene	Garo Group	Chengapara Formation	Sand, Silt stone, Clay, Marl stone,
	Bagmara	(700m.)	Pebbles, Clay, Conglomerate .
		Simgsang Formation (1150m.)	Silt stone, Sand stone, Alternation Sand.
Eocene	Jaintia Group	Kopili Formation (500m.)	Shale, Sand stone, Alternation sand.
	Langpara	Shella Formation (600m.)	Alternation of sand Stone, Limestone.
		Formation (100m)	Sandstone, Limestone
Upper Cretaceous	Khasi Group	Mahadak Formation (100m.)	Arkose (Glauconitic)
		Buttom Conglmerate Formation	Comglomerate, Arkose.
		Jadukata Formation	Sand stone, Conglomerate alternation.
		Unconfirmity	
Jrassic	Sylhet Group (600m)		Basalt, Rhyolite, Acid Tuff
		Unconfirmity	
Pre-cambrian	Shillong Group	Intrusive (Acid and basic)	Phorphiritic and Coarse Granites Pegmatite, Aplite,

Contd./.....

TABLE-1.1

contd./...

Geological Types	Group	Formation	Rock Type
			Quartz-vein, Epidionite, Dolenite, Basalt, Quartzite, Phylite, Conglomerate.
		Unconfirmity	
Archaen	Gnessic		Biotite, Gneiss-biotite, Hornblende Gneiss, Granitc, Migmatite, Mica-schist, Silimanite-quartz, Schist, Biotite, Granite, Amphibiotite,etc.

Source: G.S.I.(1974), Misc. Publication, No. 30, Part-I

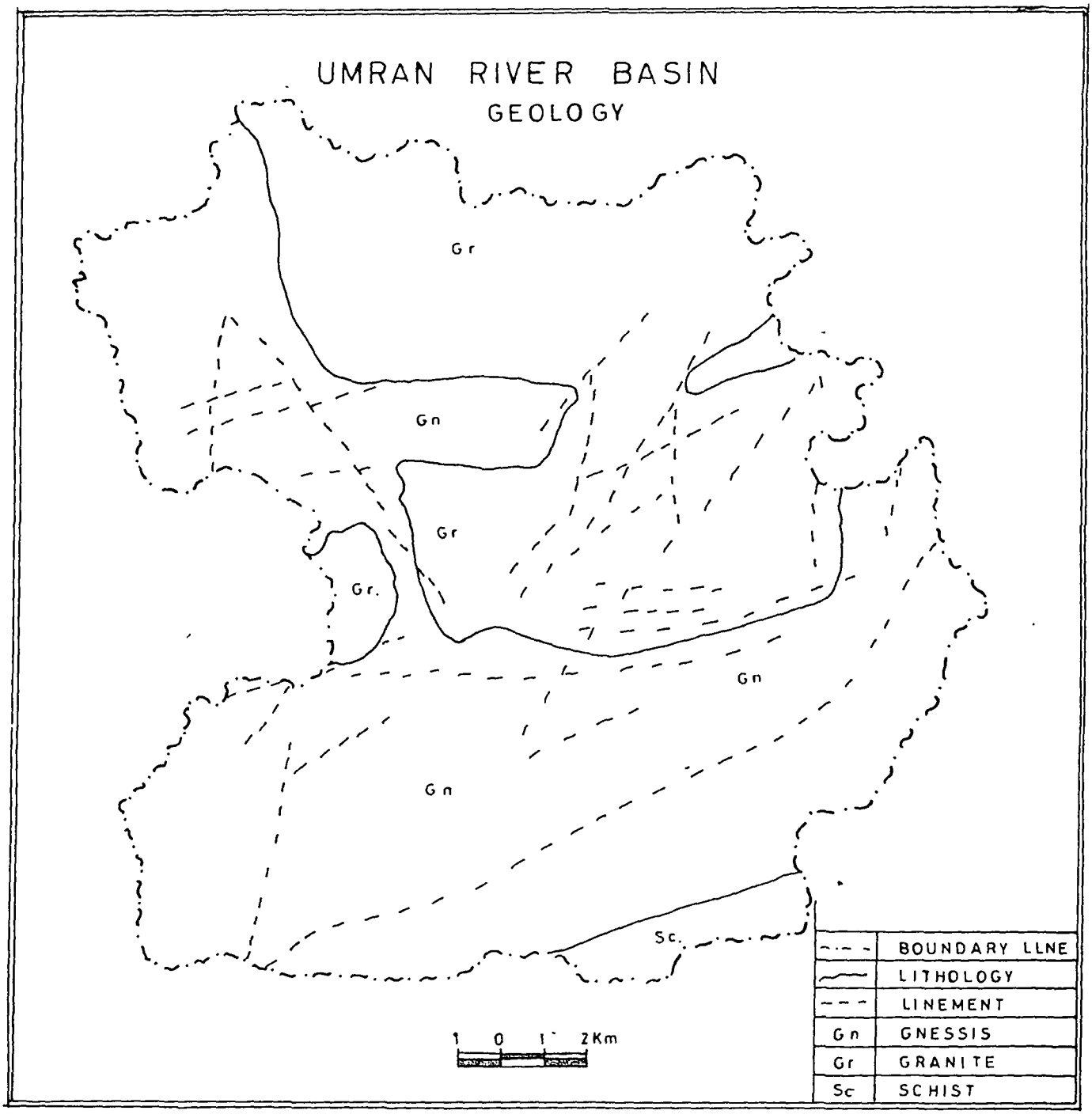
TABLE-1.2

GENERAL STRATIGRAPHY OF UMRAM RIVER BASIN

Age	Group Name	Rock Types
	Intrusive	Very corous grained prophiritic granite, Khasi green stone.
		Intrsive Contact
Pre-Cambrian	Shillong series	Conglomerate, Sand stone Shale,etc.
	Unconfirmity	
Archaean	Intrusive	Non-porphiritic granite, Gnessis and Schists with metaquertzites amphibolite, etc.

Source: P.P. Verma and N. Rajendran (1985): "A Report on the Photogeological Mapping of Nongpoh, East and West Khasi Hills Districts, Meghalya", Geological Survey of India, Shillong.

Fig.- 4


UMRAN RIVER BASIN
GEOLOGY
Gr
Gn
Gr
Gr.
Gn
Gn
Sc
1 0 1 2Km
BOUNDARY LINE
LITHOLOGY
LINEMENT
Gn GNESSIS
Gr GRANITE
Sc SCHIST

the north, the gnessic character becomes more predominant[10]. Major parts of the basin is underlain by granites (Fig.-4). The granite rocks are accompanied by chistose rocks, which are aslo of Archaen origin[11]. The southern portion is mostly gneissic in the character, while the northern parts are dominated by granite. The Table-1.2 shows the different rock strata in the basin. The domination of rocks of the Archean Age is well described by the occurence of gneisses, schists and granites,. The major rock types are quartz-biotite-gneiss with or with- out similarities with granite- gneiss and homogeneous granites[12]. North of Mydron, quartz-biotite-gneiss are observed with bands of Schists continuing till the contact with porphiritic granites. Exposure of pegmetites and granites have been observed to the north of Umran village.

Schists occuring in the area are marked with thick argilite in sequence with bands of granites. This forms a prominent ridge. East of Umsning market, these argilites have been metamorphosed to phyllitic grade. In the south-eastern direction, not far from the basin's boundry, lies a contact zone of the Schistose rocks and those of the Shillong series. It is however difficult to determine the zone of contact of the Schistose rock and that of the gnessic structure, because of gradual increase in the degree of

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10. S.K.Muzumdar (1965-66): "Systemetic Geologocal Mapping arround Nyabunblaw, UK&J Hills Dist. of Assam ", GSI, Unpublished Report.
11. P.P. Verma and N. Rajendran (1985): "A Report on the Photogeological Mapping of Nongpoh, East and West Khasi Hills Districts, Meghalya", GSI,Unpublished Report, Shillong.
12. R. P. Shing (1968) : "Geomor[hology of the Shillong Plateau of Assam ", Proc. of the Pre-Conress Symposyum, IGU, Gawahaty.

metamorphism[13].Quartz veins characterise the schistose rock, which is absent in the gneisses. On the other hand, the nearness of zones of contact with schist and gneiss is marked by the presence of pegmatite veins intruding into the gneiss have been confirmed. The studies around Nongpoh to ascertain iron ore reveal that there are no major Pegmatite veins. However, thin intruding the gneiss have been confirmed[14].

The granitic mass is largely of a non-porphiritic variety, though there are patches of porphiritic type too. The non-porphiritic variety occurs with or without foliation or incipient foliation as observed along the National High Way No.40

1.7.3 Physiography:

Considering the bench-mark along the main road a drop of 805 ft. is seen from 45 mile. The drop is very prominent along the 10 mile from Umsning to Umdihar (35 miles). On the other hand, the drop from Umdihar to Nongpoh is 120 ft. Taking into consideration it is seen that the gradient of the road is 186° slope. The gradient from Umdihar to Nongpoh is 38.80°. It is very well synchronises with zones of contact between different rock strata, one of which is at Nayabungalow. The road from Nayabungalow onwards runs on the geneissic structure till it reaches Umdihar.

On the other hand , the river Umran shows a slightly different picture. The gradient of profile is steep

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13. Op. cit. 4
14. A. C.Goswami (1960): "Report on Investigation of Alied occuances of Iron-ore in Nongpoh,, U.K. & J. Hills,Assam", GSI, Unpublished Report, Shillong.

Fig.- 5

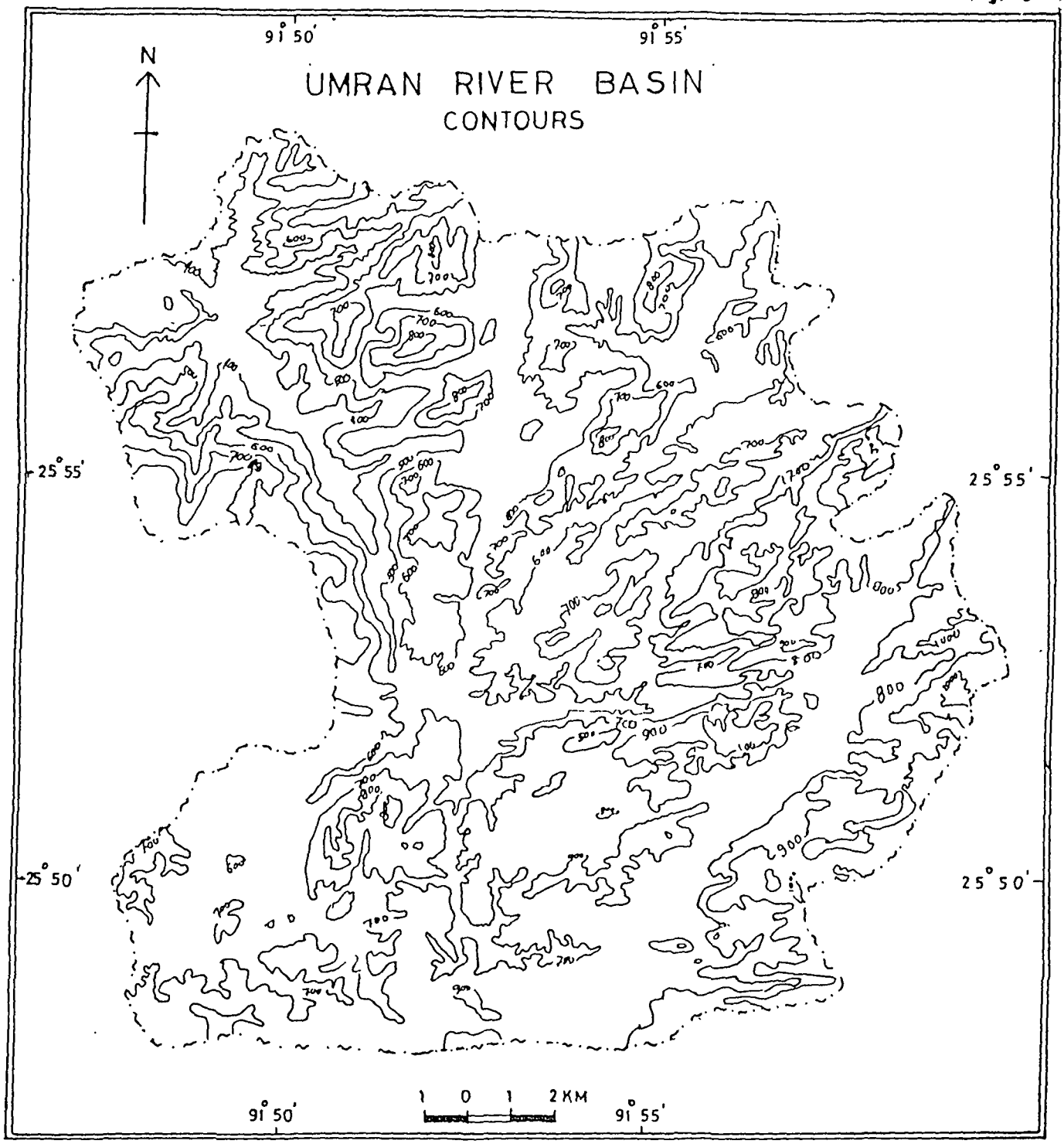
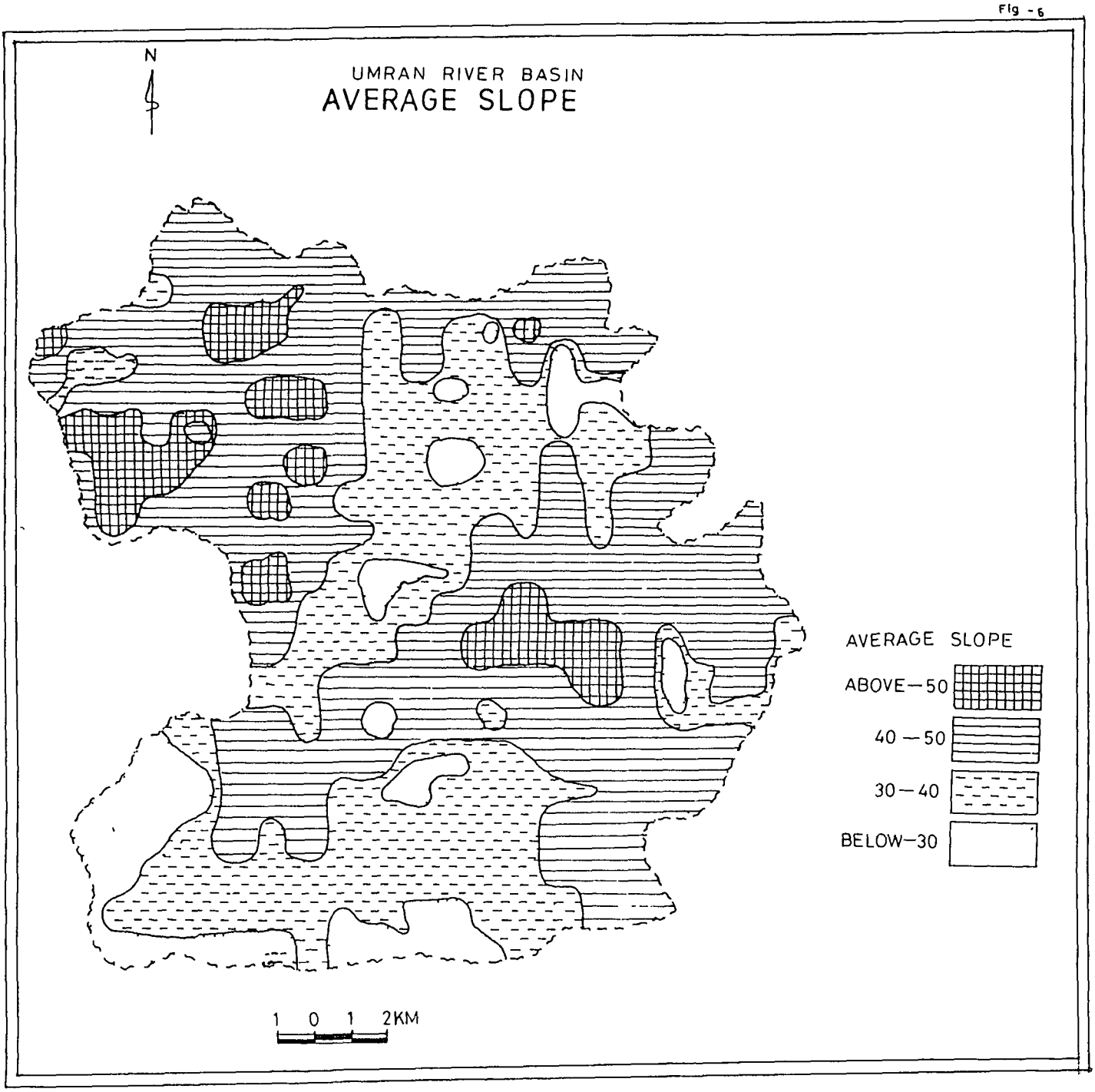


Fig - 6


N
UMRAN RIVER BASIN
AVERAGE SLOPE
AVERAGE SLOPE
ABOVE—50
40 — 50
30 — 40
BELOW—30
1 0 1 2KM

at two points. The initial stage indicates a drop of 600m. ft in 1.5 miles in its course. The Second stage is observed after 12 miles of the course from its origin, where there is a sudden break of the gentle slope. From here the gradient remains steep. Slowly the gradient gets reduced till it meets the Umtrew river. The occuring of sudden drop indicates that there are resistant rocks preventing rapid erosion.

1.7.4. Climate:

Climate the most important of all types of physical influences on man's action and the economic potentials of an area. Also, it affects the pattern of human habitation. Climate is to a great extent is controlled by the location the of area and diversity of relief.

In the basin area, winters are pleasant, Mercury touches 12.7^{o}(Fig.-7) in winter seasson. In this season the weather is mostly dry and cool. Sometimes , the basin area receives some rainfall because of western disturbances. When the warm season starts the temperature increases from March on wards. This is the season of the pre-monsoon showers. Till May, the weather of basin remains hot. However , there could be an occasional shower. Tabe-1.3 shows the monthly temperature and rainfall of Nongpoh.

The clouds obstruct direct radiation. Sunny weather prevails mostly over short period of the year. In the rainy season, the entire days are often cloudy. The river basin receives the highest amount of rainfall in this season. June is the rainiest month (Fig.-8). In this month the river basin receives 211.1 ml. rain water (Tab.-1.3). So, it causes frequent flooding.

Fig.-7

MONTHLY TEMPERATURE AND RELATIVE HUMIDIY 1992

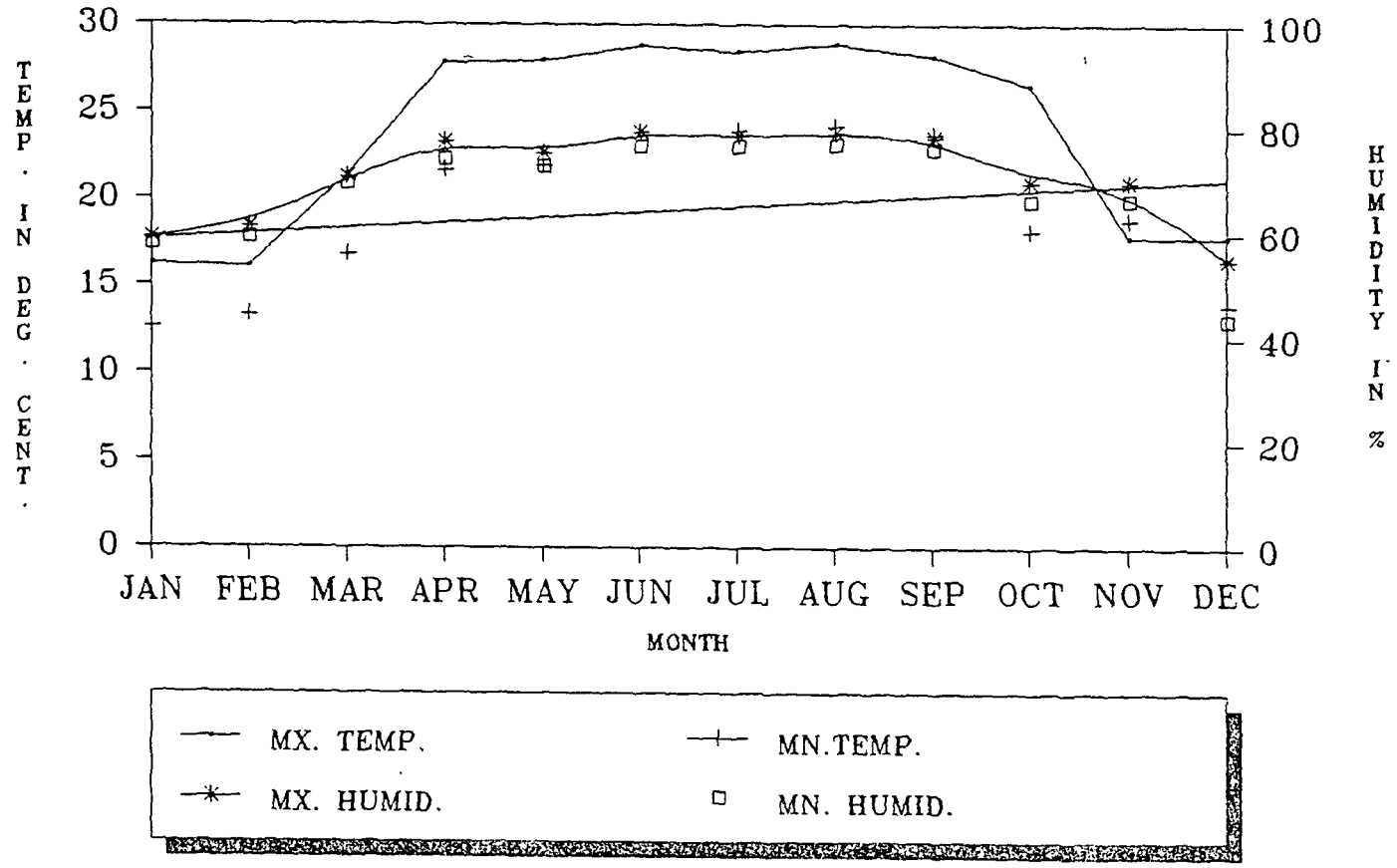


TABLE-1.3

MONTHLY MEAN TEMPERATURE, AVERAGE RAINFALL AND RELATIVE HUMIDITY AT NONGPON, RI-BHOI DISTRICT, 1992.

Month	Temperature in ^{o}C		Rainfall in ml	Humidity in %	
	Max.	Min.		Max.	Min.
Jan.	16.2	12.6	2.3	59.1	57.6
Feb.	16.1	13.3	0.0	61.1	59.1
Mar.	21.3	16.8	20.0	70.6	69.3
Apr.	27.8	21.6	82.3	77.5	73.9
May	27.9	21.9	40.3	75.4	72.6
Jun.	28.8	23.8	211.1	79.4	76.6
Jul.	28.4	23.9	175.0	78.6	76.6
Aug.	28.9	24.2	203.4	79.3	76.9
Sep.	28.2	23.7	74.0	78.5	76.1
Oct.	26.5	18.2	12.4	69.9	66.2
Nov.	17.8	18.2	0.0	69.9	66.4
Dec.	17.8	13.9	0.0	55.2	43.5

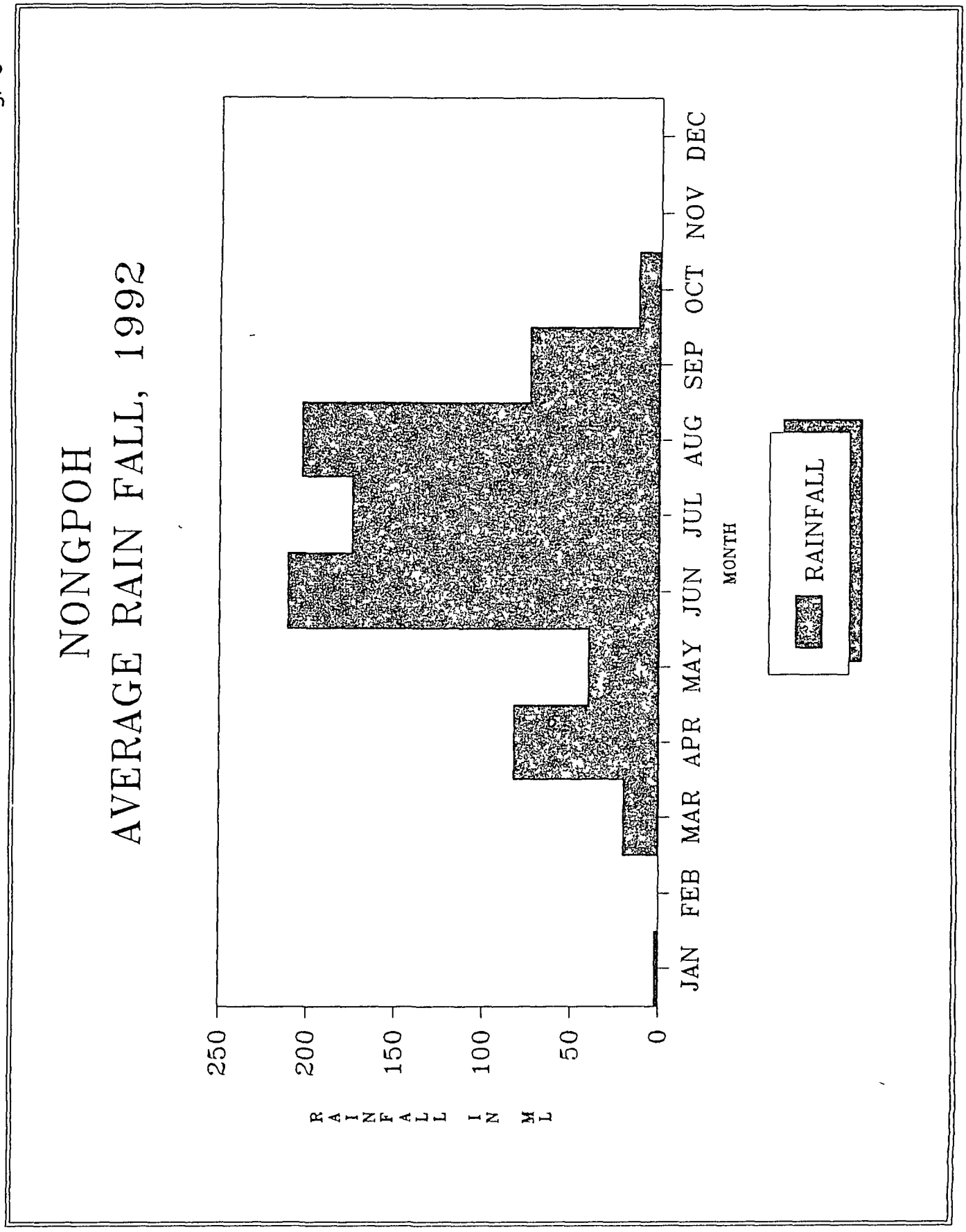
Source: Eri Seed Grainage, Govt. of Meghalaya, Nongpoh, Ri-Bhoi District, Meghalaya.

1.7.5 Vegetation:

The basin is very rich in flora. There are 1040 specis of flowering plants belonging to 158 families[15]. Besides these, there are other plants that grow wild in the area. Trees of evergreen, semi-evergreen as well as coniferous area found in this basin. Evergreen and

15. A.S.Rao (1968): "The vegetation of the K. & J. Hills", Proc. of pre-congress symposium , 21st IGU (India), Dept. of Geography, Gauhati University, Gauhati.

Fig.- 8


NONGPOH
AVERAGE RAIN FALL, 1992
RAINFALL IN ML
250
200
150
100
50
0
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
MONTH
RAINFALL

semi-evergreen are found mostly around the 900 ft. to 2900 ft elevation. Above this comes the transitional zone of the mixed type with that of conifers (Fig.-9).

There are a lot of pine trees in the basin and these form the canopy. The forest does not display prominently nature, but it is evident that tall trees form the canopy and so the highest layer. As there are no medium or short trees, the intermediate zone is absent. Rather the tall shrubs take the place of this layer. The trees are often entwined with linear and a lot of undergrowths. The shrubs create damp conditions at the forest floor. This leads to the growth of different varieties of parasities and saprophitic plants which includes a large variety of mushrooms and wood fungi. High level of litter and debris decomposition on the forest floor due to high humidity and temperature is noticed in the area providing good amount of humus to the soil under protected conditions.

1.7.6 Drainage:

The characteristics of the river systems are moulded and controlled by different fectors which are either independent or dependent. Of the independent factors, the climatic and geologic variables are important; on the other-hand, the dependent variables interact with each other at their own capacities coupled with the major independent variables to promote the net effect the drainage system.

River systems are influenced by relief structure, soil, climate and vegetation. The basin's underlying structure is composed of hard gnessic material and the grainatic mass (Fig-10). In such cases, the river system

Fig.-9

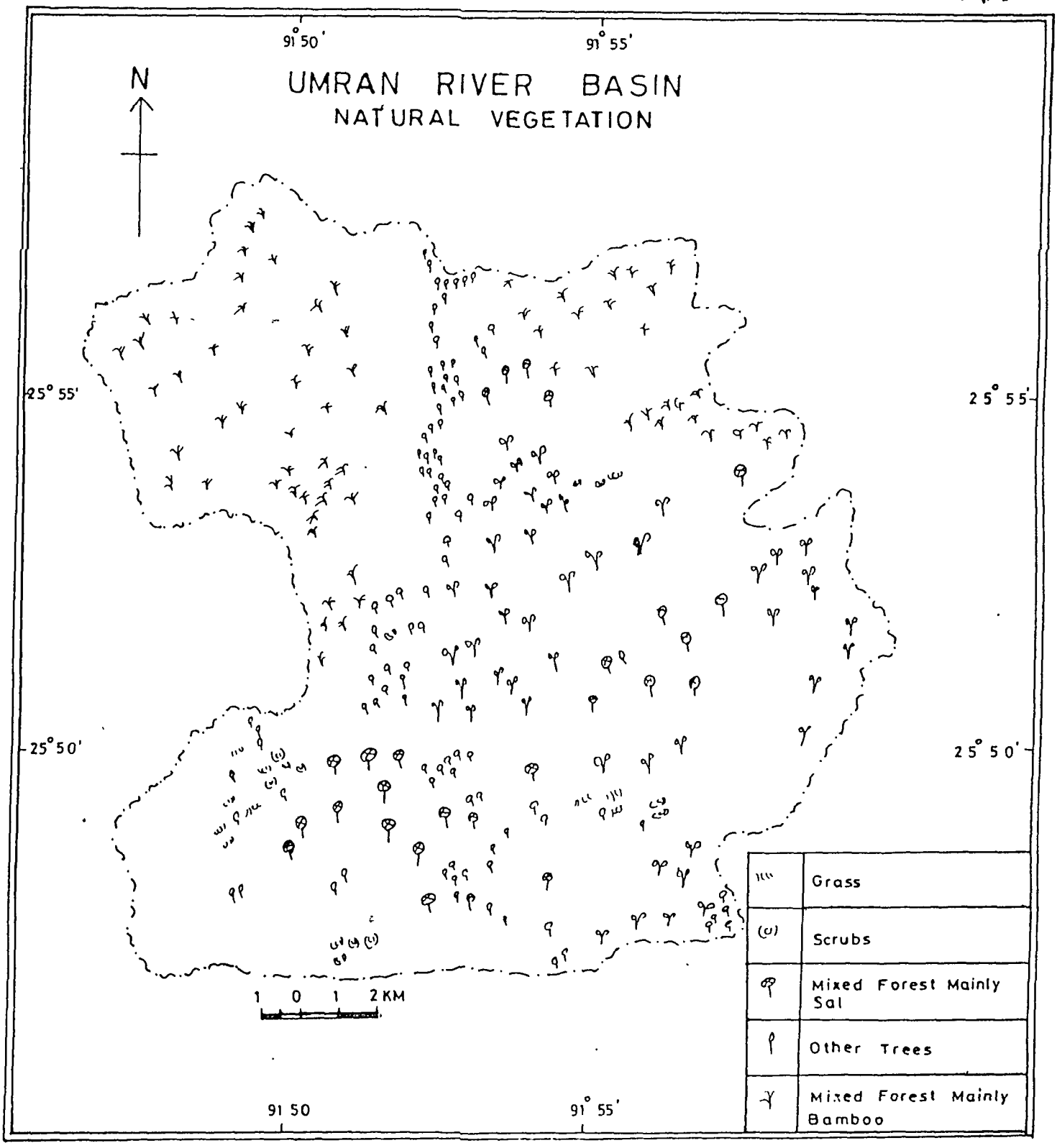

91°50'
91°55'
N
UMRAN RIVER BASIN
NATURAL VEGETATION
25°55'
25°50'
1 0 1 2 KM
Grass
Scrubs
Mixed Forest Mainly Sal
Other Trees
Mixed Forest Mainly Bamboo

Plate No.-4 Mixed Forest of Iewsir

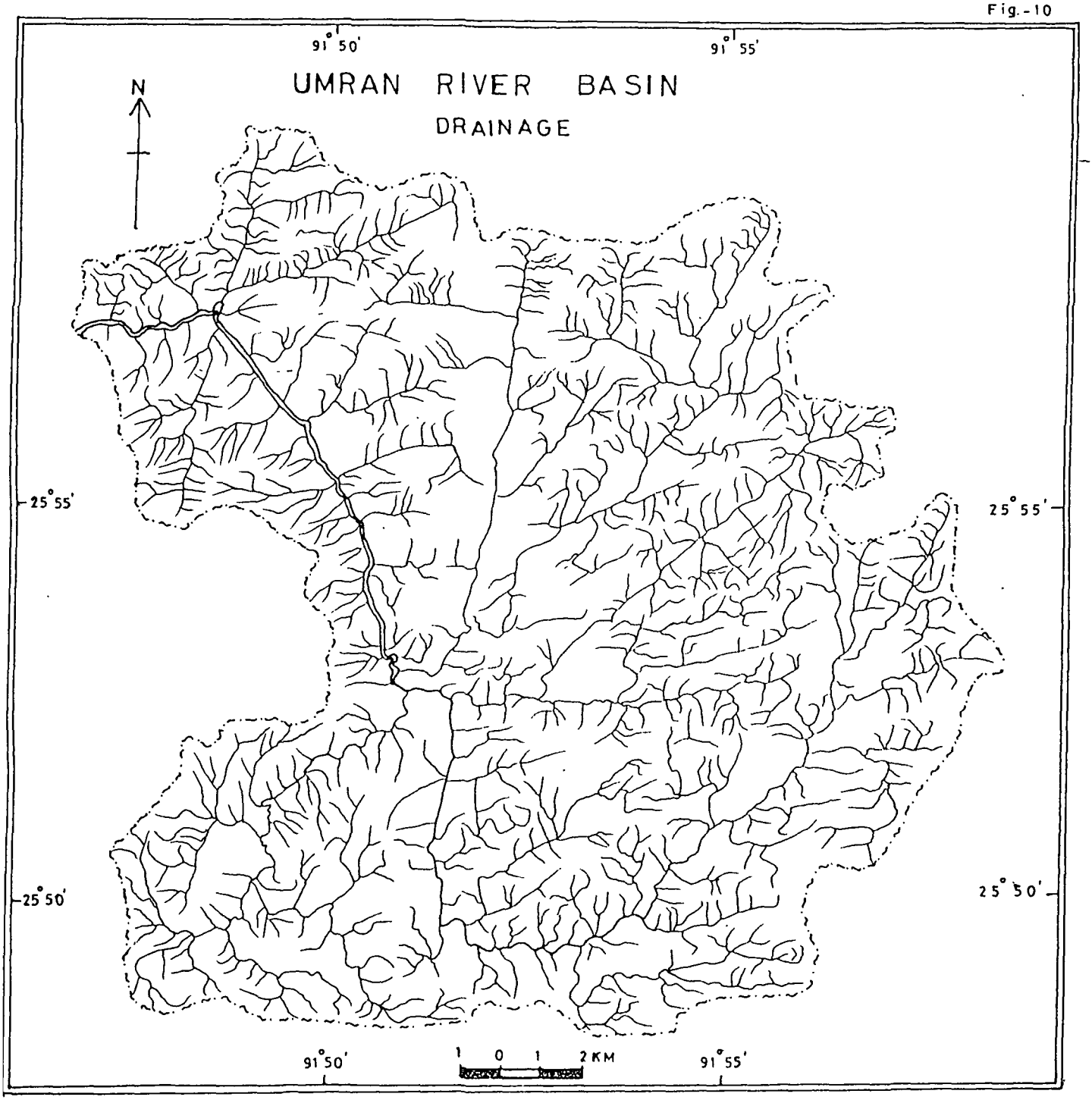
Plate No.-5 Mixed Forest of Umran

Plate No.-6 Mixed Forest with cultivated-land of Iewsir

as a whole could be following the easier path to move along. In the basin area it would be expected that the sreams will take the most favourable course not of its own choice, but, guided by the underlying structure. The river has narrow channels along its course except while it moves over the flood plains, where it meanders and has comparatively wider channels.

The drainage system is not a large one. The total area of the basin is about 298.1 sq.km. The area is infact a dissected one, with streams running in different directions adopting to the topographic conditions and lineament to a large extent (Fig.-11). The River Umran originates 36.2 km. away from the point, where it meets the River Umtrew. From the place of its origin the river flows south-east wards. Near the village Umran it swings North-West direction and condition along the same direction till it meets the River Umtrew. Before joining, the River Umran takes a sharp turn to the west and merges with Umtrew River.

Fig.-10



CHAPTER-II

PROCESS OF DEFORESTATION AND ITS CONSEQUENCES

2.1. INTRODUCTION :

Millions of years ago, before the advent of man, large part of earth was covered by vegetation. After the appearence of man, he first started his living by hunting and gathering activity. About ten thousand years ago, by the late neo-lithic period, early agriculture started and men settled down to sedentary practices. The process of deforestation is synonymous with development of an agrarian civilisation. The problem has only aggravated in the last couple of centuries due to fast rise in population, intensification of agriculture for food and industial raw meterial production, world over. Deforestation arose from four principal causes, often in combination with each other, i.e. excessive felling of trees for timber, over grazing, fire and clearence of land for cultivation and pasture. The most disastrous level of deforestation occured in areas that witnessed the birth of the earliest civilisation[1]. Once nine-tenth[2] of Europe in Roman times was covered by the Hercynian forests. During the early Middle Ages, the communities of monks cleared the forest areas to colonise. At present no more than 30 per cent[3] of the land surface of Western Europe is afforested, even that is very unevenly distributed, with the only large contiguous areas found in the Scandanavian countries.

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1. Francois Ramade (1981) : Ecology of natural Resources, John Willy and Sons, New York.
2. op. cit. 1
3. op.cit. 1

2.2. PROCESS OF DEFORESTATION :

Forests are the most valuable renewable resources, which needs greater attention, especially due to the increased human intervention. Main demands upon forest may be divided into two categories i.e. direct and indirect. Among the highest number of direct uses, the use of wood for fuel is becoming relatively more acute. In many countries the wood is converted into charcoal before being sold. Wood is also used for other industrial purposes. Forest resources can be exploited in two ways : constructively or destructively. The constructive methods make some safeguards in use of the forest. On the other hand, destructive form of exploitation can be observed very often, like cutting of trees for timber, over grazing, slash and burn agriculture etc.

Fire plays a significant role in deforestation throughout the world. It provides a permanent threat to the dry forests, particularly those consisting of conifers. The forest of Southern European countries have suffered greatly from devastating forest fires. Forest fires are the real ecological disaster in the region, which has intense summer drought. The temperature reaching the surface layer of the ground are very high. So, it burns completely, not only the litter, but the humus as well, to a considerable depth. In addition, the decomposition of organic and even inorganic compounds like nitrogen (by heat) causes even greater loss of nutrients. Enrichment of soil by burning organic matter is only apparent, since the ashes are often blown and dispersed by the wind or severely leached with the heavy rain or storms after the fire.

Tropical rainforests possess the greatest concentration of living matter in any terrestrial ecosystem. There has been immense destruction of biotic resources through the forest clearance in tropical and sub-tropical regions. The tropical forests of Asia and Latin America are severely affected by cultvation of land and agricultural colonisation. The South American forests have also suffered irreparably through human activities. Since the European Colonisation, Brazil lost 40 per cent of its forests. The great virgin forests of the world, that of the Amazonia Basin is under heavy pressure by human activities. Plantation of Coffee is another cause of deforestation in Brazil. The tropical rainforests are very rich in timber. It can supply hardwood timber on regular basis. As the population is growing day by day, the demand for wood is also increasing at an accelerated rate. In this respect the countries of South Asia are better placed to meet those requirements. Western Europe, including U.K. was for many years the main market for tropical hard-wood, drawing its supplies from Western Africa, and to a limited extent from Malaya peninsula and Burneo. In the immediate Post-War period upto 1950, each of three tropical regions of Africa, Asia and South America exported the same quantities of hard-wood timber between 0.8 and 1 million cubic metres each[4].

India at present has about two per cent of world's forest area[5]. Forest area of India occupies only

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4. Ooi Jin Bee (1990) : "The Tropical rainforests : Patterns of exploitation and Trade", Singapore Journal of Tropical Geography, Vol. 11, No. 2.
5. S.S.Sagawal (1991) : "Aggroforestry Systems in India : Problems and Prospects", My Forest, Vol. 27, No. 2.

about 22.7 per cent of the geographical area as against 33 per cent[6] as a desirable share. It is in the last few decades of Twentieth century that large virgin tracts of land have come under plough. The Net Sown Area of the country (India) has gone upto 54 per cent[7] of the total geographical area which is one of the highest in the world. When there were sufficient forests, clearance of the forests did not pose a danger. But accelerated forest colonisation poses the greatest danger to sustainability of agriculture and food production. However, it is the excessive destruction of forests which is really at the root of several problems faced by the country. During past three decades about 25 millon hectares of forests have been cleared for extention of agriculture and for other uses. At present, 7 to 8 per cent of our forest area has been opened and does not have significant vegetation cover. Defective farming practices, over grazing, burning, road construction rehabilitation of refugees have resulted in the loss of forest cover significantly.

During 1950's and 1960's Orissa lost more than 100 sq.km.[8] of mangroove forests under the 'grow more food' programme. The natural *Sal* forest of Mayurbhanj and Dhenkanal districts were ruthlessly cut down under the 'land for landless labour programme'. Rehabilitation of refugees also took major role in deforestation. For example, refugees from Bangladesh were resettled in Dandakaranya forests of Koraput

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6. K.M.Tiwari: Social Forestry in India, Natraj Publishers, Dehra Dun.
7. op. cit. 6
8. B.L. Das (1992) : "125 Years of Indian Forest service-Challenges than and now", The Indian Forester, Vol. 118,No. 10.

district of Orissa. The river valley projects are also responsible for submergence of forested areas. Shifting Cultivation is another important cause of deforestation. This type of cultivation is mostly practised by the tribal communities, who are residing in hill areas. It has diferent names in different regions. In North-Eastern Region it is known as 'Jhumming', in Orissa it is known as 'Podu'. It is also known as 'slash and burn' cultivation. About 2.6 million tribal people living in interior hill tracts of India are practising shifting cultivation[9]. The area covered under this type of cultivation is about 546 thousand hectares spread in differnt parts of India[10]. In Orissa about 2600 thousand hectares were affected by shiftng cultivation. The intensity of 'Podu' cultivation has increased in Orissa and neighbouring districts of Andhra Pradesh.

2.3. DEFORESTATION AND SOIL DEGRADATION :

Soil on from parent meterial. A thin layer of soil covers most of the earth' surface. The thickness of the layer varies from a few inches to few feet. To form one inch of soil, it takes thousands of years. In these few feet of soil, the plant and animal kingdom meets the mimeral world and establishes a dynamic relationship. Plants obtain essential nutrients and water from the soil. Animals depend upon plants for their lives. In good quality of soil, plants and treesgrow healthy. The trees create a canopy on the earth's surface. Under the tree canopy many small plants

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9. L.P.Vidyarthie (1975): "The Fate of Tribal Primitive Societies: A Case Study of Indian Shifting Cultivation", The Eastern Anthropologist, Vol. 28(4).
10. Ibid. 8.

grow. The tree canopy protects the small plants and soil in many respects. The root of the tree make a solid grip on the soil. When the tree are cut down the soil is exposed to the erosional agents. So, the humus, leaf litter, soil animals present in the soil get disturbed. The agents of erosion become active on deforested tracts. Direct sunrays fall on the top soil and desicates it. Hence, the water present in the soil evaporates quickly. Because of hot sunshine in the summer season, the top soil starts cracking. Also, the soil losses its plasticity and becomes very hard. When the rain comes, the water flows very rapidly on the slope, because, there are no trees to check the flow of water. The rain drop detaches the soil particles from its body. Then the soil particles desolve with water and is transported from its original site to the base level. The micro-channels also occur. Water transports the soil through micro-channels from hill side carrying away the nutrients. Hence, there are heavy loss of nutrients from the soil. Gully erosion also takes place in the rainy season.

Soil erosion is a natural process and throughout the world, Nature acts in reducing high areas to the base level. It can only be accelerated by human activities. In recent times, the accelerated erosion has been occuring everywhere in the world. As a result, soil gets eroded and bed rocks are exposed. Once the soil is lost there will be no chance of growth of trees on the exposed bed rocks. The tropical rainforest (ecosystems) are the greatest storehouse of the largest number of 'gene-pools' and biologically the most productive. They are characterised by the rainfall (exceeding 200 cm. per year), high humidity and temperature

conditions and by and large lie within the tropical limits of 23 1/2°North Latitude to 23 1/2° South Latitude. The greatest tropical rainforests are the Amazon Basin in South America, the Congo Basin (Zaile) in Africa, parts of Indonesian archipelago and parts of India (Malabar coast and N.E. India). They are also characterised by a thin soil cover, low availability of mineral nutrients (from soil) and thus, high degree of dependence on recycling of bio-detritus decomposition and heavy density of bio-mass, canopied by wood forests of high economic value. The tropical forests of the world is under heavy pressure of accelerated erosion, when the soil is opened by clear cutting of trees, intensity of ersion becomes very high. The top soil loses its nutrients. Because of less fertility, the plants can not grow in a healthy condition. The plants, which are present earlier, start dying slowly. The trees check the rapid flow of water. Once a path of forested land is opened by clear cutting of trees, the erosional agents start acting upon it, freely. Because of rapidness of the water on the slope, it picks up the top soil and transports along with it to base level. Though there is erosion in vegetation covered area, but not that much, what is happening in deforested tracts. From the above point of view, it widely accepted that deforestation is directly related to soil erosion.

2.4 CONSEQUENCES:

Deforestation plays a great role in soil degradation. Soils are the most vital and precious natural resource for the mankind. It is estimated that nearly two billion hectares of once biologically productive land been

rendered unproductive due to acute degradation[11]. Erosion starts with deforestation, clearing for cultivation and grasslands. The tree canopy intercepts rainfall and reduces its energy. Rain drops that reach the ground are quickly taken up by leaf litter and from there porous soil surface. When a forest is disturbed by cutting of trees, over grazing, fire etc.the entire system is disturbed. If the trees are cutdown from the forest, it does not keep the power to protect it from water erosion. Sun rays also reaches directly to the surface. It causes rapid decay of organic matter. The erosion of surface layer would cause a reduction in the rooting zone. The rate of soil erosion is estimated at 5 and 7 million hectares per year implying at 0.3 and 0.5 per cent of world's arable land has also been lost every year[12]. Progressive erosion leads to the exposure of bed rocks and also the formation of gullies. The loss of rooting depth obviously would cause a reduction in the moisture storage and also affects the other properties of soil and their production potential. The impact of water erosion becomes more on hills rather than on deep soil, because the rain water flows down very rapidly on the hill slope.

2.5. PROCESS AND DIMENSION OF DEFORESTATION IN NORTN-EASTERN STATES:

The forest of North East India is under great strain. Everyday lots of trees are cut off for timber and other purposes. The Table-2.1 shows comparative situation of

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11. R. K. Saxena (at. el)(1991):"Assessment of Land Degredation Hazards, Etah District, Uttar Pradesh, Using Land Sat Data", Jr. of Indian Society of Remote Sensing, Vol.19(2)
12. R.Dudal(1982):"Land Degradation in World's perspective", Jr. of Soil and Water Conservation, Vol. 33

TABLE-2.1
FOREST COVER: COMPARATIVE SITUATION IN 1987-89

Sl.No.	State	% of recorded forest area to geographical area	1987 assessment based on satellite imagery 1981-'83 (in sq.km.)	1987 assessment based on satellite satellite imagery 1985-'87(sq.km)	Actual forest cover per cent of geographical	Percentage change
1	Arunachal Pradesh	61.7	60500	68763	82.3	+ 13.6
2	Assam	39.1	26386	26058	33.3	- 1.2
3	Manipur	67.8	17679	17885	80.0	+ 1.16
4	Meghalaya	37.9	16511	16590	69.8	- 4.97
5	Mizoram	75.5	19092	18178	86.2	- 4.78
6	Nagaland	52.2	14351	14356	86.8	+ 0.03

TABLE-2.2

SHIFTING CULTIVATION IN NORT-EASTERN REGION

Sl. No	State	Annual area under Jhum (%)	Fallow period (year)	% of families practsing jhumming to total number of families in the state
1	Arunachal Pradesh	10.10	3 - 10	12.18
2	Assam	10.01	2 - 10	13.08
3	Manipur	23.29	4 - 7	15.79
4	Meghalaya	13.60	5 - 7	11.79
5	Mizoram	16.60	3 - 4	11.28
6	Nagaland	4.92	5 - 8	26.17
7	Tripura	5.77	5 - 9	9.71

forest cover from 1987 and 1989 of North East India. The Table-2.1 shows that only in Arunachal Pradesh forest area has increased by 13.6 per cent between 1987 to 1989. In Manipur and Nagaland the forest cover has increased by 1.16 per cent and 0.03 per cent, respectively. In the other states the forest cover has decreased. In Assam the loss of forest area is only marginal i.e. 1.2 per cent. Tripura lost 7.2 per cent of the forest area. This was the highest loss of the forest cover till 1989 in North-Eastern Region.

Shifting cultivation is practised in all the states of North- Eastern Region. The fallowing period of shifting cultivation vary from one state to other. Nagaland has only 4.92 per cent of land under shifting cultivation. Manipur has the highest share of land under shifting cultivation i.e. 23.90 per cent. In Nagaland, 26.17 per cent of families are engaged in shifting cultivation (Table- 2.2). But, the area under shifting cultivation is very less, compared to other states of the region. The fallowing period of Nagalnd and Manipur are 5 to 8 and 4 to 7 years, respectively (Table-2.2). Overall in North-East Region 3865 sq.km of forest is under shifting cultivation and 44336 families are engaged in this type of cultivation (Appendix-B)

2.6 PROCESS AND DIMENSION OF DEFORESTATION IN MEGHALAYA:

Meghalaya is situated in the North-Eastern corner of India.The geographical area of the state is 2243 thousand hectares of which 949.60 thousand hectares of land is under forest. It has a variety of natural vegetation, ranging from tropical mixed forest to pure stands of pine forest, which are affected by the variation in physiography, soil, and climatic conditions. The area under forests of

Meghalaya from 1979-80 to 1985-86 is given in Table-2.3.

TABLE-2.3

AREA UNDER FOREST OF MEGHALAYA

('000 ha.)

Year	Reserved Forest	Protected Forest+	National Park	Unclassified Forest	Total
1979-80	70.65	1.17	--	779.18	851.0
1980-81	70.65	1.17	--	779.18	851.0
1981-82	70.65	1.17	--	779.18	851.0
1982-83	71.07	1.17	--	779.18	851.0
1983-84	71.07	1.17	--	779.18	851.42
1984-85	71.07	1.13	--	779.18	851.38
1985-86	71.07	1.13	26.74	752.38	851.38
1986-87	71.07	1.49	26.74	850.30	949.60
1987-88	71.32	1.24	26.74	850.30	949.60

N.B: + Excluding the Procted under District Council.

Source: Statistical Hand Book 1987 and 1989, Meghalaya.

Table-2.3 shows, from 1979-80 to 1981-82 forest cover of the state has remained more or less the same. In 1982-83, the forest area has increased from 851.00 to 851.42 thousand hectares; because reserved forest cover has increased. The trend of reserved forest remain same till 1985-86. But, protected forests and unclassified forest have been reduced to 0.04 and 227.0 thousand hectares, respectively. There are two national parks in the state, which cover an area of 26.74 thousand hectares. The natural vegetaion of Meghalaya has been diversely affected by reckless cutting of trees, grazing and *Jhumming*. The cultivation of land in the state is of two types one is permanently settled land and the other type is shifting cultivation,

practised on hill slopes. In Meghalaya, 11.79 per cent of families are practising shifting cultivation, in an area of 13.60 per cent, annually (Table-2.2). The fallow period of the state is 5-7 years. The forest of Meghalaya is under heavy pressure due to over explotion by people as well as by the contractors. Everyday, trucks of timber have been transp-orted exporting to out of the state.

CHAPTER-III

DEFORESTATION AND SOIL EROSION IN UMRAN RIVER BASIN : DIMENSIONS

The forests of Umran River Basin are of mixed type. It ranges from mixed pine and deciduous to bamboo and scrub forests. In this basin area, dense and open forests are found. Of the total geographical area of the basin 16.7 per cent is under dense forests and 68.1 per cent is under open forest[1]. The soil of the forest is highly leached. Acidic soil is found in basin area. In fertile soils, plants can grow well. The leaf litter and other nutrients present in the soil help to make the soil fertile. The presence of nutrients also help plants to grow. Soil texture is another important factor of growth of plants. If there is more sand, the water will percolate down. If it is clay the soil will be sticky and water will not drain so well distributed pecentage of silt, clay and sand is necessary for plant growth.

3.1.1 physical Characteristics of control plots of Umran and Iewsir :

The Table 3.1.1 shows the soil texture and colour of Umran and Iewsir in different slope zones at control sites. At control plots of Umran, the soil contains 45.64 per cent silt, 16.72 per cent clay and 37.64 per cent sand at 5^{o}-15^{o} slope. At 5^{o}-15^{o} slope the colour of the soil is *Yellowish Red*. The nomenclature at the slope is loam at

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1. Land Sat: Path No-136, Row-42, Date of pass-5.3.90, Scale-1: 50,000, NRSA 1990. Spot Data: Path No-238, Row-298, Date of pass-9.12.90 corresponding the Toposheet No-78 O/13, Survey of India.

TABLE: 3.1.1

SOIL TEXTURE AND COLOUR OF CONTROL SITE OF VILLAAGE UNRAN AND IEWSIR, 1991

	Umran					Iewsir				
Degree	Silt (%)	Clay (%)	Sand (%)	Nomen-clature	Clour	Silt (%)	Clay (%)	Sand (%)	Nomen-clature	Colour
5-15	45.64	16.62	37.64	Loam	Yellowish Red	37.24	42.63	20.11	Clay Loam	Yellowish Brown
15-25	37.34	10.44	52.22	Sand Loam	Yellowish Red	47.18	34.82	17.94	Silty Clay Loam	Yellowish Brown
>25	37.69	15.96	46.35	Loam	Yellowish Red	45.18	36.74	17.98	Silty Clay	Yellowish Brown

Umran. At this site, 37.34 per cent silt, 10.44 per cent clay and 52.22 per cent sand is available in soil at 15^{o}-25^{o} slope. The soil nomenclature at 15^{o}-25^{o} slope is sandy loam, At the same slope the colour of the soil is *yellowish Red*. At Umran, the availability of silt, clay and sand are 37.69 per cent, 15.96 per cent and 46.35 per cent respectively, at above the 25^{o} slope in control plots (Table-3.1.1). The nomenclature of the soil is loam and the colour is *Yellowish Red* at above 25^{o} slope.

At Iewsir, the presence of silt is 37.24 per cent, clay is 42.63 per cent and sand is 20.11 per cent at low slope (5^{o}-15^{o}). At 15^{o}-25^{o} slope silt, clay and sand are 47.18 per cent, 34.82 per cent and 17.94per cent, respectively in control plots of Iewsir. The nomenclature is silty clay loam and colour is *Yellowish Brown*. In the high slope, the presence of silt, clay and sand in the soils are 45.18 per cent, 36.74 per cent and 17.98 per cent, respectively at Iewsir. The nomenclature and colour at this slope are same as 15^{o}-25^{o} slope at Iewsir.

3.1.2. Chemical characteristics of soil at control plots of Umran and Iewsir:

The soils of Umran as well as Iewsir are acidic at control plots (Table-3.1.2). The Table-3.1.2 shows the presence of nutrients in the control plots of Umran and Iewsir. At Umran, the presence of Organic Carbon is 2.98 per cent at 5^{o}-15^{o} slope in June. At this slope the presence of P and K are 1.94 kg/ha. and 320.54 kg/ha., respectively. The pH value of soil at 15^{o}-25^{o} slope is 4.42. At this slope, 1.93 per cent is Organic Carbon, 1.83 kg/ha. P and 378.69 kg/ha. K

were present in the same month. At slopes above 25° the presence of Organic carbon is 2.86 per cent, P is 1.55 kg/ha. and K is 289.43 kg/ha at Umran in June.

In the month of November, the pH value is reduced at each slopes of Umran (Table-3.1.2). In this month, the chemical properties are also reduced from all slope at Umran, at control plots. In the month of November, the availability of organic carbon is 2.51 per cent, P is 1.79 kg/ha. and K is 257.60 kg/ha. at 5°-15° slope (Table-3.1.2). At 15°-25° the presence of organic carbon is 1.09 per cent in November. At this slope, the availability of P and K is 1.68kg/ha and 235.20kg/ha., respectively in November at Umran. At above 25° slope, 2.57 per cent organic carbon, 1.35 kg/ha. P and 190.40kg/ha. K are present in the soil of Umran in November.

The Table-3.1.2 shows that there is a loss of nutrient at each slope at Umran. At 5°-15° slope, the per cent loss of Organic Carbon is 0.47 per cent. At the same slope P and K have been also lost by 0.15 kg/ha. and 62.94 kg/ha., respectively. In the same way Umran soil lost its nutrients from 15°-25° and above 25° slope (Table-3.1.2).

At Iewsir the presence of Organic Carbon in the soil was 2.80 per cent at 5°-15° in June 1991. In the same slope, the presence of P and K were 1.75 kg/ha. and 495.70 kg/ha, respectively. At 15°-25° slope 1.95 per cent of Organic Carbon was available. At this plot, the availability of P and K were 1.68 kg/ha. and 358.68 kg/ha., respectively. At high slope zones, 2.83 per cent Organic Carbon, 1.43 kg/ha. P and 550.63 kg/ha. were present in the soil.

TABLE-3.1.2

CHEMICAL PROPERTIES OF SOIL BEFORE AND AFTER MONSOON AT CONTROL PLOTS, VILLAGE UMRAN AND IEWSIR

Month	Degree	UMRAN				IEWSIR			
		pH	Organic Carbon (%)	Phosphorous (kg/ha)	Potassium (kg/ha)	pH	Organic Carbon (%)	Phosphorous (kg/ha)	Potassium (kg/ha)
June	5 - 15	4.52	2.98	1.94	320.54	5.95	2.80	1.75	495.70
	15 - 25	4.42	1.93	1.83	378.69	5.87	1.95	1.68	358.86
	> 25	4.95	2.86	1.55	289.43	5.90	2.83	1.43	550.63
November	5 - 15	4.37	2.51	1.79	257.60	5.42	2.61	1.54	451.64
	15 - 25	4.38	1.09	1.68	235.20	5.35	1.32	1.35	341.60
	>25	4.71	2.57	1.35	190.50	5.24	2.42	1.32	463.40

Earlier it has seen that there is loss of nutrients in the soils of Umran, likewise there is loss of nutrients from the soil of Iewsir also. The acidity of the soil at Iewsir has also increases at each slope zone during June to November. At Iewsir, the Organic Carbon at 5^{o}-15^{o} slope decreased to 2.61 per cent in November. There is a loss of 0.19 per cent Organic carbon from June to November. At this slope the P and K have decreased from 1.75 kg/ha to 1.54 kg/ha and from 495.70 kg/ha to 451.64 kg/ha., respectively (Table-3.1.2). At 15^{o}-25^{o} slope, there is a loss of 0.63 per cent of Organic Carbon from June to November at Umran. At same slope P decreased by 1.35 Kg/ha. and K by 341.60 kg/ha. At the high slope zones (>25^{o} slope) also there is loss of Organic Carbon, P and K by 2.42 per cent, 1.32 kg/ha and 463.40 kg/ha., respectively.

There are many differences between the soils of Umran and Iewsir. The soil of Umran is more acidic than Iewsir. In the month of June, the availability of P in the soil of Umran is more than that of Iewsir at 5^{o}-15^{o} slope and above 25^{o} slope. At 5^{o}-15^{o} slope, Umran soil contained more of Organic Carbon than Iewsir. At this slope (5^{o}-15^{o} slope) the soil of Umran contain 320.54 kg/ha. K where as Iewsir contain 495.70 kg/ha. K. The availability of K in the soil of Umran is more than the availability of K at Iewsir. But, at 15^{o}-25^{o} slope, the soil at Umran contained more K than the soil of Iewsir at this slope in June. The availability of Organic Carbon in the Soil of Iewsir is a little more than availability of Organic Carbon at Iewsir at above 25^{o} slope. At this slope the availability of P is more than Iewsir. But, availability of K is less at Umran at

above 25^{o} slope than Iewsir at this slope in June. There is loss of nutrients at all the plots of Umran and Iewsir from June to November. At 5^{o}-15^{o} slope the content of Organic Carbon is less than the availability of Organic Carbon at Iewsir, in November. But, K in the soil of Umran is less than availability of K in the soil of Iewsir at 5^{o}-15^{o} slope in November. At 15^{o}- 25^{o}, the availability of Organic Carbon is more at Umran i.e. 1.09 per cent than the availability of Organic Carbon at Iewsir i.e. 1.32 per cent in November. But, K content in the soil of Umran is less than that of Iewsir at 15^{o}-25^{o} slope. At above 25^{o} slope, the soil of Umran contained more Organic Carbon and P than at Iewsir at this slope. In the month of November, the availability of K at above 25^{o}. slope was 190.40 kg/ha. But at this slope, the soil of Iewsir contain more K, i.e. 463.40 kg/ha. On an average Iewsir soil contain more K than the soil of Umran. But, Umran soil contain more Organic Carbon and P than the soil of Iewsir.

3.2.1. Physical Characteristics of open sites (experimental plots) of Umran and Iewsir :

The Table-3.2.1 shows the soil texture and colour of open sites of Umran and Iewsir. At Umran, the percentage of silt, clay and sand are 37.73 per cent, 18.89 per cent and 43.39 per cent at 5^{o}- 15^{o} slope, respectivly. At this slope (5^{o}-15^{o}) the nomenclature of the soil is loam and the colour is *Yellowish Red*. At 15^{o}-25^{o} slope, the presence of silt, clay and sand are 24.24 per cent, 23.51 per cent and 52.25 per cent, respectively , at Umran. The colour of the soil is *Yellowish Red*. At above 25^{0}slope, the soil contain 4.11 per cent silt at Umran. At this slope, the soil at Umran

TABLE: 3.2.1

SOIL TEXTURE AND COLOUR OF CONTROL SITE OF VILLAAGE UNRAN AND IEWSIR, 1991

	Umran					Iewsir				
Degree	Silt (%)	Clay (%)	Sand (%)	Nomen-clature	Clour	Silt (%)	Clay (%)	Sand (%)	Nomen-clature	Colour
5-15	37.37	18.89	43.39	Loam	Yellowish Red	47.18	35.14	17.68	Silty Clay Loam	Yellowish Brown
15-25	24.24	23.51	52.25	Sandy Clay	Yellowish Red	40.07	31.83	28.10	Clay Loam	Dark Yell-oish Brown
>25	4.11	17.12	37.26	Loam	Dark Redd-ish Brown	34.19	45.34	20.A7	Silty Clay	Dark Yell-Aish Brown

contain 17.12 per cent and 37.26 per cent clay and sand respectively. The colour of the soil at above 25^{o} is *Dark Yellowsh Red* at Umran (Table-3.2.1).

At Iewsir, the soil contain 47.18 per cent, 35.14 per cent and 17.68 per cent silt, clay and sand, respectively at 5^{o}-15^{o} slope. The soil at this slope is silty clay loam and colour is *Yellowish Brown*. The soil colour of rest of the slopes (15^{o}-$25^{o}$and $>25^{o}$) are same as the soil colour of 5^{o}-15^{o} slope at Iwesir i.e *Yellowish Brown*. At 15^{o}-25^{o}slope, the availability of silt, clay and sand in the soil are 40.07 per cent 31.83 per cent and 28.10 per cent, respectively at Iewsir. The nomenclature at 15^{o}-25^{o} slope is clay loam and colour of the soil is *Dark Yellowish Brown*. The percentage of silt, slay and sand in the soil of Iewsir at above 25^{o} slope is 34.19 per cent, 45.34 per cnt and 20.47 per cent, respectively at Iewsir. The soil is silty clay loam and the colour is *Dark Yellowish Brown* at above 25^{o} slope at Iewsir.

The availability of silt and clay in the soil of Umran is less than that of Iewsir. But, The soil of Umran contain higher percentage of sand than the presence of sand in the soil of Iewsir (Table-3.2.1). At 5^{o}-15^{o} slope, the soil of Umran contain 37.73 per cent of silt where as the soil of Iewsir contain 47.18 per cent of silt at the same slope. Likewise, availability of clay at Umran is less than at Iewsir. But at Umran, the soil contains more sand than the soils of Iewsir at 5^{o}-15^{o} slope. The colour of the soil of Umran is *Yellowish Red*, but at this slope colour of soil at Iewsir is *Yellowsh Brown*. The nomenclature of the soil at Umran is loam whereas the nomenclature

of the soil of Iewsir is silty clay loam at 5^{o}-15^{o} slope. At 15^{o}-25^{o} slope the percentage of silt is 24.24 per cent at Umran. At this slope, availability of silt at Iewsir is more i.e. 40.07 per cent. But, soil of Umran contains more sand i.e. 52.25 per cent in comparison with the availability of sand at Iewsir i.e. 28.10 per cent at 15^{o}-25^{o}. At 15^{o}-25^{o}, the nomenclature of soil of Umran is sandy clay loam where as the nomenclature of soil of Iewsir is clay loam. The colour at this slope is *Yellowish Red* at Umran where as the soil colour at Iewsir is *Dark Yellowish Brown* (Table-3.2.1). The presence of silt at above 25^{o} slope is very less comparatively, than the availability of silt at Iewsir at the same slope zones. At Umran 17.12 per cent of clay is present in the soil, where as 45.34 per cent clay is present at Iewsir at the same slope. But the percentage of sand is higher at Umran i.e. 37.26 per cent than that of Iewsir i.e. 20.47 per cent at above 25^{o} slope zones. At this slope, the soil of Umran is loam where as the soil of Iewsir is clay loam. The soil colour at above 25^{o} slope is *Dark Redish Brown* at Umran, where as the soil colour of Iewsir is *Dark Yellowish Brown* the same slope.

3.2.2. Chemical Characteristics of open plots of village Umran and Iewsir:

In the month of June the pH value of the soil was 4.95 at 5^{o}-15^{o} slope of Umran. In the same slope, the presence of Organic Carbon was 1.34 per cent, P and K was 1.42 kg/ha. and 234.00 kg/ha., respectively at Umran in June. In this month the pH value of the soil of Umran was 4.86 at 15^{o}-25^{o} slope. The percentage of Organic Carbon is 2.68 per cent at 15^{o}- 25^{o} slope. The presence of P and K are 1.36

kg/ha. and 368.31 kg/ha., respectively at 15^{o}-25^{o} slope in June at Umran (Tab.-3.2.2). At above 25^{o} slope, the pH value of Umran was 4.34. The presence of Organic Carbon was 2.79 percent in June. In the same slope and month the soil at Umran contain 1.54 kg/ha and 350.48 kg/ha. P and K, respectively.

The soil of Iewsir is also acidic (Table-3.2.2). The pH value at 5^{o}-15^{o} slope was 4.90 in June. The presence of Organic Carbon at this slope was 3.45 per cent at Iewsir. At 5^{o}-15^{o} slope, the soil contain 1.00 kg/ha. and 560.70 kg/ha. P and K, respectively in June. At 15^{o}-25^{o} slope the soil pH of Iewsir was 4.73. At this slope, the presence of Organic Carbon, P and K were 1.98 per cent, 2.05 kg/ha. and 593.84 kg/ha, respectively. At the high slope($>25^{o}$) the pH value of the soil was 4.81. At this slope, the availability of Ogranic Carbon, P and K were 2.00 per cent, 5.98 kg/ha.and 509.75 kg/ha, respectively in the month of June.

At 5^{o}-15^{o} slope the pH value of Umran was 4.31 in the month of November (Table-3.2.2). In this month, the availability of Organic Carbon and K were 1.26 per cent and 184.00 kg/ha. in November. The availability of P was very less at all the slopes of Iewsir in November(Table-3.2.2). At 15^{o}-25^{o} slope, the soil pH value was 4.31. At this slope the availability of Organic Carbon and P are 2.00 per cent and 274.40 kg/ha, respectively at Umran. At high slope($>25^{o}$) the pH value of soil at Umran is 4.20 in November. The presence of Organic Carbon and K at this slope is 2.51 per cent and 263.20 kg/ha., respectively in November at Umran.

The Table-3.2.2 shows, there are soil loss in

TABLE-3.2.2

CHEMICAL PROPERTIES OF SOIL BEFOREA ND AFTER MONSOON AT OPEN PLOTS, VILLAGE UMRAN AND IEWSIR

Month	Degree	UMRAN				IEWSIR			
		pH	Organic Carbon (%)	Phosphorous (kg/ha)	Potassium (kg/ha)	pH	Organic Carbon (%)	Phosphorous (kg/ha)	Potassium (kg/ha)
June	5 - 15	4.95	1.34	1.42	234.40	4.90	3.45	1.00	560.70
	15 - 25	4.86	2.68	1.36	368.31	4.73	1.98	2.05	593.84
	> 25	4.34	2.79	1.54	350.48	4.81	2.00	5.98	509.75
November	5 - 15	4.31	1.26	TRACE	184.00	4.75	3.14	1.79	515.20
	15 - 25	4.31	2.00	TRACE	274.40	4.53	1.36	1.80	463.40
	> 25	4.20	2.51	TRACE	263.20	4.32	1.42	5.38	369.60

all the plots of Iewsir in June to November. The soil of this site has bacome more acidic. The pH value at 5^{o}-15^{o} slope decreased to 4.75. In this month, the presence of Organic Carbon, P and K are 3.14 per cent, 1.79 kg/ha. and 515.20 kg/ha, respectively at 5^{o}-15^{o} slope. At 15^{o}-25^{o} slope the pH value of Iewsir is 4.53 in November. The presence of Organic Carbon, P and K are 1.36 per cent, 1.80 kg/ha and 463.40 kg/ha., respectively at 15^{o}-25^{o} slope in November at Iewsir. In this month at above 25^{o} slope the pH value is 4.32 at Iewsir. At above 25^{o} slope the soil of Iewsir contains 1.42 per cent organic Carbon, 5.38 kg/ha. P and 369.60 kg/ha. K in November.

The Table-3.2.2 shows that there are nutrient loss from June to November at all the slopes of Umran. In the month of June 1.34 per cent Organic Carbon was present. But, in November the Organic Carbon decreased to 1.26 per cent at Umran at 5^{o}-15^{o} slope. Here, there is a loss of 0.08 per cent of Organic Carbon from June to November. The Table-3.2.2 shows that there is a heavy loss of P at all the sites (5^{o}-15^{o}, 15^{o}-25^{o} and $>25^{o}$) from June to November at Umran. The availability of P at 5^{o}-15^{o} slope was 1.42 kg/ha. in June. But, in November the availability of P if very negligible at 5^{o}-15^{o} slope of Umran. In the month of November the availability of Organic Carbon is 2.00 per cent at 15^{o}-25^{o} slope of Umran. There is a loss of 0.68 per cent of Organic Carbon at 15^{o}-25^{o} slope from June to November at Umran. At this slope, P also decreased to 274.40 kg/ha in November at Umran. From June to November, P has been eroded down 83.91 kg/ha from June to November at 15^{o}-25^{o} slope of Umran. At the high slopes. 0.28 per cent Organic Carbon has been lost from

Umran.The availability of P was 350.48 kg/ha at above 25° slope in June at Umran. But in November, it decreased to 263.20 kg/ha from same site. At this slope, there is a loss of 87.28 kg/ha P at Umran.

The Table-3.2.2 shows the soil of Iewsir has also lost nutrients from June to November at all the plots. The soil became more acidc from June to November at Iewsir. In the month of June the soil of Iewsir contained 3.45 per cent Organic Carbon at 5°-15° slope but, in November it was reduced to 3.14 percent from the same slope at Iewsir. In at June, 560.70 kg/ha P was available at 5°-15° at Iewsir. In the month of November it decreased to 515.20 kg/ha from 5°-15° slope at Iewsir. In June, at 15°-25° slope, presence of Organic Carbon, P and K were 1.98 per cent, 2.05 kg/ha and 593.84 kg/ha, respectively. But, at 15°-25° all those nutrients have been reduced by 1.36 per cent, 1.80 kg/ha and 463.40 kg/ha, respectively. Likewise there is nutrient loss at slopes above 25° from June to November. The availability of Organic Carbon, P and K was 2.00 per cent, 5.98 kg/ha and 509.75 kg/ha, respectively at above 25° slope zones. But, in the month of November Organic Carbon , P and K decresed to 1.42 per cent, 5.38 kg/ha and 369.60 kg/ha, respectively at above 25° slope at Iewsir.

The pH value of Umran and Iewsir are more or less the same at all the plots. The availability of Organic Carbon at 5°-15° slope 1.34 per cent at Umran. But, at this slope, the availability of Organic Carbon is more at Iewsir i.e. 3.45 per cent. At 5°-15° slope, the soils contain more P at Umran than that of Iewsir, i.e. at Iewsir it is 1.00 kg/ha and at Umran it is 1.42 kg/ha. in June. The availability of K

at 5^{o}-15^{o} slope is 234.00 kg/ha at Umran, where as the soil of Iewsir contains 560.70 kg/ha K in June(Table-3.2.2). At 15^{o}-25^{o} slope, the soil of Umran contain more Organic Carbon than the soils of Iewsir in June. At Umran the presence of Organic Carbon in the soil is 2.68 per cent and at Iewsir 1.98 percent only. P and K are less in the soil of Umran than that of Iewsir. The P and K contained in the soils of Umran is 1.36 kg/ha and 368.31 kg/ha at 15^{o}-25^{o} slope in the month of June. In the same slope, Iewsir has 2.05 kg/ha and 593.84 kg/ha P and K in June. At above 25^{o} slope, the presence of Organic Carbon at Umran is more than Iewsir. But, the availability of P and K are less at Umran than Iewsir at above 25^{o} slope.

From June to November there is a loss of nutrients at all the plots of the two sites(Table-3.2.2). The availability of Organic Carbon at all the sites of Umran remains higher than Iewsir in November. But, at Umran there is a heavy loss of P from all the plots. The availability of K at 5^{o}-15^{o} slope at Umran is less than that of Iewsir. Likewise, at rest of the plots K is less at Umran than Iewsir.

3.3.1 Soil volume loss from control plots at various slopes, 1991:

There is natural soil loss from two plots at each of the slope zones. The Table- 3.3.1 shows soil volume loss at various slope zones from control plots. At 5^{o}-15^{o} slope 1.18 t/ha in the month of July. But, at 15^{o}-25^{o} slope a very negligible amount of soil loss was observed. At high slopes, the loss became more i.e. 2.18 t/ha. In the month of July, Umran lost 3.36 t/ha of top soil. But, from Iewsir,

TABLE -3.3.1
SOIL VOLUME LOSS FROM CLOSE PLOTS
AT VARIOUS SLOPES.1991

Soil loss in t/ha.

Month	Degree	Umran	Iewsir
July	5 - 15	1.18	NA
	15 - 25	0	NA
	> 25	2.18	1.18
	Total	3.36	1.18
August	5 - 15	0	NA
	15 - 25	2.18	NA
	> 25	NA	2.18
	Total	2.18	2.18
Sept-ember	5 - 15	0	NA
	15 - 25	2.18	NA
	> 25	NA	1.18
	Total	2.18	1.18
Grand Total		6.72	4.54

soil loss figures of 5^{o}-15^{o} and 15^{o}-25^{o} were not available. It was available only at above 25^{o} slope. There was a loss of 1.18 t/ha from the top soil. Table-3.3.1 shows that soil at 5^{o}-15^{o} slope and 15^{o}-25^{o} slopes were not available at Iewsir in July. In the month of July, only at above 25^{o} slope the soil figures were available at Iewsir. At this slope there was a loss of 1.18 t/ha. In comparison with the loss at Iewsir at above 25^{o} slope, the soil loss at Umran was more, i.e. 2.18 t/ha.

In August, soil loss of Umran was very less at 5^{o}-15^{o} slope. At 15^{o}-25^{o} slope the erosion of top soil became more at 5^{o}-15^{o} slope at Umran i.e.2.18 t/ha. But, the sediments from high slope was not available. From the two plots i.e. low and medium slope zones of Iewsir, the sediments were not found(Table-3.3.1) (negligible collection). Only the availability of sediment was from above 25^{o} slope. At this slope ($>25^{o}$) the amount of soil loss at Iewsir was 2.18 t/ha in August.

In September Umran lost very little amount of sediment at 5^{o}-15^{o} slope. At 15^{o}-25^{o} slope, Umran lost 2.18 t/ha of top soil in September. But from high slope zones at Umran, the sediment collection was negligible. The sediments from low and medium slopes were negligible at Iewsir. Only above 25^{o} slope the sediments could be measured. At this slope, the erosion of top soil was 1.18 t/ha (Table-3.3.1).

3.3.2 Soil volume loss from experimental plots at various slopes, 1991

Table-3.3.2 shows that at 5^{o}-15^{o} slope, 2.18 t/ha of soil was eroded down from the top soil at Umran. At above 25^{o} slope, there was heavy sediment loss from Umran in

only in July.

In August, 2.18 t/ha of top soil was eroded down from 5^{o}-15^{o} slope at Umran. The amount of loss from top soil of Umran is the highest in the season at above 25^{o} slope in August i.e. 6.55 t/ha. In this month Iewsir lost 4.37 t/ha soil at 15^{o}-25^{o} slope. At above 25^{o} slope Iewsir lost 6.55 t/ha sediments.

In the month of september 1.18 t/ha soil was eroded down from 5^{o}-15^{o} slcpe at Umran. At 15^{o}-25^{o} slope Umran lost 3.36 t/ha of top soil in September. Surprisingly, at high slopes, the erosion was very less i.e. 0.44 t/ha at Umran in September. At Iewsir the erosion of top soil was 1.18 t/ha at 15^{o}-25^{o} slope. But, at the high slopee the erosion of top soil was more than Umran. At this slope Iewsir lost 2.18 t/ha of top soil, where as Umran lost 0.44 t/ha in September.

The Table-3.3.1 and 3.3.2 shows that the loss of top soil at control plots are significantly less than the experimental (open) plots in each case. At 5^{o}-15^{o} slope Umran lost 1.18 t/ha from close plot, where as at the same plot (5^{o}-15^{o} slope) 2.18 t/ha of soil was eroded down from experimental plots in July. At high slope zones, 2.18 t/ha of soil was eroded down from covered plots, where as from experimental plots the loss became double i.e. 4.37 t/ha at Umran in July.

Like-wise in the month of August, very little amount of soil was lost from control plots at 5^{o}-15^{o} slope, but in experimental plots, it was more. In this month a significantly higher amount of soil was eroded down from high slope zones from the experimental plot. In the month of

TABLE-3.3.2

SOIL VOLUME LOSS FROM OPEN PLOTS

AT VARIOUS SLOPS, 1991

Soil loss in t/ha.

Month	Degree	Umran	Iewsir
July	5 - 15	2.18	NA
	15 - 25	NA	2.18
	> 25	4.37	NA
	Total	6.55	2.18
August	5 - 15	2.18	NA
	15 - 25	NA	4.37
	> 25	6.55	6.55
	Total	8.73	10.92
Sept-ember	5 - 15	1.18	NA
	15 - 25	3.36	1.18
	> 25	0.44	2.18
	Total	4.98	3.36
Grand Total		20.26	16.46

September, the erosion decreased. But compared to control plots, the amount of soil loss was more at experimental plots.

3.4.1. Nutrient loss from control plots at various slopes, 1991:

The Table-3.4.1 shows the nutrient loss from control plots of Umran and Iewsir. In the month of July, Umran lost 0.01 per cent Organic Carbon, 0.001 kg/ha P and 1.2 kg/ha K at 5^{o}-15^{o} slope. In this month there was a less amount of nutrient present at 15^{o}-25^{o} slope zone. At above 25^{o} slope, 0.02 per cent Organic Carbon, 0.006 kg/ha P and 4.1 kg/ha K was eroded down in July at Umran. In July, the data from 5^{o}-15^{o} slope and 15^{o}-25^{o} slope was not available at Iewsir. At above 25^{o} slope the loss of nutrient was less than Umran. In July, 0.004 per cent Organic Carbon and 1.9 kg/ha P were eroded down, But, loss of P was very less at 5^{o}-15^{o} slope at Iewsir in July.

In August 0.01 per cent of Organic Carbon was eroded down at above 25^{o} slope of Iewsir (Tab.-3.4.1). At this plot the loss of P was very little and K was also lost i.e 3.5 kg/ha from Iewsir in July. A very negligible amount of nutrients was lost from covered plots of Umran at 5^{o}-15^{o} slope in August. At 15^{o}-25^{o} slope the loss of nutrients because more. In September also the loss of nutrients are very less at 5^{o}-15^{o} slope of Umran. At 15^{o}-25^{o} slope 0.02 per cent Organic Carbon was eroded down. At this slope loss of P and K from the top soil were 0.01 kg/ha and 3.1 kg/ha, respectively.At above 25^{o} slope 0.005 per cent Organic Carbon was eroded from covered plots at Iewsir in September. In this month, 0.005 kg/ha and 2.1 kg/ha P and K was eroded from the

TABLE-3.4.1

CHEMICAL PROPERTIES PRESENT IN ERODED SOIL SEDIMENTS AT COVERED PLOTS, VILLAGE UMRAN AND IEWSIR, 1992

Month	Degree	UMRAN			IEWSIR		
		Ogranic Carbon (%)	Phosphorous (kg/ha)	Potassium (kg/ha)	Ogranic Carbon (%)	Phosphorous (kg/ha)	Potassium (kg/ha)
July	5 - 15	0.01	0.001	1.2	NA	NA	NA
	15 - 25	0	0	0	NA	NA	NA
	> 25	0.02	0.006	4.1	0.004	TRACE	1.9
August	5 - 15	0	0	0	NA	NA	NA
	15 - 25	0.006	0.006	3.2	NA	NA	NA
	> 25	NA	NA	NA	0.1	TRACE	3.5
Septe-mber	5 - 15	0	0	0	NA	NA	NA
	15 - 25	0.02	0.01	3.1	NA	NA	NA
	> 25	NA	NA	NA	0.005	0.005	2.1

top soil at above 25° slope of Iewsir (Tab.-3.4.1). Soil samples for the rest of the slopes zones of Iewsir were not available.

3.4.2 Nutrient loss from experimental plots at various slopes, 1991:

The Table-3.4.2 shows the loss of nutrients from open plots at Umran and Iewsir. In July, 0.03 per cent, 0.01 kg/ha and 3.6 kg/ha Organic Carbon, P and K were lost from the top soil of Umran, respectively. At the medium slopes the sample was not available. At above 25° slope 0.03 per cent Organic Carbon was eroded at Umran. At this slope 0.04 kg/ha and 6.3 kg/ha P and K was eroded from the top soil respectively. In August, Umran soil lost 0.06 per cent, 0.06 kg/ha and 8.6 kg/ha Organic Carbon, P and K, respectively from the top soil at above 25° slope. In the month of September 0.01 per cent Organic Carbon was eroded from top soil at Umran at 5 -15 slope. At the same slope very less amount of P was eroded. At the same slope 1.1 kg/ha K was eroded from soil of Umran at above 25° slope.

From the two slopes of Iewsir i.e. 5°-15° and above 25° slope the sample was not available. At 15°-25° slope 0.01 per cent Organic Carbon was eroded at Iewsir In July. From the same site the loss of P was very less in July at 15°-25° slope zones. At this slope 3.6 kg/ha P was eroded from the top soil of Iewsir in July. At 15°-25° slope, 0.01 per cent Organic Carbon was eroded from the soil of Iewsir in August. At this slope the loss of P was very less. But, K loss was 7.1 kg/ha from the top soil at 15°-25° slope in August at Iewsir. The loss of Organic Carbon at above 25° slope is 0.04 per cent in August at Iewsir. At this slope the

TABLE-3.4.2

CHEMICAL PROPERTIES PRESENT IN ERODED SOILSEDIMENTS AT OPEN PLOTS, VILLAGE UMRAN AND IEWSIR

Month	Degree	UMRAN			IEWSIR		
		Ogranic Carbon (%)	Phosphorous (kg/ha)	Potassium (kg/ha)	Ogranic Carbon (%)	Phosphorous (kg/ha)	Potassium (kg/ha)
July	5 - 15	0.03	0.01	3.6	NA	NA	NA
	15 - 25	NA	NA	NA	0.01	TRACE	3.6
	> 25	0.03	0.04	6.3	NA	NA	NA
August	5 - 15	0.009	0.01	2.6	NA	NA	NA
	15 - 25	NA	NA	NA	0.01	TRACE	7.1
	> 25	0.06	0.06	8.6	0.04	TRACE	10.9
Septe-mber	5 - 15	0.01	TRACE	1.1	NA	NA	NA
	15 - 25	0.03	0.01	2.5	0.007	TRACE	1.9
	> 25	0.003	TRACE	0.03	0.01	0.03	3.7

the erosion of P was very less. At above 25° slope there is a significant loss of K in August at Iewsir i.e. 10.9 kg/ha.

At 15°-25° slope 0.007 per cent Organic Carbon was eroded from Iewsir in September (Table-3.4.2). The loss of P was very less at 15°-25° slope in September. At 15°-25° slope 1.9 kg/ha K was eroded down from the top soil at Iewsir in september. At above 25° slope, the loss of Organic Carbon was 0.01 per cent P was 0.03 kg/ha and K was 3.7 kg/ha from the soil of Iewsir.

3.4.3 Comparison of nutrient loss over slope :

(*i*) Control plots:

The Table-3.4.1 shows the nutrients loss from two sites at various slopes.The loss of Organic Carbon was 0.01 per cent at 5°-15° slope in July. But at medium slopes the nutrient loss was very less. Again at high slope (>25° slope), the loss of Organic carbon was a mere 0.02 per cent at Umran. In the same way the loss of P and K became more at high slope than low slope at Umran. In the month of August the loss of Organic Carbon, P and K was very les. At the increasing slope the loss of nutrients also increased in August at Umran (Table-3.4.1). The data for above 25° slope was not available. In the month of September the loss of nutrients at 5°-15° slope is very less (Table-3.4.1). At 15°-25° slope the erosion became high. So at this slope Organic Carbon was eroded. Likewise P ahd K was also eroded from the two sites at 15°-25° slope.

(*ii*) Open plots:

The Table-3.4.2 shows that, the loss of Organic Carbon at low and high slope remained same at Umran. At high slopes of Umran, the erosion of P increased to 0.04

kg/ha in July. In this month, the loss of P became almost double at Umran. In the month of August, the loss of Organic Carbon increased as the slope incresed at Umran. In the same way, the erosion of P and K increased from low to high slope i.e 0.01 kg/ha to 0.06 kg/ha and 2.6 kg/ha to 8.6 kg/ha, respectively at Umran. The loss of K was very high in this month at above 25^{o} slope at Umran. In September, the percentage loss of Organic Carbon increased from low slope to medium slope at Umran. At above 25^{o} slope, the erosion became less. As a matter-fact, only 0.003 per cent Organic Carbon was eroded at high slope in September at Umran. In same respect loss of K and P was also reduced from 15^{o}-25^{o} slope to above 25^{o} slope at Umran (Table-3.4.2).

From the open plots of Iewsir, samples were not available from all the slopes. So, it is very difficult to assess the soil erosion problem of Iewsir. In the month of July 0.01 per cent Organic carbon and 3.6 kg/ha K was eroded at 15^{o}-25^{o} slope at Umran.At this slope, the erosion of P was negligible. In August, erosion of Organic Carbon and P remained the same as in July at 15^{o}-25^{o} slope. But, at this slope, the erosion of K increased to 7.1 kg/ha in August. At the same site i.e. Iewsir, at above 25^{o} slope Organic Carbon was eroded little more than 15^{o}-25^{o} slope in August. The trend of P remained same as medium slope. But, at above 25^{o} slope, there is a signifcant loss of K at Iewsir in August. In September, the loss of Organic Carbon was decreased to 0.007 per cent at 15^{o}-25^{o} slope. At this slope, loss of P remained the same as July and August. In September, the loss of K became very less at Umran. The loss of K at 15^{o}-25^{o} slope was 1.9 kg/ha at Iewsir. At above 25^{o} slope, the loss

of nutrients became high comparatively medium slope in September. Erosin of Organic Carbon, P and K were 0.01 per cent, o.03 kg/ha and 3.7 kg/ha, respectively at high slope (>25^{o} slope at Iewsir). In comparasion with high slope in August and september the loss of nutrients i.e. Organic Carbon and K decreased at Iewsir, but there is a slight increase of P at high slopes at Iewsir.

3.5 Alteration in soil quality:

There are important changes in the quality of soil at control plots as well as experimental plots during the season of study at both the sites. From each plots (close and experimental) of Umran and Iewsir the pH value decreased from June to November (Table-3.1.2 and 3.2.2). At 5^{o}-15^{o} slope the pH value decreased from 4.52 to 4.37 at Umran (Table-3.1.2). The soil became more acidic in November. From both the sites and each plots the soil lost the nutrients like Organic Carbon, P and K. The plots of Iewsir was also faced with the same problem. There was a heavy amount of nutrient loss from the top soil of Iewsir.

CHAPTER-IV

PEOPLE'S PERCEPTION' DEFORESTATION AND SOIL EROSION

4.1. INTRODUCTION :

The deforestation and degradation of land is a major problem of the humid tropics of the N.E. India, especially the hill tracts including the study area of Umran Basin. There are several factors influencing deforestation, soil erosion and land degradation. These factors could be, (a) lack of awareness of the local communities about the benefits of forests and the adverse effects deforestation can make; (b) lack of or erosion of community control over social assets like forests; (c) sheer greed of groups of individuals in the community to use community assets for private gains; and (d) administrative apathy or even collusion with forest contractors in stealing community property and so on. To make an assessment of the problem from the point of view of the communitys' perception and response, a village of Umran River Basin was taken into consideration. The name of the village is Iewsir, which is locally known as 'Nonmati'. The village is 9 km away from the main road, N.H. 40. A small unmetalled jeepable road links the village with the N.H-40. The illage is small with only 22 households under the Ri-Bhoi District of Meghalaya. The general topography of the village is undulating and situated along the valley of the river Umran.

4.2. POPULATION, OCCUPATION AND PUBLIC AMENITIES :

4.2.1. Population :

The population of the village is very small. The total population of village is only 87 (Appendix-B). Out

of the total population, 49.43 per cent are male and 50.57 percent are female. The Table-4.1 shows the age-structure of the population of village Iewsir. Of the total population

TABLE-4.1

AGE-STRUCTURE OF THE POPULATION, VILLAGE IEWSIR, 1992

Age-Group	% to total population	% to total Male	% to total female
< 15	39.08	34.88	43.18
15 - 30	26.44	25.58	27.29
30 - 45	17.24	18.60	15.90
45 - 60	10.34	11.64	9.09
> 60	6.90	9.30	4.56

Source : Field work, Dec. 1992.

39.08 per cent are below 15 years of age. In this age group, male population constitutes 34.88 percent and female population 43.18 per cent of the total male and female population, respectively. Only, 26.44 per cent of the total population is between 15-30 years of age and 25.58 per cent and 27.29 per cent are males and females, respectively. Of the total population 17.24 per cent are between 30-45 years of age, 10.34 per cent between 45-60 years and 6.90 per cent are above 60 years of age (Table-4.2). The dependency ratio is 1:29[1].

4.2.2. Occupational Structure :

Out of the total population of the village of 87.34 (39.08%) are workers. The male work participation rate (male workers to the total workers) is 67.65 per cent

1. Ratio of dependent population to total workers, estimated from Table - 4.1.

and female workers participation rate is only 32.35 per cent, which is quite low. Since, the village is extremely backward and small in size, the number of occupations are also limited. The occupations have been divided into 3 broad categories; i.e. Agricultural Labourers (those landless and depend on wage work around the year), Cultivators (those who have their own or leased-in land and cultivate themselves) and others in business, trade and services, put together. The main occupation of the villagers is agriculture. Almost all the people are engaged in agricultural activities. Many of them are landless labourers. All those landless labourers are engaged in agricultural works. The total agricultural land in the village is 126 acres (Appendix-B). Of the total workers, 73.53 per cent are engaged in agricultural activity (Table-4.2). Of the total workers, 44.12 per cent and 29.42

TABLE-4.2

OCCUPATIONAL STRUCTURE OF VILLAGE IEWSIR

Classification of works	% of total workers	% of male workers to total workers	% of female workers to total workers
Agricultural Labourers	73.53	44.12	29.42
Cultivators	11.76	11.76	0.00
Business and Services*	14.71	11.76	2.94

Source : Based on village survey 1992

N. B * - Business includes contractors and other business.

per cent are male and female labourers, respectively. The number of cultivators are very few in the village. They, by and large employ landless labourers of the village. Though, in the Khasi Society, females are the head of the families,

but there is not a single female, who has land. Because, many Khasi families have leased-out their landed property to others. Those, who have leased-in the land from Khasi families happend to be other tribes. Those tribal families are dominated by male members. For that reason, no single female cultivator was found in the village. There are some other persons in the village (14.71 per cent) who are engaged in service, trade and business occupations. Among the latter category, 11.76 per cent are male workers and 2.94 per cent are female workers.

4.2.3. Public Amenities :

There are no public amenities like, Public Health Centre, Post and Telegraph Office, Transportation, Primary School, Local Market etc. in the village. The PHC, Post Telegraph Offices are located in Nongpoh which is 12km away from the village. So, people use to walk upto Nongpoh to get commodities and other services. The Primary School is also located 9 km away from the village i.e. at NH.40. The village is however, electrified. Though the village is electrified, only 3 houses are found to avail of the facilities because most ofthe people of the village are very poor they cannot afford the cost of electrification.

4.3. SIZE OF OPERATIONAL HOLDINGS :

The village Iewsir is dominated by agricultural activity. Many of them are landless agricultural labourers. But, some of them have taken lands in lease from local people. In the village, only 4 families have own landed property and 5 families have leased-in the land. The Table-4.3 shows, 20 acres i.e. 18.87 per cent to the total cultivated land has been taken by families in lease, and 106

acres (84.13 per cent) are owned by the families

TABLE-4.3

LAND HOLDING BY OWNERSHIP STATUS, IEWSIR

Land Holding	No. of families	Land in acres	% to total cultivated land
Owned by families	4	106	84.13
Leased-in by families	5	20	18.87
Total	9	126	100.00

The total cultivated land in the village is 126 acres. Out of 126 acres, 84.13 per cent are owned by families. The cultivators use the land in various ways. They use to cultivate fruits, paddy and others crops. The Table-4.4 shows the size of landholding of the families in the village. There are seven (7) families who are marginal farmers. One family each is included in the latter categories (5-20 and 20-80 acres) of land (Table-4.4). The Table-4.5 shows the land use pattern of village Iewsir. The wet paddy covers an area of 91 acres i.e. 72.22 per cent to the total cultivated area. Fruit cultivation covers an area of 7.94 per cent of total cultivated land. The fruits include Orange, Bananas, Guava etc. A little land area (1 acre)is under shifting cultivation ('Jhumming'). The forest cover is 19.05 per cent, which is owned by families (Table-4.5).

4.4 LEVEL OF INCOME :

The main source of income ofthe villagers is from agriculture. Of the total workers, 73.53 per cent are 'land less labourers' (Table-4.2). They work in the field on daily wage basis. The labourers consist of both males and

TABLE-4.4

SIZE OF LAND HOLDINGS AT VILLAGE IEWSIR

Land in Acre	No. of families
< 5	7
5 - 20	1
20 - 80	1
Total	9

TABLE-4.5
LAND-USE PATTERN IN VILLAGE IEWSIR

Land use for:	Total Cultivated Area (in acre)	Percentage to total Cultivated area
Wet Paddy	91	72.22
Fruit	10	7.94
Jhum	1	0.79
Forest*	24	19.05
Total	126	100.00

N.B. * - Forest owned by family.

females. The Table-4.6 shows the income distribution of the village Iewsir. Of the total holdings, 36.35 per cent families are below poverty line (< 12,000 rupees). Despite the fact that both the adult males and females work on wage employment in agriculture, a large segment of them are extremely poor. The Table-4.6 shows, 50 per cent to the total families in the village are earning Rs 12,000-25,000 per annum. In the village, there are 3 (three) families earning above Rupees twenty five thousand per annum, constituting 13.74 per cent of the total number of families.

TABLE-4.6

LEVEL OF INCOME OF VILLAGE IEWSIR

Family income in Rupees/year	Total Holding	Percentage to total Holding
< 12,000	8	36.35
12,000 - 25,000	11	50.00
25,000 - 50,000	1	4.58
50,000 - 100,000	1	4.58
> 100,000	1	4.58
Total	22	100.00

Source : Based on village Survey, December '92

4.5 INCOME AND EDUCATIONAL STATUS :

The main source of income of the families of India is agriculture. Majority of the population are under daily wage work. Some of the people are working under road contractors on daily wage basis. But these types of activities are few and far between in the village. A few persons (2 to 3) are engaged in aforestation and forestry activities which have been undertaken by the State Government. Some of the families are engaged in animal husbandry, like Poultry as a subsidiary source of family food or income. Economically and educationally the people of Iewsir are very backward. There is no primary School in the village. The nearest primary school is located near on N.H.-40, which is 9 km. away from the village. So, there is no opportunity for the children of the village for primary education. The Table-4.7 shows the sex-wise literacy of the village Iewsir. Only, 22.99 per cent of the population are literates, 80 per cent of total literates are below class X. The percentage of male literate to the total literate is 60

TABLE-4.7

LITERACY OF THE VILLAGE IEWSIR

Educational Status	% to total literates	% to total literates	
		Male	Female
< 10	80.00	50.00	30.00
10 - B.A.	10.00	5.00	5.00
> B.A.	10.00	5.00	5.00
Total	100.00	60.00	40.00

Source : Computed by author.

per cent and the female literate is only 40 per cent. Majority of the literates are below class X level of education. Only 20 per cent to the total literates have acquired higher qualification, i.e. above B.A. The percentage of male and female, who have done higher qualification is same i.e. 5 per cent (Table-4.7). Those who have gained higher qualification (above B.A.) are staying near by town and they are the land-lords of the village. The rest of the villagers are below the 'poverty' line (Table-4.6), so, they can not afford to send their children for study. Hence, the poor children became illiterate and helped their parents in the fields. Slowly, they (the illiterate children) became daily wage labourers.

4.6. USE OF FOREST :

Directly or indirectly the village people are using the forest. The Table-4.8 shows, lumbering or fuel-wood gathering is not an important source of income of the

TABLE-4.8

PEOPLE'S PERCEPTION TOWARDS ENVIRONMENTAL DEGRADATION

Sl. No.	Respondence towards	Respondence awareness (Percentage to total household)	
		Positive	Negative
1	Lumbering and fuel wood gathering	13.66	86.36
2	Cutting trees for fuel wood	95.45	4.54
3	Relation between deforestation and soil erosion	50.00	50.00
4	Loss of soil fertility	36.36	22.72
5	Using of fertilizers	31.82	13.66

Source : Computed by author from Appendix-B

villagers. Maximum i.e. 86.36 per cent of the households responded denying the use of wood from forest for sale, but 13.66 per cent of the households answered in positive. But an overwheleming 95.45 per cent of the total households are cutting trees from the forest for domestic use as fire wood. As most of the people are agricultural labourers, they are very poor and their poverty forces them to use community assets like forest for family needs. These families are not concerned for environmental degradation of the forests, because they are illiterate and are not aware of the consequences of deforestation. Moreover, they have no stake in the land since they are landless and work in other's fields. Those who are having landed property, 31.82 per cent are using fertilisers and 13.66 per cent are not using chemical fertilizer. About 50 per cent of the total households are concerned about the soil erosion and 50 per

cent are not even aware of the problem. Families with high income and literacy are better informedabout the problems associated with deforestation and soil erosion. Therefore, higher level of family income, literacy status and education becomes an important input in the environmental awareness of the people. Moreover, since majority of the households have no land, therefore, their immediate concern is not land degradation. Perhaps, better community based campaign on preservation and regeneration of forests would be a better strategy for maintaining the local forests resources.

CHAPTER V

FINDINGS CONCLUSIONS AND SUGGESTIONS

5.1. FINDINGS :

The main findings of the study on deforestation in Umran river Basin are given below :

(i) It was found that, from deforested tracts (plots) the loss of top soil and nutrients are more than that of control plots at Umran and Iewsir sites.

(ii) There is loss of top soil by natural process, though less as was observed in the control plots, but the accelerated erosion in the deforested tracts are enormous as observed in volume loss figures. In the month of July the top soil of Umran lost 1.18 t/ha. from covered plots (Table-3.3.1), but from the same slope zone and monthly 2.18 t/ha of top soil was lost at Umran (experimental plots: Table-3.3.2). In the month of August 2.18 t/ha. of top soil was lost at Iewsir from the above 25° slope (Table -3.3.1), but from the same slope zone, Iewsir lost 6.55 t/ha top soil in August (Table-3.3.2, Chapter-III).

(iii) It was also observed that the loss of nutrients was more from deforested tracts (plots) than from covered plots. The Table-3.4.1 shows that Umran lost 0.01 per cent Organic Carbon, 0.001 kg/ha P and 1.2 kg/ha K at 5°-15° slope in July. But from the same slope zone Umran lost 0.03 per cent organic carbon, 0.01 kg/ha P and 3.6 kg/ha K was eroded down from experimental plots of Umran (Table-3.4.2).

(iv) It was observed that due to deforestation and soil erosion during the monsoons, there is an increase in acidity in the soil (lowering of pH value). This results in obstruction to cation exchange in the soil and, therefore, non-utilization of nutrients by the plants. In the month of June, the soil pH of Umran was 4.52 at 5^{o}-15^{o} slope at control plot (Table-3.1.2). But, in November the soil pH of the same plot of Umran decreased to 4.37 at 5^{o}-15^{o} slope zone. The soil pH of Iewsir also decreased at each slope zone at both the control and the experimental plots from June to November (Table-3.1.2 and Table-3.2.2).

(v) It was observed that, there were nutrient loss from soil at each slope zone at both the sites (Table-3.1.2 and Table - 3.2.2).

(vi) The soil at control plots of Umran is more acidic than the soil of Iewsir (Table-3.1.2). The Table-3.1.2 shows at 5^{o}-15^{o} slope the soil pH of Umran at control plot was 4.52, but at the same slope, the soil pH was 5.95 at Iewsir in June.

(vii) In comparision with the control and experimental plots of Umran the soil pH was more at 5^{o}-15^{o} slope at experimental plot (Table-3.1.2 and Table-3.2.2). From Table-3.1.2 and Table-3.2.2, it can be seen that the pH value was more at Iewsir at each of the slope zones of control plots than the slope zones of experiemental plots.

(viii) It was seen that there was heavy loss of P from the open plots of each slope zones from June to November at Umran (Table-3.2.2). During the monsoons, the open plots of Umran was containing 1.42 kg/ha, 1.36 kg/ha and 1.54 kg/ha P at each slope zones, respectively. But in the month of November, there was a heavy loss of P from each of the slope zones of Umran from experimental plots (Table-3.2.2).

(ix) While looking at the response of the community to the problem of soil erosion, it was found that most of the villagers of Iewsir are landless labourers. Very limited number of families have landed property. These landless laburers are working under landlords on daily wage basis. Some of them are working under forest contractors and road contractors on daily wage basis also. They are economically and educationally very weak (Chapter-V). Therefore, awareness about the problem of deforestation and degradation of land is neither this connection or affects their livelihood.

(x) Most of the people (86.36 per cent) deny the cutting of trees for timber. On the other hand, they admit that they are cutting trees for fire-wood (Table-4.8). As a matter of fact, small and medium size trees are disappearing very fast.

(xi) It has been seen from the Chapter-IV that, half of the respondents are realising, deforestation is directly related with soil erosion. But half of the respondents deny that there is any relation between deforestation and soil erosion (Table-4.8).

(xii) From the Table-4.8, it has seen that, 36.36 per cent respondents are aware of loss of soil fertility, but 22.72 per cent said the soil of Iewsir has not lost any nutrients (Table-4.8).

(xiii) Those who have landed property 31.82 per cent are using fertilizers, but 13.66 per cent are not applying fertilizers in their land (Chapter-IV, Table-4.8).

5.2 CONCLUSION :

It can be concluded that deforestation leads to soil erosion. Depletion of forest cover leads to disturbance in the micro-ecosystem. When the soil is eroded, the soil micro-organisms present in the soil are also displaced. For thåt matter, nutrient cycle also changes. The soil loses its fertility. In the present world, the tropical forests are heavily strained. The explosion of population has been putting heavy pressure on the forest ecosystem especially in the humid tropics. Tropical forests are the best supplier of hard wood as well as soft wood. Because of human intervention, the forest cover have been reduced, mostly in tropical areas.

The tropical forests of North-East India are heavy pressure. In this region, the people are practicing 'slash and burn' ('Jhum') cultivation. They use to cut the forest for jhum land. Then they cultivate the deforested tracts. Jhumming in the North-East remains a major reason for deforestation and degradation of soil.

In the present study, on the basis of findings one could conclude that loss of top soil as well as

nutrients are more in freshly deforested tracts (plots) than under natural condition of forest cover. In fact, the soil and nutrient loss at covered plots was found to be extremely small.

For people's participation about this matter a small village, i.e. Iewsir was taken into consideration. It was seen that most of the people are educationally and economically backward. They are cutting the trees from the forest for their own livelihood. As most of them are landless labourers, they are not aware of environmental hazards resulting from deforestation. Some of the suggestions have been given below.

5.3 SUGGESTIONS :

Government of India is planning to develope the forest area in many ways. Though the government is taking initiative, there is no people's participation in such projects. Some of the suggestions are given below :

(i) People's participation is very important. To make people aware there should be awareness campaigns for the communities about their environment and how to preserve it;

(ii) Most of the rural people are economically and educationally weak. Any environmental programme has to recognise this and the programmes are to be linked up in up grading the economic status. If they do not see the scheme directly bringing in only benefits to them, the schemes are to end up in failure;

(iii) The rural people are practicing 'slash and bur.. cultivation ('Jhum'). This process should be stopped. Again

this cannot happen unless adequate alternative avenues are available. There is a need for providing viable alternatives to 'Jhum', so that people can move to new methods and techniques of earning a livelihood;

(iv) The management of forest resource is nesessary. Afforestation of deforested tracts as an economic venture for the people look alternative;

(v) There must be greater community control and management of of forests if they are to be preserved with necessary technical inputs from the government.

BIBLIOGRAPHY

1. Allen, J.C. and Barenes, D.F. (1985) : "The Causes of Deforestation in Developing Countries", Annals of American Geographers,Vol.75. No. 2.

2. Almed, Shaharudin (1990): "An Investigation of forest Micro-climate : The Pasoh Forest Reserve, Nigeri Semblian, Malaysia", Singapore Journal of Tropical Geography , Vol. 11,No.1.

3. Arora. M.P. (1990): Ecology, Himalayan Publishing House, Delhi.

4. Aweto, A. O. (1990) : "Plantation Forestry and forest Conservation in Nigeria", Environmentalist, Nigeria Vol. 10, No. 2.

5. Black, C. A. (1968) : Soil Plant Relationships, 2nd Edition, John Willy and Sons Inc., New York.

6. Bowonder, B. (1985) : "Deforestation in Developing Countries", Journal of Environmental System, Vol. 15.

7. Browder, J.O (1988) : "Public Policy and Deforestation in Brazilian Amazom in Repetto and Gillis, (ed.) Public Policy and Misuse of Forest Resorce, New York.

8. Burih, P. (1970) : Introduction to the study of soils in tropical and sub-tropical region, Oxford and IBH Publishing Co. New Delhi.

9. Das, B.L. (1992) : "125 Years of Indian Forest Service-Challenges Then and Now", Indian Forester, Vol. 118, No.10 .

10. Davision, J., Tho, Y.P., and Bijleveld, M.(ed) (1985) : The Feature of Tropical Rain Forest in South East Asia, CIUCN.

11. Donahue, R., Miller, R.W. and Schickluna, J.C. (1987) : Soils: An Introdudtion to Soil and Plant Growth, 5th Edition, Prentice Hall of Indian Private Limited, New Delhi.

12. Dregne, H.E. (1990) : "Erosion and Soil Productivity in Africa",Journal of Soil and Water Conservation, Vol. 45, No.-4.

13. Dudal, R. (1982) : "Land Degradation in World Perspective", Journal of Soil and Water Conservarion , Vol.33.

14. FAO (1982) : Tropical Forest Resource, FAO Forestry Paper, No.30, Rome.

15. FAO (1978) :Soil Erosion by Water: Some measures for its control on cultivated lands, Food and Agriculture Organisation of the United Nations, Rome.

16. Fitzpatric, E. A.(1986) : An Introduction to soil Science, 2nd Edition, Longman Scientific and Technical.

17. Fosberg, F.R., Garnier, B.J.and Kuchler, A.W. (1961) : "Delimitation of Humid Tropics", Geographical Review, Vol. 15.

18. G.S.I. (1974) Misc. Publication No.30 Part-VI

19. Goswami. A.C. (1960) : "Report of Investigation of Alleged occurance of Iron ore in Nonghpoh, U.K. & J. Hills, Assam", GSI, Unpublished Report, Shillog,

20. Hect, S. and Cockburn, A. (1989): "The Fate of Forest: Developers and Defenders of Amazon", American Geographical Society, Vol. 12.

21. Holy, M. (1980): Erosion and Environment, Pergamon Press, Oxford.

22. Hughes, J.D. and Thirgoos, J.V. (1982): "Deforestation in

ancient Greece & Rome", The Ecologist, Vol .12.

23. Ives, J.D. and Messerli, B. (1991): "The Himalayan Delima-Reconcling, Development and Conservation", American Geographical Society, Vol.4.

24. Jin-Bee, Ooi (1990) : "Tropical Rain Forest : Trade and Patterns", Singapore Journal of Tropical Geography, Vol. 11(2).

25. Loony, J.W. (1991) : "Land degradation in Australia : The search for a legal remedy ", Journal of Soil & Water Conservation, Vol.46(4).

26. Mawthoy, P.R. (1991) : "Shifting Cultivation or Jhumming in Meghalaya", Shifting cultivation in North-East India,(ed) D.N. Majumdar, Omsson Publications, New Delhi.

27. Mikesell, M. W. (1960) :"The Deforestation of Mount Lebanon", Geographycal Review, Vol.59

28. Mukhopadhya, S. (1991): "Tribal Development Through Forest Resource Management : A Study of South Bandhuan Police Station of Purulia District, West Bengal", Indian Journal of Regional Science. Vol. XXII, No. 1.

29. Muzumdar, S.K. (1965 - 66) : Systemic Geogological Mapping Around Nayabunglow, UK & J. Hills District, Assam, GSI, Unpublished Report.

30. Nandi, K. (ed) (1982): Resource Potentials, of North East India, Climate of North East India, Meghalaya Science Society, Shillong.

31. Odum, E.P. (1975) :Ecology, 2nd Edition, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.

32. Panda. G.C. (1987): "Geomorphilogy: Rural Settelment Khasi and Jaintya Hills, Meghalaya", Ph. D. Thesis (Unpublished), Dept. of Geography, NEHU, Shillong.

33. Ramakrishnan, P.S.(1985) : "Tribal man in Humid Tropics of the North-East India", Man in India, Vol.65(1).

34. Rao, A.S. (1968) : "The vegetation of the Khasi and Jaintya Hills", Prpc. of Pre-Congress Symposiun, 21 IGU (India), Dept. of Geography, Gauhaty University, Gauhaty

35 Rathakrishnan, L (1991) : "Tropical rainforest and its, present crisis", My Forrest Vol. 27(1)

36. Raychudhury, S.P. (1966) :Land and Soil, National Book Trust, New Delhi.

37. Royburman, B.K (1991) : "An Over view of Shifting Cultvation in India", Shifting Cultivation in North-East India, (ed) D.N Majumdar, Osman Publications, New Delhi.

38. Ryan, J. (1983) : "Soil Conservation in Lebanon", Journal of Soil and Water Conservation, Vol. 38.

39. Sagaraya, K. P. (1967) : Forest and Forrestry National Book Trust, New Delhi.

40. Savage, M. (1991) : "Structural Dynamics of a South Western Pine Forest under chronic human Influnce", Annals of American Geographers, Vol. 18.

41. Sanders, D.W. (1990) : "New Strategies for Soil Conservation", Journal of Soil and Water Consevation, Vol. 45

42. Saxena, R.K., Verma, K.S., Borthwal, A.K (1991) : Assessment of Land Deghradation Hazards, Etah District, UttarPradesh using Land Sat Data", Journal of the

Indian sociert of Remote Sensing. 19(2)

43. Sharma, T.C. (1991) : "The Prehistoric back ground of Shifting Cultivation ", Shifting Cultivation in North-East India,(ed) D.M. Majumdar, Omson Publications, New Delhi.

44. Sharma, P.D. (1990) :Ecology and Environment , Rastogi Publications, Meerut.

45. Symmons, I.G. (1975) : Forest, The Ecology of Natutal Resources, Edward Arnold, London.

46. Smith, R.L. (1977) : Elements in Ecology, Harper and Row Publishers, New York.

47. Singh, R.P. (1968) : "Geomorphology of the Shillong Plateau of Assam", Proc. of the Pre-Congress Sym., IGU, Gauwahati.

48. Sutton, S.L., Whitmore, and Chadwick, A.C. (ed)(1983) : Tropical Rain Forest : Ecology anf Management, Special Publication Series of the Britisah EcologicalSociety, No. 2, Blackwell Scientific Publications.

49. Tabatali, M. Ali and Bremner, J.M. (1983) : "Automated Instruments for Determination of Total Carbon, Nitrogen and Sulpher in Soil by Combustion Techniques", Soil Analysis, (ed) Keith A. Smith, Marcel Dekker Ins., New York.

50. Thapa, G. B. and Weber, K.E. (1991) : "Deforestation in Upper Pohara Village, Nepal", Singaporre Journal of Tropiucadl Geography,Vol. 2(1).

51. Thompson, L.M. and Troeh, F.R. (1973) : Soils and Soil Fertility, McGrow-Hill Publications, New York.

52. Tiarks, A.E. (1990) : "Growth of Slash Pine Planted in Soil disterbed by wet-water logging", Journal of Soil and Water Conservation, Vol. 45(5).

53. Veeresh, G.K. (1990) : "Role of Soil Funa in the Organic Matter Turnever and Tutrint Cycling", Journal of Soil, Biology and Ecology, Vol. 10(2)

54. Verma, P.P. and Rajendran, N. (1985) : " A Report on the Photogeological Mapping in the area Around Nanghalaw and South of Nongpoh, East and West Khasi Hills District, Meghalaya", GSI Unpublished Report, Shillong.

55. Wilde, S.A. (at el)(1972) : Soil and Plant Analysis for tree Culture, (ed) Gordon Chester, 4th Revised Edition, Oxford and IBH, Publishing Co., New Delhi.

56. Zachar, D. (1982) : Soil Ersion, Elsevier Science Publication Co., Amsterdam, The Netherland.

57. "A manual on Conservation of soil and water : United States Dept. of Agriculture", Oxford and IBH Publishing Co., New Delhi, 3rd print, 1974.

58. The State of Indians' Environment (1984-'85) : The Second citizens' Report, Centre for Science and Environment, New Delhi.

APPENDIX-A

1. Name of the H. H _____

2. M/F _____ 3. Age _____

4.Family Demography.

Sl. No.	Relation with H.H	M/F	Age	E.A.	Work Participation
1					
2					
3					
4					
5					
6					

5.	Income Level (Family)	Quantity	Price
	(a) Annual harvest of cereals		
	pulses/oil seed.		
	(b) Annual harvest of fruight/		
	vegetable		
	(c) Sale of animals/birds		
	(No. of animals/ birds)		
	(d) Sale of animal/birds produce		
	(Milk, egg, fish, dung etc.)		
	(e) Sale of fire wood.		
	(f) Sale of timber		
6.	Expenditure (family)		
(i)	(a) Food (Rice/wheat/oil)		
	(b) Clothing		
	(c) House repair		
	(d) Education		
	(e) Medical		

(ii) (a) Cultivation of crop/vegetable :

(b)Maintenance of animal/birds :

7.	Land holding	Local value :	Metric Value
	(a) Land owned by family	:	
	(b) Land leased-in by the family	:	
	(c) Land leased-out by the family	:	
	(d) Share of community land	:	
	(e) Total operational holding	:	
8.	Land use		
	(a) Land under paddy cereals	:	
	(b) Land under fraught/vege-	:	
	table Horticulture	:	
	(c) Land under homestead	:	
	(d) Land undeR temporary	:	
	occupation	:	
	(e) Wasteland/fellow land	:	
	(f) Land under forest	:	
	(g) Degicaded land/LAAC	:	
9.	Animal/birds	:	
	(a) How many cows/buffaloes	:	
	(b) Pigs		
	(c) Goats		
	(d) Fowl		

10. (a) Is the lumbering and fuel gathering important source for you? Yes No

(b) (i) If, yes then tell me how many trees you cut from the forest to sell and how many bundles of fuel wood you collect to sell?

(ii) What types trees you cut?

Big/small High variety/low variety

(iii) Is it from your forest/village forest/others?

(c) (i) Do you think that in last 10-15 years the near by forest have thinned? Yes No

(ii) If yes, what is the reason for deforestation?

(d) (i) Do you feel that the soils of your land is getting less fertile? Yes No

(ii) If yes, what are the reasons you attribute to this to this problem?

(iii) Do you use more of cowdung/Fertilizers to grow the same crops? Yes No

(e) (i) Do you think there is some relation between deforestation and depletion in soil quality?

Yes No

(ii) If yes, please tell what you wish to do about it?

(iii) Do you discuss these problems in your village meetings? Yes No

(f) Do you have any land which you had cultivated earlier, but has become completely infertile?

Yes No

APPENDIX-B

TABLE - 1
AGE-STRUCTURE OF THE POPULATION OF VILLAGE IEWSIR

Age - Group	Total	Male	Female
< 15	34(39.08)	15(34.88)	19(43.18)
15 - 30	25(26.44)	11(25.58)	12(27.28)
30 - 45	15(17.24)	8(18.60)	7(15.90)
45 - 60	9(10.34)	5(11.64)	4(9.09)
> 60	6(6.90)	4(9.30)	2(4.56)

N.B. Bracted fogures are parecentage to total population and percentage of male/female population to total male/female population.

Source: Based on village survey, 1992

TABLE - 2
OCCUPATIONAL STRUCTURE OF VILLAGE IEWSIR

Classification of works	Total	Male	Female
Agricultural Labourer	25(73.53)	15(44.12)	10(29.42)
Cutivators	4(11.76)	4(11.76)	00
Govt. Srevice & Business*	5(14.71)	4(11.76)	1(2.94)

N.B. : *Business inclides contracters, soap owners etc.
Bracketed fogures are percent to total labourers and percentage of male/female labourersto total labourers.

Source: Based on village survey, 1992

TABLE - 3
LAND HOLDING OF VILLAGE IEWSIR

Land Holding	Land in Acre	Percentage to total cultivated land
Owned by family	106	84.13
Leased-in by family	20	18.87

Source:Based on village survey.

TABLE - 4
LAND USE PATTERN IN VILLAGE IEWSIR

Land use for	Total Area in acre	Percentage to total cultivates land
Wet Paddy	91	72.22
Fruit	10	7.93
Jhum	1	0.79
Forest	24	10.04
Total	126	100.00

Source :Based of village survey

TABLE - 5
INCOME LEVEL OF VILLAGE IEWSIR

Income in Rupees	Total Holding	Percentage to total holding
< 12,000	8	36.35
12,000 - 25,000	11	50.00
25,00 - 50,000	1	4.58
50,000 - 100,000	1	4.58
> 100,000	1	4.58
Total	22	100.00

Source :Based on village survey. 1992.

TABLE - 6
SEX - WISE LITERACY RATIO OF VILLAGE IEEWSIR

Educational	No. of literates	Male	Female
< 10	16(80.00)	10(50.00)	6(30.00)
10 - B.A.	2(10.00)	1(5.00)	1(5.00)
> B.A.	2(10.00)	1(5.00)	1(5.00)
Total	20(100.00)	12(60.00)	8(40.00)

N.B.: Based on village survey

TABLE - 7
PEOPLE'S PERCEPTION ON ENVIRONMENTAL DEGRADATION

Sl. No	Respondence attitude towards	Respondence awareness Positive	Negetive
1	Lumbering or fuelwood gathering	3(13.66)	19(83.66)
2	Cutting of trees for firewood	21(95.85)	1(4.54)
3	Using fertilizers	7(31.82)	3(13.66)
4	Relation between defo- restatiin & soil erosion	11(50.00)	11(50.00)
5	Loss of soil fertility	8(36.36)	5(22.72)

Source : Based on village survey

TABLE-8
SHIFTING CLTIVATION IN NORTH EAST REGION

Sl. No.	State	Annual area under Shifting cltivation	Fellow period (in year)	No of families practising shifting cultivation
1	Arunachal Pradesh	700	3 - 10	54000
2	Assam	696	2 - 10	58000
3	Manipur	900	4 - 7	70000
4	Meghalaya	530	5 - 7	52290
5	Mizoram	630	3 - 4	50000
6	Nagaland	190	5 - 8	1160046
7	Tripura	220	5 - 9	43000

source: Basic Stastics of North Eastern Region, 1990
North Eastern Council, Shillong.