

ENVIRONMENTAL CONSTRAINTS ON AGRICULTURE
IN HIGHLAND ECONOMY WITH SPECIAL
REFERENCE TO PADDY CULTIVATION
(A CASE STUDY OF CHAMPHAI)

C. LALTANI

Dissertation

SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENT
OF THE DEGREE OF
MASTER OF PHILOSOPHY

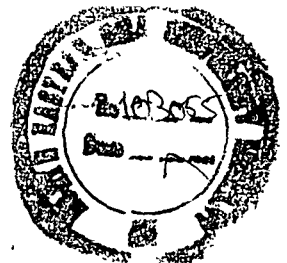


DEPARTMENT OF GEOGRAPHY
SCHOOL OF ENVIRONMENTAL SCIENCES.

North-Eastern Hill University


SHILLONG - 14

1993.



DS
633.10954166
KAL

STAT. A. D.

27-2-98




पूर्वात्तर पर्वतीय विश्वविद्यालय
पू. प. विवि. परिसर, शिल्लॉग - 793022 (मेघालय)
North-Eastern Hill University
NEHU Campus, Shillong - 793022 (Meghalaya)

Phone :
Grams : NEHU

This is to certify that the Dissertation submitted by Miss C. Laltani for the Award of degree of Master of Philosophy (M.Phil) at the Department of Geography, NEHU, Shillong, entitled "Environmental Constraints on Agriculture in Highland Economy with Special Reference to Paddy Cultivation: A Case Study of Champhai." is a bonafide study of the author to the best of my knowledge and belief. This study may now be placed before the examiners for evaluation.

RK Rai
Head
(Prof. R. K. Rai)
Department of Geography
North Eastern Hill University
Shillong.
Head,
Deptt. of Geography
School of Environmental Sciences
NEHU, Shillong-14

B. S. Majumdar
Department of Geography,
(Dr. B. S. Majumdar)
North Eastern Hill University,
Shillong - 793022
Supervisor,
Deptt. of Geography,
School of Environmental
Sciences
NEHU, Shillong -14

ACKNOWLEDGMENT

At the very outset, I gladly take this opportunity to express my supervisor Dr.B.S.Mipun, Reader, Department of Geography, NEHU, Shillong who with patience and endurance had supervised this study, without whose help I would not have been able to complete this study.

My heart felt thanks goes to all the Faculty members of the Department of Geography for their help and cooperation towards the successful completion of this work.

I express my sincere thanks to various officers of different departments in Mizoram for the valuable help and cooperation in making available the required information.

I appreciate the efforts put in by Mr. Zarzoenga, Assistant Town Planner for the valuable help in interpreting the Aerial Photographs.

It is my sincere duty to express my thanks to Miss Lalmuanzovi, Mr. C. Lalhliapa, Mr. R. Lalthanglura, Mr. T. T. Zothansanga for their help and cooperation in preparing maps and Typing my manuscripts and also to Dr.N.P.Goel for helping in computer editing.

I duly acknowledge the help rendered by my friends and colleagues.

It is my sincere duty to express my thanks to my parents, Mr C. Laichungnunga and Mrs Israeli for helping me in collecting materials and encouragements. I have been largely inspired by his knowledge.

Dated Shillong


(C. LALTANI)

CONTENTS

ACKNOWLEDGMENT

LIST OF TABLES

LIST OF MAPS

CHAPTER - I

Page No.

INTRODUCTION

1 - 9

Statement of the Problem
Survey of Literature
Study Area
Research Questions
Objectives
Data Base
Methodology
Chapter Scheme.

CHAPTER-2

GEOGRAPHICAL ASPECTS OF MIZORAM

10 - 32

Location
Physiography
Drainage
Geomorphology
Geological Structure
Soils
Natural Vegetation
Climate
Socio-economic conditions
Administrative Divisions
Transport and Communications
Population Characteristics

CHAPTER- 3

ENVIRONMENTAL FACTORS INFLUENCING PADDY CULTIVATION 33 - 40

Temperature
Solar Radiation
Wind
Relative Humidity
Rainfall
Soil
Average Slope
Relief

CHAPTER- 4

PHYSICAL ENVIRONMENT AND PADDY CULTIVATION 41 - 72

Environment and Cropping system and cropping pattern
Environment and method of cultivation
Environment and rice varieties
Environment and Area, Production and Yield of Paddy
Constraints of Paddy Production,
Environment and Landuse

CHAPTER- 5

SUMMARY AND CONCLUSIONS 73 - 81

BIBLIOGRAPHY 82 - 83

LIST OF TABLES

2.1	Districtwise growth rates of population for 1971-81 and 1981-91 for males and females in Mizoram.....	28
2.2	Districtwise density of population, Mizoram: 1971-91...	28
2.3	Districtwise sex-ratio in Mizoram, 1971-91.....	29
2.4	Literacy Rates in Mizoram.....	29
2.5	Proportions of main workers to total population, Mizoram: 1971 and 1991.....	30
2.6	Percentage of total workers, main workers and marginal workers to total population by sex, Mizoram 1981 & 91....	31
2.7	Percentage of main workers in cultivation, agricultural labourer, household industry and other workers to total main workers for Mizoram 1971 to 1991.....	32
4.1	District wise Area under Paddy: Mizoram.....	52
4.2	Area under Paddy in Champhai.....	54
4.3	Village - wise area under Paddy in Champhai.....	55
4.4	Area, Production and Yield of Paddy in Mizoram.....	56
4.5	District wise Area and Production of Paddy in Mizoram.....	58

LIST OF FIGURES

2.1	Location Map of Mizoram.....	11
2.2	Relief features of Mizoram.....	13
2.3	Drainage Systems of Mizoram.....	15
2.4	Administrative Divisions of Mizoram.....	23
2.5	Road Network of Mizoram.....	25
4.1	Area and production of paddy, Champhai.....	59
4.2	Area, Production and Yield of rice, Champhai.....	61
4.3	Rainfall in Champhai.....	63
4.4	Village-wise General Land-Use Pattern, Champhai...	69
4.5	Landuse/Landcover Map of Champhai.....	72

CHAPTER I

INTRODUCTION

Agriculture has been the subject matter of the geographical study since long. It is not only because most of the people depend for food and several raw materials on it, but also because largest fraction of land under human occupancy is used for agricultural purposes. It is still largely dependent on environmental conditions and presents wide spatial variation. Agriculture is the main occupation of working population and major source of income in developing countries. Though significance of agriculture in terms of employment and generation of national income is gradually declining, the development of agriculture is an essential, though by no means, a sufficient condition for rural development in such countries. Schultz remarks that agriculture sector, no matter what is done for it, is not capable of contributing to economic growth as much as other sectors of the economy, nevertheless, its development will strengthened the rate of industrial development by increasing food production capacity, by capital formation, by providing market for industrial output of consumers goods and lastly, by utilizing agricultural inputs originated industrial sector(1).

Rice cultivation occupies the largest part of cultivated land. But generally, the per unit average rice yields achieved on farmers field are lower than those commonly obtained in the

1. A.V.Rao, Mahajan & YRB Sharma: Growth Analysis of state-wise Area Productivity and Production of Rice in India. Agricultural situation in India June 1981, Vol.35-36, pp.171-73

experimental plots. Even in the highland, farmers' rice yields are often lower than the known crop potential yield which is obtainable in a farmers' field from the improved rice technology. There are, of course, various reasons as to why the technology has not percolated down to the field. Environmental constraints such as uncertainty of rainfall, short duration of sunshine hours, variation of temperature and humidity, difficult terrain with poor accessibility, development of irrigation are some of the important aspects that deserve consideration in this regard.

STATEMENT OF THE PROBLEM

Explanations for two problems have been sought in this study. First of them is to ascertain how far the environmental factors contribute to the potential for agricultural production in Champhai, and secondly, the existing cropping pattern may be examined in order to ascertain the human response to the physical setting. The utilization of the modern implements and techniques of farming also needs to be viewed in relation to the environmental setting. Since the ecological attributes are more suited to paddy cultivation, emphasis will be laid on this crop and forces required for a more effective cropping pattern and greater productivity.

SURVEY OF LITERATURE

Agriculture is dependent on environmental factors to a great extent. The physical environmental factors particularly, physiography, drainage, climate and soil play an important role in shaping the agriculture of a region. The patterns of cropping in

different environmental conditions has been studied in agricultural geography. In areas of rugged topography, the type of cultivation is shifting cultivation whereas in areas of even topography, permanent cultivation is possible. A good type of soil favour the growth of plants and yield huge quantity.

According to A.V.Rao, Mahajan and YRB Sharma, "The study indicates that spread of improved rice technology, though not uniform in different states, has led to the increased rice production in the country. Future strategy for the increase in rice production should be the spread of improved rice technology in all important rice growing states of the country".

T. Haque(2) has also studied the factors accounting for low yields of rice in West Bengal and he revealed that the constraints to high yield of rice as indicated by the farmers varied from district to district, although the factors like -

- i) the absence of adequate irrigation facilities and water management,
- ii) lack of capital,
- iii) undulating topography, and
- iv) non-availability of quality inputs are some of the major constraints.

In addition to the above, the high prices of inputs including that of labour, irregularity of rainfall leading to drought and flood situations, and absence of land reclamation measures were reported to be the important constraints.

2. Haque, T.: "Factors Accounting for Low yields of rice in West Bengal" Agricultural situation in India, Dec. 1985, Vol. XL No.9 pp.781-783.

D.K. Desai(3) has also made a study on the analysis of paddy production and productivity in Eastern India.

The study of Food, climate and man, the editors Margaret R. Biswas and Asit K. Biswas(4) emphasized the fact that self-sustaining development must be maintain on a long term basis and cite several environmental and agricultural production problems that have developed in many parts of the world.

According to V. Nath(5), "Expansion of cropped area results from extension of cultivation to new lands and from increased multiple cropping. The growth of multiple cropping is closely linked with the extension of irrigation facilities, irrigation is necessary in most part of India to produce the second (post monsoon) crop.

A.N. Asthana(6) has studied thoroughly on the agriculture in the North-Eastern hill regions. He emphasized in his study that being rice is the most important crop, in all the states, it is necessary to lift the low-input-low risk low yield technology to, at least, medium input medium low to low risk medium high yield technology. He has also given the ample scope for increasing rice

-
3. Desai, A.K.: "Analysis of Rice Production and Productivity in Eastern India, Agricultural situation in India, Aug. 1984, Vol. 39. pp.335-341.
 4. Margaret R. Biswas & Asit K. Biswas: Food, Climate and Man; A Wiley-interscience publication, 1979.
 5. Nath, V. : "The growth of Indian Agriculture: A regional Analysis" Geographical Review, Vol.59 1969 pp. 348-372.
 6. Asthana, A.N.: Agriculture in the North Eastern Hills Region" Agricultural situation in India, 1981, Vol.35-36. pp.831-840.

production. D. N. Borthakur, H. S. Gupta and R. N. Prasad(7) have also given a detail study of rice production in North-East India which are relevant for the researchers.

It is a matter of common knowledge that the annual production from the given area of land could be increased either by improving the yield of a crop or by growing an extra crop during a year. The traditional systems are no longer able to meet the needs of our rapidly expanding population for increased supply of food(8).

The studies dealing with the influence of environmental factor on paddy cultivation were not available. M. J. Abraham(9), Atar Singh(10), G.C. Munda(11), D.K. Pandey(12), R.N. Prasad(13) were the important scientists who made a valuable contribution for rice production technology. P. Basuchaudhury(14) has also

-
7. Borthakur, D.N., Gupta, H.S. and Prasad, R.N. : "Problems and Prospects of Increasing Rice Production in North Eastern States". Journal of the North Eastern Council, 1986. Vol.VII No.9-12, pp.1-18.
 8. Patel, C.S.: "Rice Based Cropping systems & their Fertilizer Management" Paper presented in state level subject matter Training cum Discussion Seminar on Rice Production Technology 1989, pp. 39-44.
 9. Abraham, M.J. : Rice varieties for NEH Region - Needs and improvement. Ibid pp.57-62.
 10. Atar Singh - Water and Drainage Requirement of Rice crop.Ibid pp.78-80.
 11. Munda, G.C.: Important Packages for Rice Cultivation pp.63-65
 12. Pandey, D.K. : Varieties for Uplands including Jhum pp.54-56.
 13. Prasad, R.N. : Management of Rice soils in the NEH Region pp.1-6,
 14. Basuchaudhuri, P.:Role of climate in Rice Production pp.66-70

given a brief account of the role of climate on rice production.

A review of a monograph, 'Rice Research in India' has also given authentic information on all aspects of rice research including improved rice production technologies and provides a synoptic account of recent progress in rice. The authors like K.S. Murty(15), P.S. Sreenivasan(16), B.P. Ghildyal(17) were the scientists who were dealing with the environmental parameters influencing rice production.

The environmental factors played a very important role in increasing rice production. Under the same environment conditions, use of inputs and application of modern technologies and enlarging the area are considered to be the necessary aspects for increasing production. Thus there are two basic ways of augmenting agricultural output; increasing the yield of land already under cultivation, and enlarging the area cultivated by expanding agricultural operations to previously virgin areas(18).

STUDY AREA

The study area is confined to the state of Mizoram with a case study of Champhai valley in Aizawl District, which is the biggest flat land in the state where permanent field cultivation

-
15. Murty, K.S.: Physiological Studies on Rice. A paper presented in Rice Research in India, 1985, pp.154-155.
 16. Sreenivasan, P.S.: Bio-climatology of the paddy crop. *Ibid* pp.213-218.
 17. Ghildyal, B.P.: Physical conditions of the soil affecting the Growth of Rice, *Ibid* pp.323.
 18. Kainth, G.S. & Mehra, P.L. : Rice Production, Potential and Constraints, Inter India Publications, New Delhi 1985.

is carried on. This valley located at the eastern most part of Mizoram and occupies 760.6 hectares of land under wet paddy cultivation.

RESEARCH QUESTIONS

- 1) Whether production declines with altitude and slope?
- 2) Whether soil fertility declines with slope, so production declines ?
- 3) Is high rainfall, and high velocity of wind causes destruction of crops ?
- 4) Is poverty, isolation & limitations of farmers education and knowledge of agriculture obstacle to improve agriculture ?
- 5) Is lack of good seeds, farm equipments, fertilizers and other necessities causes low productions ?
- 6) Is inadequate or lack of irrigation facilities decreases agricultural production ?

OBJECTIVES

The main objective of the study may be stated as follows:-

- 1) To get an insight into the system of agriculture and its effect on agricultural potential.
- 2) To examine the cropping pattern in relation to the environmental and ecological factors.
- 3) To study the methods of paddy cultivation and production in relation to environmental parameters.
- 4) To suggest measures for a more effective pattern of paddy cultivation as revealed from the analysis of environmental factors.

DATA BASE

Primary Source:

- a) Field visit and information collected through questionnaires.

- b) Aerial photo - interpretation for landuse/land cover information.
- c) Satellite imagery interpretation for regional pattern information of landuse/land cover.

Secondary Source

- a) .Toposheets published by Survey of India.
- b) Agricultural census of India with different years.
- c) District statistical Handbook of Mizoram.

METHODOLOGY

Analysis of the collected data has been taken with both absolute and percentage values. The essential matter so derived is presented in maps, diagrams, graphs and tables, synthesizing a large body of data into the present study.

CHAPTER SCHEME

The present study has been divided into five chapters in all.

In chapter I, the Introduction of the study is presented.

In Chapter 2, elements of physical environment which are of relevance to agricultural structure, relief, physical divisions, soils and climatic elements and population characteristics and socio-economic characteristics of the people of the study area are analyzed.

In chapter 3, the physical environmental factors which influenced paddy cultivation are presented.

In chapter 4, the influence of physical environment on agricultural systems, methods of cultivation, varieties, landuse pattern and Area, production and yield of rice were discuss in detail.

In chapter 5, summary of the findings, suggestions for development of paddy cultivation of the study area and conclusion are presented.

CHAPTER 2

GEOGRAPHICAL ASPECTS OF MIZORAM

LOCATION

Mizoram lies between 21° 56' N to 24° 31' N latitudes and 92° 16' E to 93° 26' E longitudes(1). The Tropic of Cancer divides the state into two nearly equal parts. Occupying the north-eastern corner of India, Mizoram has a total geographical area of 21,087 sq. km. Its share is only 0.64 per cent of India's area as a whole (Fig - 2.1).

Mizoram is bounded in the north by Cachar district of Assam and the south by Chin Hills of Burma, and in the west by Chittagong Hill Tracts of Bangladesh and the state of Tripura. Mizoram occupies a great strategic importance in the north-east corner of India, as it has a total length of 1633 Kilometers international boundary with Burma and Bangladesh(2).

PHYSIOGRAPHY

Mizoram is a land of hills. The hills run in ridges from north to south at a latitude from 20° 21' to 24° 27' and a longitude from 92° 40' to 93° 29' E. They have an average height of 900 meters. The highest point being the Blue mountain in the

-
1. Pachuau, Lalrintluanga: "Khawiahnge Mizoram in dah?" Meichher A monthly Bulletin of Adult Education Wing, Education Department, Government of Mizoram, Aizawl, June 1990, pp.2-6.
 2. Pachuau, Lalrintluanga : Population Structure and Settlement Patterns in Mizoram, A Geographical Analysis Ph.D. thesis, Dept. of Geography, NEHU, 1991, (Unpublished).

LOCATION OF MIZORAM

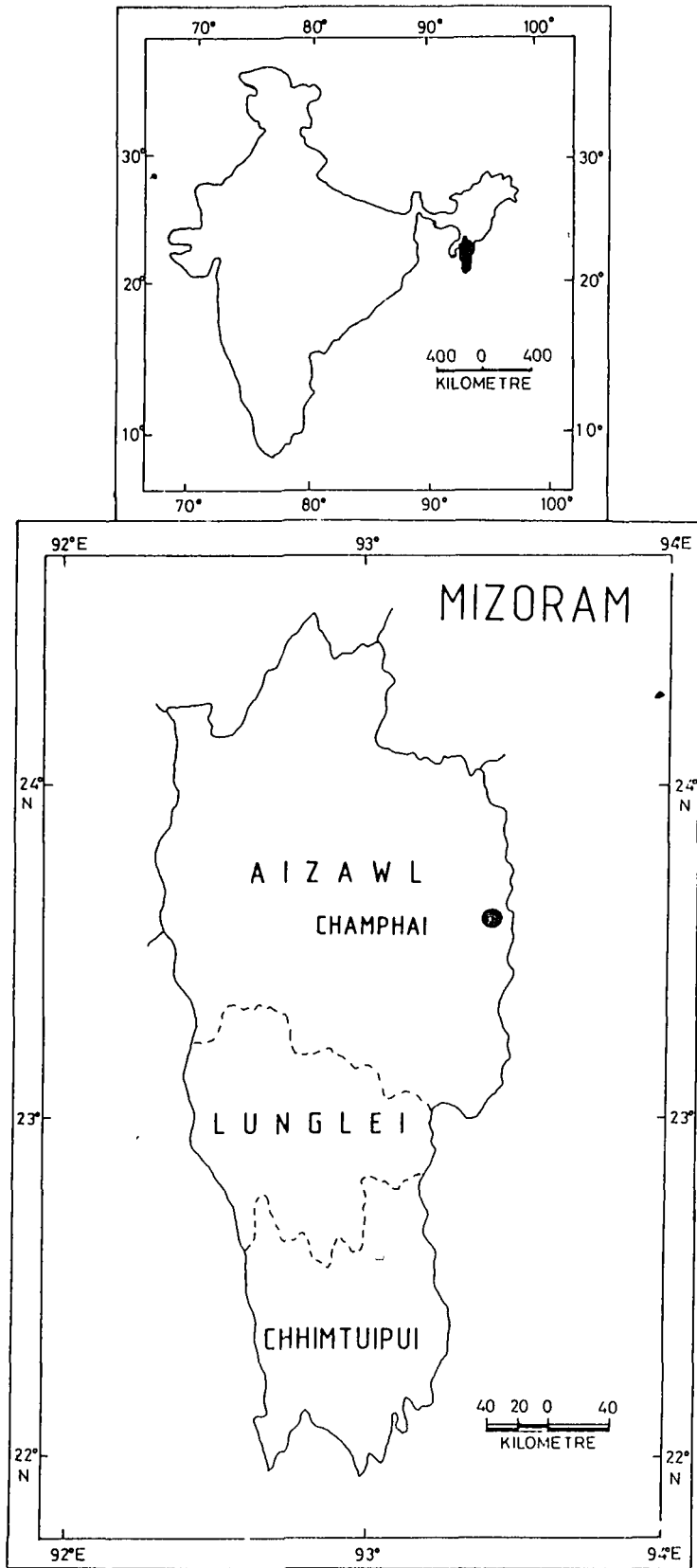


FIG. 2.1

south which rises to a height of 2165 meters. The hills are steep and cut apart by rivers which have created deep gorges. The terrain on the whole is mountainous except low depression amid hills and small river valleys where wet rice cultivation is practiced (Fig - 2.2).

The terrain of Mizoram is young and immature. It shows prominent relief features with steep slopes and is still undergoing denudation in response to various exogenic and endogenic processes. Since the terrain is young, the geomorphic features of Mizoram do not show much diversity in the formation of landforms. Most of the landforms are of erosional nature. The most dominant process in evolution of these forms is the action of the running water and is operating from upper tertiary onwards till today(3).

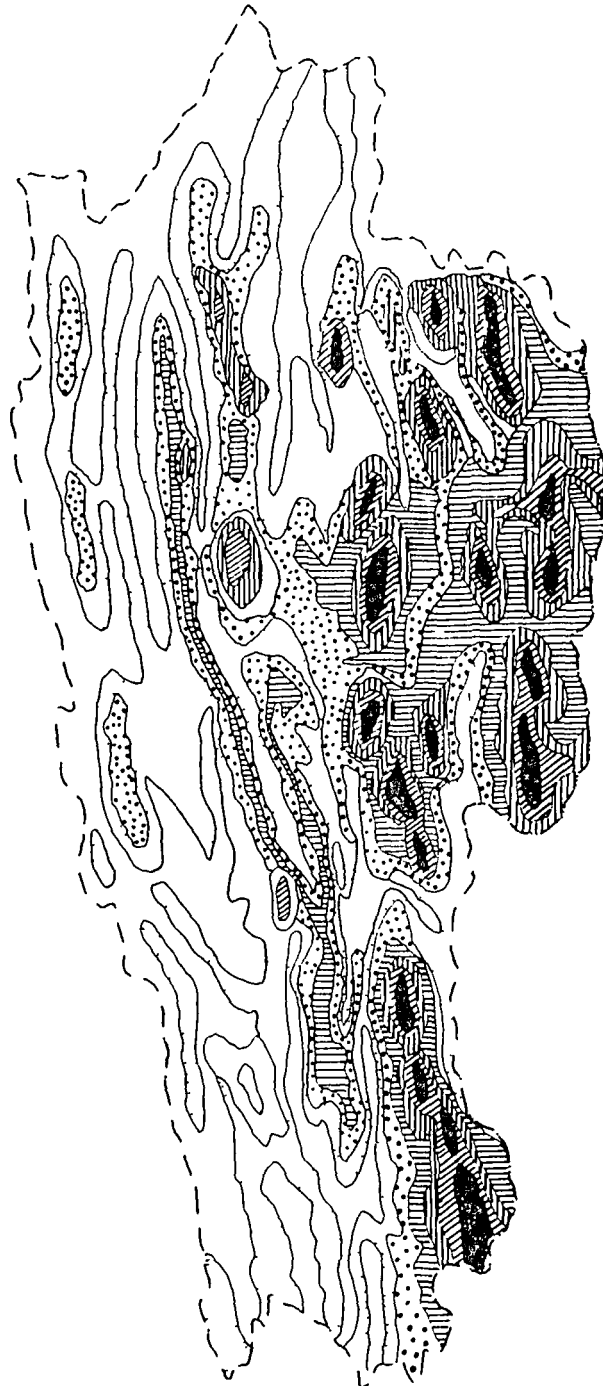
Physiographically, Mizoram is hilly terrain with strike parallel ridges and alternating narrow to wide valleys. The ridges show serrated top and hogback pattern which are highly dissected and separated by intervening V-shaped narrow valleys. Slopes are steep to very steep and escarpment are common. The major physiographic units of the area are:-

- 1) Hills,
- 2) Rolling
- 3) Undulating lands and
- 4) Valleys.

3. Report on Soil and Land Capability, Survey of Thingdawl Rural Development Block, Aizawl District, Mizoram, 1991, published by Soil Survey Organisation, Department of Agriculture, Mizoram, Aizawl, pp.3

MIZORAM
RELIEF FEATURES

KM 10 5 0 10 20 KM



HEIGHT IN METRES

1800 and above	
1500 1800	
1200 1500	
900 1200	
600 900	
300 600	
Below 300	

FIG. 2.2

DRAINAGE

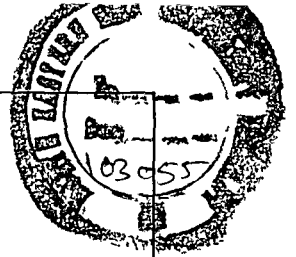
The most dominant drainage pattern of Mizoram may be described as the 'Trellis' type. In this type of pattern, secondary tributaries are commonly elongated parallel to the master stream and join the primary, tributary at right angle and the primary tributaries join the master stream orthogonally. Besides, the trellis type, the other type of drainage pattern, observed in the area is 'Dendritic' type. The dendritic type branching of tributaries is non-systematic or tree-like extended in many directions. In some places, the tributaries show parallel arrangement to the main stream but join the master streams at acute angles(4)

There are thirteen rivers which run through the state with a total length of 1393 Kms. The most important and useful rivers are the Dhaleswari, the Sonal and the Lujvawl which drained the northern area of the state and eventually join the river Barak. The southern area is drained by 'Kolodyne' (Chhimgtuipui) and its tributaries and the western area by Khawthlangtuipui which is its tributaries (Fig - 2.3).

GEOMORPHOLOGY

The terrain may be said to be quite immature in respect of recent tectonically elevated feature of high relief. The chief geomorphic elements include both structural and topographic

4. Report on Soil and Land capability, survey of Thingdawl Rural Development Block, Aizawl District, Mizoram, 1991, published by Soil Survey Organisation, Department of Agriculture, Mizoram, Aizawl, pp.4.



MIZORAM DRAINAGE SYSTEM

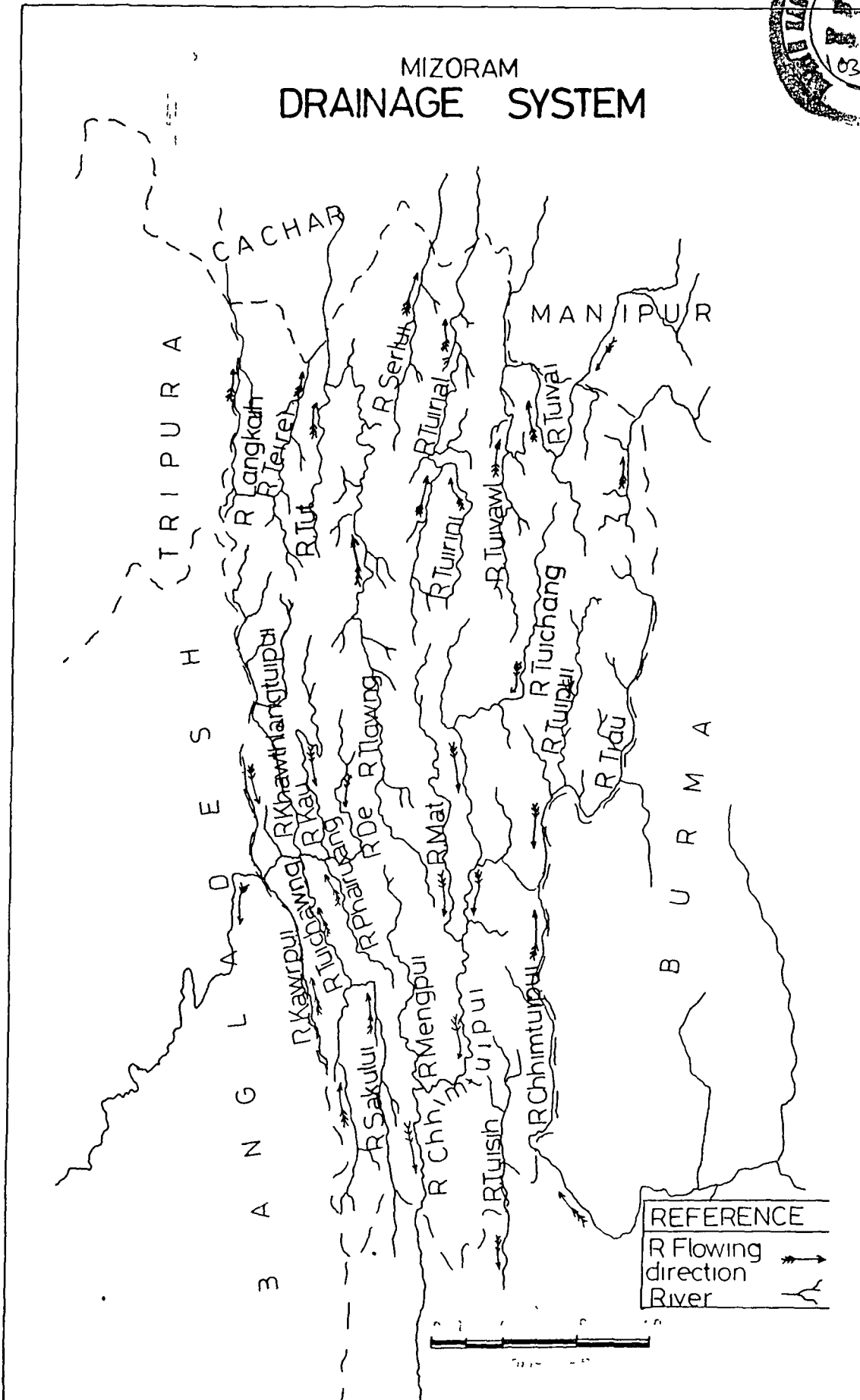


FIG. 23

'high' and 'low' depressions and slopes that are sculptured on the topography arranged in a more or less linear fashion. The topographic 'depressions' are in all cases, in accordance with the normal first order structural elements but the topographic 'high' constitutes both the structural 'high' and 'depressions' in the structural 'high'. Thus the various geomorphic features impart a physiography that is characterized by N-S trending steep, largely anticlinal hill ranges parallel to each other with intervening narrow synclinal valleys occasionally broken up by parallel low lying flat hummocks, the topographic, 'high'. In general, the anticlines are asymmetric with steep westerly limbs and gentle easterly limbs. The other geomorphic elements are highly dissected gorges and spurs which developed due to intensive erosion by down cutting river(5).

GEOLOGICAL STRUCTURE

Mizoram is made up of rocks belonging to the tertiary period, Surma group of Oligocene, Miocene age(6). The major structural trend coincides with the regional tectonic lineament. The general strike of the formation is N-S to N5 E/N. SW-55/55 E, with dips varying from 40 to 50 either towards west or east. Structurally, the rocks of the area lie on highly compressed asymmetrical anticlinal ridges and narrow valleys with the folds having parallel to sub-parallel sub-vertical axial planes. The fold axes show convergence in the direction of plunge, except in few cases where they are parallel(7).

-
5. Mizoram Jhum control Programme, Aibawk Block, Government of Mizoram, Aizawl 1992 A Report pp.2-3.
 6. op. cit.

Primary sedimentary structures recorded in the area are those that one comes across in flysch type of sequences, viz. graded bedding, flute casts, load casts, ridge structure, groove marks, ripple drift cross lamination of several types, flame structures, convoluteous laminations. The various structures may be correlated with sequence in analogous area.

SOILS

Soil of Mizoram have been derived from siltstones, shales and sandstones of the Surma group and the Barail group. The rock of Surma group are exposed in the western part of the state showing typical ridge and valley type of topography and trellis drainage pattern. The Barail group of rocks are exposed in the eastern part of the state, showing dendritic drainage pattern and denudational hills oriented in the different directions. Though very small in the total geographical area, Mizoram is endowed with a number of physiographic units viz. ridges, very steep side slopes, steep side slopes, straight slopes, flat lands, terraces and narrow valleys. The soils are, by and large, deep to very deep. The entire state enjoys cool temperate to sub-tropical type of climate. However, due to complexity of physiography, various micro-climates, prevail from the high elevation to low elevation. The foothills and the narrow valleys bordering Cachar district of Assam, with hot and monsoon rain, climate has the soil order of Entisols and Inceptisols whereas the hilly areas having cool and temperate climates with tropical wet evergreen to tropical semi -

7. Mizoram Jhum control programme, Aibawk Block. A report, Government of Mizoram, 1992, pp. 4-5.

evergreen forest and montane sub-tropical pine forest have the soil order of ultisols. Of these, the alluvial soils occurring in the valley irrespective of elevation, comprise the most fertile and productive soils of the state.

Soils which are developed on sandstone are usually coarse textured, deep and permeable while those derived from shales and siltstones are medium to heavy textured, moderately deep or shallow and are moderately to slowly permeable. Soils are non-calcareous, acidic and rich in organic carbon. The available potash is medium.

Soils of Mizoram may be described into the following broad groups:-

A. Cool and Temperate zone with Mountain sub-tropical Pine Vegetation: Hill ridges and steep side slopes.

Strong brown to yellowish brown soils derived mainly from non-calcareous hard sandstones. These soils are shallow to medium in depth, clay loam, acidic, rich in organic matter, but poor in phosphate and potash content.

B. Coal, Mountain Climate with Broad Leaved Deciduous Vegetation : Hill Side Slopes.

Brown to yellowish brown derived from sandstones, siltstones and shales. These soils are medium to deep, coarse to medium in texture. Strongly acidic, rich in organic matter but poor in available phosphorus and potassium.

C. Hot, Monsoon Rain Climate with Mixed Vegetation mostly bamboos: Undulating and Rolling Topography

These soils occur over the foot hills and are reddish brown to yellowish brown in colour. They are formed by the colluvial action as characterized by a layer of boulders underlying the sub-soils. These soils are usually medium in texture, moderately acidic and rich in organic carbon. The content of available phosphorus is medium to low while the content of available potassium is low.

D. Alluvial Soils

These comprise both old and recent alluvial soils which are formed by the fluvial action.

These soils are deep to very deep, silty clay loam, slightly acidic and rich in organic carbon content. Available phosphorus and potassium varies from medium to low. The soil colour ranges from very dark to yellowish brown. Surface drainage may be well-drained, moderately or impededly drained. This comprises the most fertile and productive soils of the state(8).

NATURAL VEGETATION

The vegetation of Mizoram can be broadly divided into three categories.

- 1) Tropical wet Evergreen Forest.
- 2) Tropical Semi-Evergreen Forest.
- 3) Montane sub-Tropical Forest.

8. Agricultural Guide Book of Mizoram, 1991 Published by the Department of Agriculture, Mizoram, pp.28-29.

The most important forest type is the tropical wet evergreen forest which is rich in timber with evergreen trees in the top canopy. Besides climate and soil, the altitude of the terrain plays a vital role in changing the nature of plants in quick succession. The usual practice of shifting cultivation has led to a severe degradation of forest and plant succession has been disturbed. On the basis of altitude, it may be said that the natural vegetation upto 800m altitude and below 800m altitude are of mixed semi-evergreen and evergreen type of vegetation.

CLIMATE

Mizoram has a cool and humid temperate climate over high hills, and warm humid sub-tropical climate in the low hills. It is influenced by the SW monsoon from May to October and the NE monsoon from November to April. The annual mean rainfall in the area is around 2650 mm. Precipitation is recorded in almost all the months but the distribution is not uniform. Mean monthly rainfall exceeds 200mm in almost seven months but there is a rather dry season from December to March. The number of rainy days in a year average 158 days in high to very high intensity. Frost appears during November and continues upto March. Relative humidity is high throughout the year but it reaches more than 90 per cent during the month of June, July, August and September. In high hills, the monthly mean average summer temperature is almost constant ranging between 21°C and 21.6°C and between 13°C and 19°C in winter whereas in low hills and valleys, the temperature fluctuates from 23°C to 28.3°C during summer and 18.6°C to 20.5°C in winter.

SOCIO-ECONOMIC CONDITIONS

Though the economic status varies from place to place and individual to individual, the general condition of the people is poor. The crop production per unit area is low and marketing facilities is also poor due to disruption in transport and communication.

The inhabitants of Mizoram mostly depend on jhum cultivation. The source of income other than agricultural products are forest products like timbers firewood and bamboo. However, people do not earn their living from these sources. A few of them live on private business, daily labour, carpentry and through government jobs.

The average per capita income has been found to be not more than Rs. 2000/-. This income is, however, found, to be not sufficient enough to maintain a living beyond subsistence level. Agriculture contributes nearly 72% of the total income. The sources like horticulture, animal husbandry, fishery, cottage industry and sales of minor produce are not significant. The income from each source is ranging from 0.5% to 1.7% of the income. The expenditure pattern on the other hand, indicates the annual per capita expenses.

Food items alone take lion's share of annual expenditure which is about 68% of the total. The next important item of expenditure is an education which has been reported to be 9.6%. The other significant items are clothing, luxuries and traveling expenses. Expenditure on liquor and beverages is found to be as

low as 1.3%.

The hilly terrain of Mizoram confined the agricultural practices to shifting cultivation except for the small patches of flat land where permanent field cultivation is carried on(9). Out of the geographical area of 21 lakhs hectares of Mizoram, the potential flat land available for Rice cultivation is around 50,000 hectares out of which 20,000 hectares is put under cultivation. The annual jhum area is 40,000 hectares(10). In jhum land, all the crops are grown together whereas the main crop is always paddy.

ADMINISTRATIVE DIVISIONS

For administrative purpose, Mizoram is divided into three districts of Aizawl, Lunglei and Chhimtuipui with district headquarters at Aizawl, Lunglei and Saiha respectively. Among these three districts, Aizawl has the largest area of 12,588 square kilometers and Lunglei district has an area of 3,957 square kilometers. Aizawl district is sub-divided into four sub-divisions namely Aizawl, Champhai, Kolasib and Mamit. Lunglei district is divided into two sub-divisions of Lunglei and Tlabung, while Chhimtuipui district has three sub-divisions of Saiha, Lawngtlai and Chawngte, thereby comprising nine sub-divisions (Fig 2.4).

9. Thangchungnunga: The Agricultural Profile in Mizoram, Journal of the North Eastern Council 1986, Vol.VII No.1-4 pp.15

10. Thansanga, R.: The Present Status of Food Crops and Oilseeds in Mizoram (1992-1993) Zoram Loneitu, Vol.36, Issue 1, Bi-Monthly Magazine, Jan-Feb. 1993. Organised by Dept. of Agriculture, Government of Mizoram, Aizawl, pp.52-56.

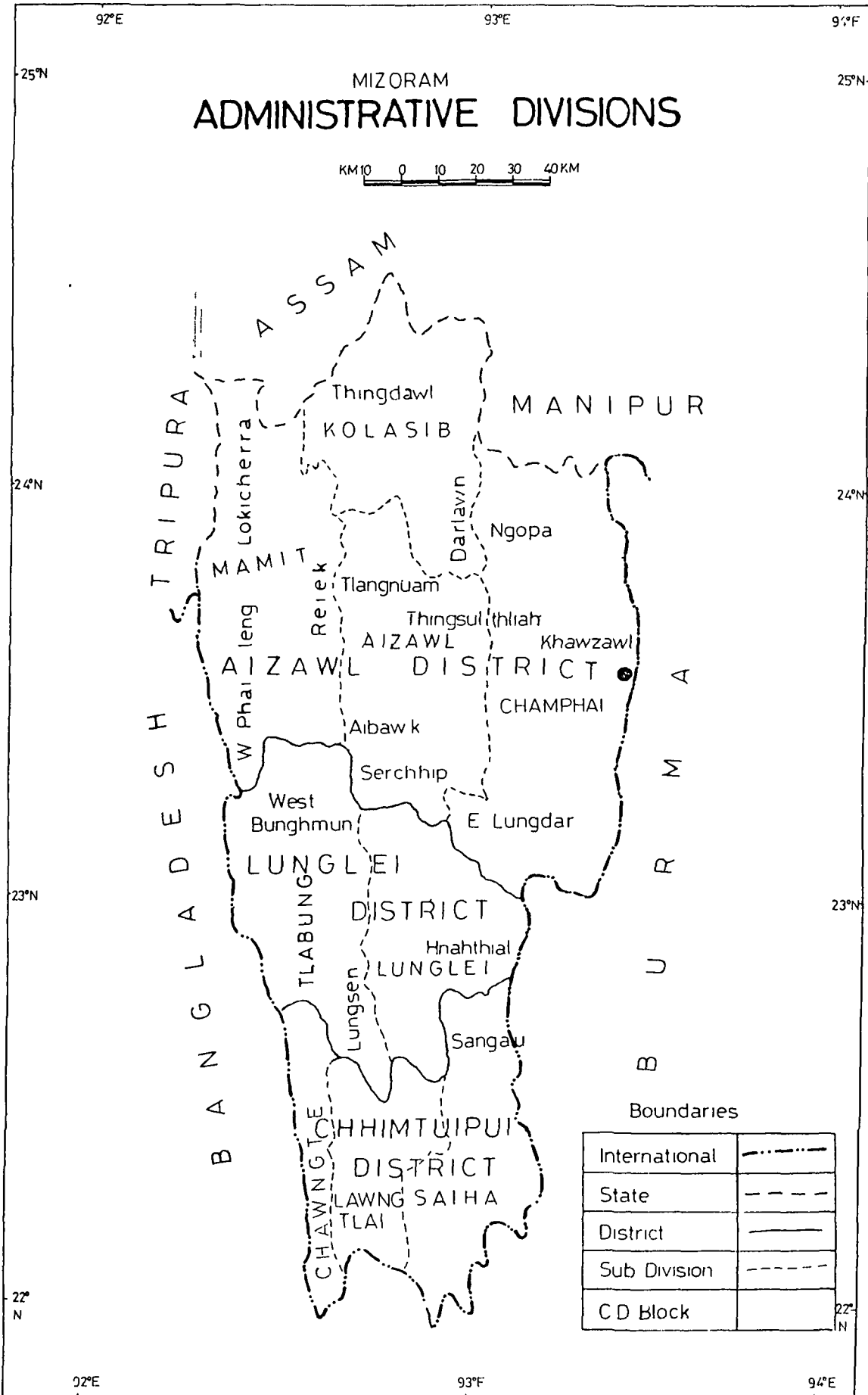


FIG. 2.4

For the smooth functioning of developmental operations, the region is further divided into twenty Community Development Blocks. They are - Lokicherra, West Phaileng, Reiek, Thingdawl, Darlawn, Tlangnuam, Aibawk, Serchhip, Thingsulthliah, Ngopa, Khawzawl, East Lungdar are within Aizawl districts and Chawngte, Lawngtlai, Sangau and Tuipang within Chhimituipui district and West Bunglei, Lungsen, Hnahthial and Lunglei within Lunglei district.

TRANSPORT AND COMMUNICATIONS

ROADS

Road characteristics include the surface conditions of roads, their width, number of lanes, gradients and sharpness of curves. These characteristics are of great significance as they limit or promote the frequency, speed and permissible load of motor vehicle.

Due to ruggedness of the land, the development of roads in Mizoram is of great difficulty. As a result of the north-south alignment of ranges, there is a wider scope constructing the roads in same direction while construction in the east-west direction is best with numerous obstacles. As such, there are number of blind curves, steep gradients and bridges along the roads running east-west direction (Fig 2.5).

The roads in Mizoram can broadly be classified into three types namely -

- 1) National Highway
- 2) State Highway and,
- 3) District roads.

MIZORAM ROAD NETWORK

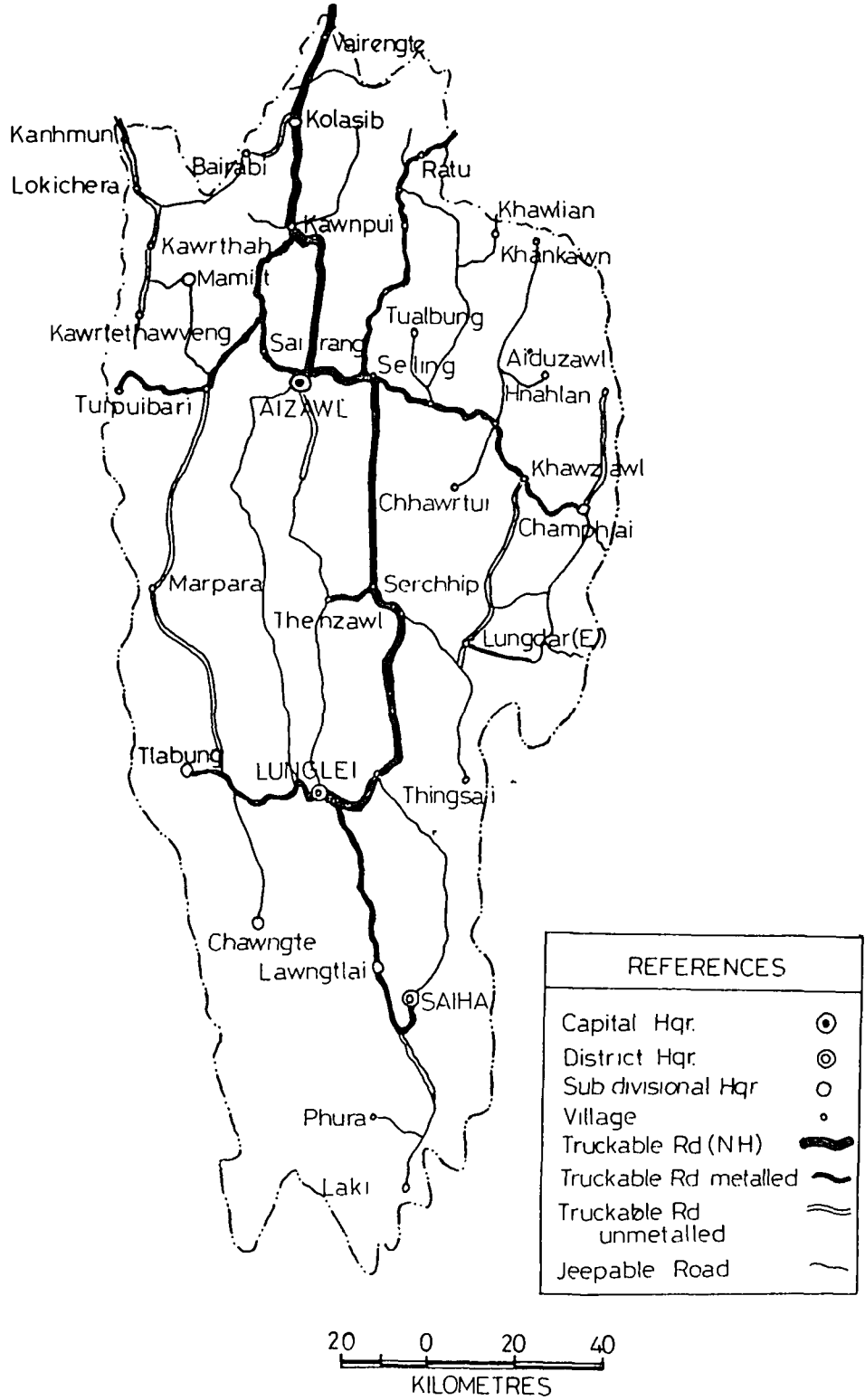


FIG. 2.5

1) National Highway: Mizoram is connected with only one National Highway i.e., National Highway No.54. This Highway connects Silchar(Assam) with Tuipang in the southern corner of the state through Aizawl and Lunglei. The total length spans 572 kms but Mizoram portion is 521.70. The Highway is the most important road at present which facilitates transportation within the state and with the adjoining district of Assam.

2) State Highway: The state Highway is all weathered, motorable metalled road. Important road under this classification in Mizoram are:-

- a) Seling-Champhai road(150 Kms)
- b) Seling-Tippaimukh road (139 Kms)
- c) Sairang-Tuipuibari road (134 Kms)
- d) Lunglei-Tlabung road (88 Kms)
- e) Serchhip-Thenzawl road(34 Kms)

3) District Road: There are numerous district roads in the state. Some of the important lines are - Kanmun-Kawrtethawveng, Khawzawl-East Lungdar, Aizawl-Lunglei via Thenzawl, W.Phaileng-Tlabung via Marpara, Kolasib-Zamuang, Daplui-Tuidam, Kawnpui-N.Hlimen, Saitual-Ratu, Champhai-N.Vanlaiphai, Tlabung-Chawngte, Keitum-Thingsai.

RAILWAY: Mizoram is isolated from the rail network of the country and is served by the railheads at Silchar. The Government of India has completed an extension of meter gauge line from Lalabazar (Assam) to Bairabi (Mizoram), a distance of 48.76 Kms with a view to integrate this remotely situated state with the rest of India by providing cheap reliable and efficient system of communication.

AIRWAYS: Like other aspects of economic infrastructure, the state of Mizoram has a long way to go in the field of air transport. Till now, it has only one mini airfield which lies in the valley of Tuirial river. At present, the airfield is engaged by Vayudoot connecting Aizawl with Silchar-Guwahati-Calcutta with airlinks.

INLAND WATER TRANSPORT : The inland water transport has not been developed though it played an important role in Mizoram. Only the rivers Tlawng, Tuirial and Khawthlangtuipui are navigable throughout the year.

POPULATION CHARACTERISTICS

The population of Mizoram in 1991 stood at 686,217 consisting of 356,672 males and 329,545 females. A growth rate of 38.98% has been registered during the decade 1981-91, whereas the decennial growth rate registered during the decade 1971-81 was 48.55%. Therefore, there has been a significant drop in growth rate of population in Mizoram.

The density of population in 1991 is only 33 persons per square kilometer. Therefore, in 1991, 10 more persons have found to be living per square kilometer than the number found to be living in 1981.

The following table gives the district wise density of population figures for 1971 to 1991 census.

Table - 2.1

**District wise growth rates of population for 1971-81 and 1981-91
for males and Females, Mizoram**

State/ District	1971-81			1981-91		
	Persons	Males	Females	Persons	Males	Females
1	2	3	4	5	6	7
Mizoram	48.55	50.59	46.39	38.98	38.65	39.33
Aizawl	48.76	51.41	46.02	39.47	39.84	39.07
Lunglei	39.23	36.35	42.65	28.55	26.59	30.77
Chhimituipui	61.44	69.18	53.61	50.03	48.51	51.71

Source : Census of India 1991, Provisional population Totals.
Mizoram, Series 17, Paper 1 of 1991 supplement.

Table - 2.2

District-wise Density of Population, Mizoram : 1971-91

State/District	Density of Population		
	1971	1981	1991
Mizoram	14	23	33
Aizawl	18	27	38
Lunglei	14	19	25
Chhimituipui	10	17	25

Source : Census of India, 1991 Provisional Population totals,
Mizoram, Series 17, Paper 1 of 1991, Supplement.

It will be clear from the above table that Aizawl District has maintained a higher density of population than the state figure in all the three censuses. Though Lunglei district ranked second in both 1971 and 1981 censuses, in 1991 census, both Lunglei and Chhimituipui districts have on the average 25 persons per square kilometer.

There were 924 females per 1000 males in Mizoram in 1991 which was 5 more than the number of females found exactly 10 years ago. The sex ratio was above national average till 1971 but in 1981 and 1991 the ratios went below the national average.

The following table gives the sex-ratio for each district from 1971-1991.

Table - 2.3

District-wide Sex Ratio in Mizoram 1971-1991
Females per 1000 males

State/District	Sex Ratio		
	1971	1981	1991
Mizoram	946	919	924
Aizawl	968	934	929
Lunglei	842	881	910
Chhimituipui	989	898	917

Source : Census of India 1991, Provisional Population Total, s Mizoram, Series 17, Paper 1 of 1991 Supplement.

Mizoram ranked third with a literacy rate of 74.26% in 1991 and has the second highest literacy rate of 81.23% in the country in 1991.

Table 2.4

Literacy Rates in Mizoram 1981-1991

Year	Persons	Males	Females	Gap between Male & Female.
1981	74.26	79.37	68.60	10.77
1991	81.23	84.06	78.09	5.97

Source: Census of India 1991, Provisional Population Totals, Mizoram Series 17, Paper 1 of 1991, supplement.

From the above table, it can be stated that female literacy has grown at much faster pace than male literacy. The gap between male and female literacy also bears out this fact.

Out of 6,86,217 persons in Mizoram, about 3,69,177 live in rural areas, and 3,17,040 in urban areas which indicates that 53.80% of the population of Mizoram live in rural areas and the rest 46.20% live in urban areas.

Table 2.5

**Proportions of main workers to total population: Mizoram
1971-1991**

Year	Percentage of main workers to total population.		
	Persons	Males	Females.
1971	45.61%	51.43	39.46
1981	41.73	50.39	32.32
1991	42.20	49.56	34.43

Source: Census of India 1991, Provisional Population Totals, Mizoram Series 17, Paper 1 of 1991, Supplement.

In 1991, the total workers in Mizoram has increased by 3.92 percentage points from the 1981 level of 45.44% of while the increase in proportion of main workers was only by 0.56percentage points. The proportion of marginal workers increase from 3.71 percent in 1981 to 7.07 per cent in 1991.

The following table gives the percentage of total workers, main workers and marginal workers to total population for Mizoram for 1981 and 1991.

Table - 2.6

Percentage of total workers, main workers and marginal workers to total population by Sex, Mizoram, 1981-1991

	Total workers		Main workers		Marginal workers.	
	1981	1991	1981	1991	1981	1991
Persons	45.44	49.36	41.73	42.29	3.71	7.07
Males	52.54	54.37	50.39	49.56	2.15	4.81
Females	37.72	43.94	32.32	34.43	5.40	9.51

Source : Census of India 1991 Provisional Population Totals, Mizoram, Series 17, Paper 1 of 1991, Supplement.

The main workers have been categorized into four groups namely - cultivators, agricultural labourers, workers in household industry and other workers. The proportion of cultivators among the main workers in Mizoram has declined significantly since 1971, whereas in 1971, 83.53 percent of workers were engaged as cultivators in 1991, the corresponding figure has declined to 60.89%. In 1981, cultivators constituted 70.63% of total main workers. The proportion of workers in all other categories have shown definite upward trends. It is encouraging to find that the proportion of workers in the category of non-agricultural work in Mizoram has shown significant increase. The rising trend of working population generally in non-agricultural sector seems to reflect the diversification of economic activity in the state.

Table - 2.7

Percentage of main workers in cultivation, agricultural labour, household industry and other work to total main workers for Mizoram: 1971-1991

Categories	1971	1981	1991
Cultivators	83.53	70.63	60.89
Agricultural Labourers	0.37	2.49	3.73
Household Industries	0.32	0.85	1.25
Other Workers	15.78	26.63	34.13

Source: Census of India 1991 Provisional Population totals, Mizoram, Series 17, Paper 1 of 1991 Supplement.

CHAPTER 3

ENVIRONMENTAL FACTORS INFLUENCING PADDY CULTIVATION

Rice has a wide physiological adaptability and is grown successfully in tropics, sub-tropics and temperate regions, from below the sea-level to 2000 metres above the sea level. There is a wide spectrum of varieties cultivated with differential response to climatic factors such as temperature, rainfall and day length, with a wide range of adaptability to different soil conditions and different physiographic factors such as high lands, valleys and low lands which may be inundated from a few centimeters to 5-6 meters for various periods of crop growth(1).

TEMPERATURE

It was found that the temperature had a favorable and in some cases unfavorable influence on the development, growth and yield of rice. Thus, when the seed is germinating and is in the seedling stage, with its growing point till under water, the temperature of water is important. Later, after the appearance of the growing point and the vegetative parts of the plant above the level of water, both the day and night temperature of the air appear to play an important role in many of the varieties. Rice requires a fairly high temperature ranging from 20^o C to 40^o C. The optimum temperature appears to be in the neighborhood of 30^o C for the day time maximal and 20^o C for the night time minimal.

-
1. Sreenivasan : Agroclimatology of Rice in India Rice Research in India, Publications and Information Division, ICAR, New Delhi, October 1985 pp.213

Low temperature depresses the rate of germination and prolongs it beyond the desirable spans of 6 days. In some varieties, this phenomenon manifests even at a low temperature of 13^o C and the time taken may be 10 days or longer. During the growth of the seedling, low temperature may promote faster root development and better penetration, but less proliferation. The photosynthetic activities go on in some seedlings even at a low temperature of 5^o C. The germination rate is inhibited by low temperature, but the period of germination is prolonged, resulting in more tillers and more panicles than at higher temperature. Low temperature depresses the internodal elongation and may result in the partial emergence of panicles, all of which result in a low rate of photosynthesis and partial sterility, but the low temperature during the ripening phase prolongs the period of ripening and helps to maintain the green leaves, all of which contributed to the accumulation of carbohydrates in the grain. It has been noticed that the low temperature during the final ripening stage leads to an excessive shattering of grain during harvesting and transportation, resulting in high losses.

A high temperature of 35^o C or more, often shows many of the effects of low temperature, although the biochemical reactions are very different. Germination is halted because of high respiration rate. The pollen germination at the time of fertilization is slow. At the ripening period, high temperature increases the thickness of bran.

If the temperature is near the optimum, as is the case in the humid tropics, the yield appears to be proportional to the

temperature, but this is only apparently so, as both yield and temperature are influenced in the same direction by the intensity of solar radiation. It is apparent that the interaction of photo period, water temperature and day and night temperatures on the development of rice at different phytophases is a complex one(2).

The low temperature prevailing in Mizoram during winter months not only limit the growing season but also leads to other problems such as longer growing period in early planted crop, grain sterility and non flowering in late planted crops.

SOLAR RADIATION

Sunlight is the source of energy for plant life and the effect of solar radiation differs with the phytophases. In general, solar radiation has a profound influence on the yield of rice particularly during the last 35 to 45 days of the ripening period. When water temperature and nitrogenous nutrients are not the limiting factors, the effect of solar radiation is more profound. The response to solar radiation is a varietal character.

In general, low temperature accompanied with bright sunshine during the ripening period are highly desirable in the development of carbohydrates during this critical period. Since the upland rice is grown during the rainy season, solar radiation is often found to be the limiting and deciding factor in the production of grains. The duration of light or day length affects

2. Sreenivasan: Agroclimatology of Rice in India, Rice Research in India, Publications and Information Division, ICAR, New Delhi, October, 1985, pp 214.

the maturity of the photosensitive varieties. In the case of irrigated paddy, it is possible to manipulate the date of transplanting, thereby synchronizing the ripening period with the period of high solar radiation. Thus, it has been possible to develop mathematical models from the intensity of solar radiation as the main factor for calculating the potential rice yield(3).

It remains cloudy on most of the days. Number of sunshine hours per day on year basis may not be more than three to four. This may be one of the major factors limiting the growing and ripening period and productivity in Mizoram

WIND

Light wind helps to stir the air within the crop and to transport carbon dioxide to the leaf canopy. Strong winds at the time of the opening of flowers may induce sterility and increase the number of abortive endosperms. Also strong winds during the ripening period lead to the shedding of leaves, serious lodging and the shattering of grains and is known to be followed by epidemics of bacterial blight(4).

RELATIVE HUMIDITY

Paddy which is cultivated in standing water builds up an environment with high relative humidity. Such high humidity is often favorable to the development and spread of many fungal and bacterial diseases. It is also responsible for a great deal of

3. op.cit. pp.214.

4. op.cit.

spoilage of grains. For prolonged storage, the moisture content of the grains should be reduced to 13 percent and to 11 percent for optimum milling. Hence, it is desirable that rice crop is grown in such a way that it will be possible for drying it in the sun immediately after harvesting(5).

RAINFALL

Rainfall is the most important climatic factors as it determines the potential of any region in terms of crops to be raised, farming systems to be adopted, the nature and sequence followed and target to be achieved in agricultural productivity.

Uncertainty of rainfall effects the paddy cultivation in Mizoram because the cultivators are very much depending on the rainfall for cultivation of paddy and other crops. Monsoon is of immense importance for the cultivators because they practice dry farming which depends on the natural rain which comes from monsoon. Rice is the mainstay of the people and largely depends on the timely arrival of the monsoon. Some years due to untimely arrival of monsoon the paddy crops die out due to drought. So, the agriculture is in the hand of monsoon rain. The late monsoon arrival means failure in the crop production.

SOIL

Rice crops required an adequate and balanced amount of different plant nutrients. For better production of rice, the following four are considered as general requisites and a soil

5. op.cit. pp.215.

having these is considered most suitable for rice production.

- 1) At least a perched water table, if there is no high water table reaching almost the soil surface, but there is need in any case for a slowly flowing or percolating water in the root zone.
- 2) The soil should have on the surface a water stable lamina structure and in the sub-soil at the root zone, a water stable particle (single grain) structure which can persist during the period of root growth of the rice crop under water-logged conditions.
- 3) There should be moderate supplies of available iron and manganese in the soil and also a organic matter if green manuring is not practiced in the region.
- 4) The soil in the root zone should have an adequate proportion of hexosamine fraction among the forms of soil nitrogen(6).

The soils of Mizoram on which rice is grown are so extraordinarily varied that there is hardly any type of soils on which it cannot be grown with some degree of success. It is, however, necessary that the deficiencies of the various soils are identified and made up to increase their productivity.

AVERAGE SLOPE

Average slope of an area is the most important controlling factor for agriculture. Concave and gentle slopes, alluvial fans, tillage fans, and river flat terraces have comparatively deeper soil deposits and they provide most suitable sites for agricultural field terracing. Concave slopes are either made gentle by back-breaking human labour or are avoided. Steep scarp slopes are generally avoided for agricultural practices.

-
6. Ramamoorthy, B., Murthy, R.S. and Shinde, J.E. : Soils, their classification and Agro-chemical characteristics Rice Research in India, Publications and Information Division, ICAR, New Delhi, 1985, pp.241-242.

Successful cultivation is possible only on reasonably level ground. In sloping terrain, such level land has been found by terracing. If the slopes were gentle, the terrace could be wider with the same amount of labour. Even a slope of $2\frac{0}{10} - 3\frac{0}{10}$ makes terracing inevitable particularly for the cultivation of transplanted paddy which requires level ground in which water should stay.

It is clear that the lesser slopes support wet rice, hill terrace and other cash crops whereas the steep slopes do not favour the development of agriculture. The highly dissected terrains, the deep narrow valleys and scarps are the main factors which control the types and patterns of agricultural land use.

RELIEF

Topography effects cultivation and limits in several manners. First, the alternate distribution of valley and spur, it creates an interlocking of contrasted climates. Secondly, the contrast of level land and slope so steep as to be prohibitive for field cultivation is a matter of great significance. An obvious limit to the amount of production land in hilly region is the degree of slope. Nothing is more valued in hilly region than level land.

Water supply or irrigation is very much influenced by the form of land. The amount of ground moisture varies indirectly with the degree of slope. Low gradient ensures slow discharge and the effect of steep slope is to wash away the flowing water by quick run off. Dissected terrain is, a great impediment in the

provision of irrigation to agriculture. In very dissected terrain, there is no extensive area with gentle gradient to facilitate the construction of long irrigation canals. Much of the topography is dissected into isolated hills. These hills are separated by deep narrow valleys. Thus, these isolated hills have limited land for cultivation(7).

Agricultural practices takes place in catchment area of the rivers and streams. The common feature is rugged topography with narrow valleys and as a result, a sizable percentage of land is not under cultivation. It is very difficult and at the same time very costly to convert these rugged terrains into agricultural land.

7. Rinawma, P. :; Geomorphology and Agricultural Development in Lunglei District, Mizoram - A thesis submitted for the award of the degree of Doctor of Philosophy in Geography, NEHU, Shillong, 1986 (Unpublished) pp. 207-233.

CHAPTER 4

PHYSICAL ENVIRONMENT AND PADDY CULTIVATION

Physical environment may be defined as the integrated study of geology, topography, climate, soil and vegetation. Man's relation with his physical environment is a complex one. Man has a great role in changing the face of the landscape; as such we have to understand also the degree to which the physical environment has shaped the way of his life. It becomes necessary to view thoroughly the nature of physical framework in reference to location, géology, topography, climate, soil and vegetation cover and the related phenomena in spatial context(1).

Rice has a wide physiological adaptability and is grown successfully in tropics, sub-tropics and temperate regions, from below the sea-level to 2000 meters above the sea level. There is a wide spectrum of varieties cultivated with differential response to climatic factors. Temperature, rainfall and day length with a wide range of adaptability to different soil conditions and different physiographical factors such as high lands, valleys and low lands which may be inundated from a few centimeters to 5 to 6 meters for various periods of crop growth(2).

The present chapter deals with the influence of environment on the cropping system and cropping pattern, land use patterns,

-
1. Jordan, T.G. : The European culture Area -A systematic Geography, New York, Harper and Row, 1971, Chap.2, pp.325 - 326.
 2. Sreenivasan: Agro climatology of Rice in India -Rice Research in India ICAR, New Delhi 1985 pp 213-18

production and yield of rice in Champhai region.

ENVIRONMENT AND CROPPING PATTERN

It is a matter of common knowledge that the annual production from the given area of land could be increased either by improving the yield of a crop or by growing an extra crop during the year. Cropping systems provide the technology that will help increase production by both these methods(3).

The major systems of cultivation are followed in Champhai region. Jhuming is prevalent which is done on hill slopes after cutting and burning the forest. The land is abandoned for few years after two to three years of cultivation. Under settled form of cultivation, there is valley land cultivation and terrace cultivation. In Champhai valley, rice covers all the cultivated area because the transplanted paddy can be grown successfully. The terrace cultivation covers a very limited area on milder slopes on which a mixed crop is taken for home consumption and for local market.

The present study area is still monocropped and rain-fed. Double cropping is possible wherever irrigation facilities are available as there are practically no winter rain. Rice is the most important crop in this region and covers the major cultivated area. Mixed cropping with rice as a principal crop is quite common on jhum lands which are generally monocropped. The

3. Patel, C.S.: Rice Based cropping systems and their fertilizer Management paper presented in State Level Subject Matter Training-cum Discussion Seminar on Rice Production. Technology, 8-12 Sept. 1989 organised by Division of Agronomy, ICAR, Research Complex for NEH Region, Shillong- 793 004.

valley land is most suitable for rice cultivation and rice is the single crop grown throughout the year.

The cropping systems in this area are mainly depended upon the altitude, climatic conditions and food habits. The soils and agro-climatic conditions mostly affect the choice of the crops in these cropping systems. Rice is the main crop of the area and is grown from valley to hill tops. Maize, pulses and oilseeds are the next important crops. The crops are essentially grown as rainfed and very much depending the monsoon rhythm. The major constraints that limits crop yields are lack of appropriate variety for higher altitude, moisture stress during germination and at reproductive phases, weed infestation, poor soil fertility and incidence of pest which were adversely affected by environmental factors.

Difference in altitude is quite marked This effects the temperature moisture and fertility status and also the system of cultivation. The altitude of Champhai is ranging between 1287 to 1678.05 m.(4). It is evidence that in higher altitude, the terrace, the jhum system of cultivation were practiced. Mixed cropping is taken with rice as the principal crop whereas the lower altitude i.e., the valley land were covered by wet rice cultivation due to the suitable topographical conditions.

Most of the soils are poor in fertility There is lot of soil nutrient loss due to the hills/slopes. Valley is comparatively more fertile. Soils on the hills are generally

4 Agricultural Guide book of Mizoram, 1991, Department of Agriculture, Mizoram.

porous resulting in lot of leaching. So, when the crop is taken in the second year in the high lands, the fertility is reduced. Thus, it would appear that in high lands, jhum cultivation is a must due to the reduction of soil fertility. As valley is more fertile than that of hilly areas, the settled form of cultivation is practiced.

To achieve desired level of crop productivity, fertilizer and proper farm management is very important. It would be clear that soil acidity followed by P and K deficiencies are the major constraints for successful crop production. Application of market lime equivalent to 25% lime requirement would increase the crop yield markedly. In wetland rice culture, 50%N should be applied - through organic or bio-fertilizers and 50% N through inorganic sources(5).

ROLE OF ENVIRONMENT IN CULTIVATION SYSTEM

Wet paddy cultivation is quite distinct in Champhai valley. Since paddy cultivation is very much conditioned by the rainfall rhythm, farmers have to get their fields ready before the commencement of the rainy season. Bunds or ridges that separate one field from the other have to be constructed, usually with compact mud, and any broken bunds have to be repaired, usually by hand. The weeds are cleared and the inundated ground is ploughed by weeders to a depth of a few inches. A wooden ribbed roller is

-
5. Munda, G.C. : Important Packages For Rice Cultivation A paper presented in State level subject matter Training cum Discussion Seminar on Rice Production Technology, 8-12 Sept. 1989 organised by Division of Agronomy ICAR Research Complex For NEH Region, Shillong - 793 004 pp.63-64.

then used to break up any soil clumps and a wooden rake with rows of teeth is employment to bury any remaining weeds under the soft mud. Manures and fertilizers are added to the soil. The field is then ready for receiving young seedlings from the nursery.

The preparation of the field for transplanting rice in this area is greatly influenced by the behaviour of south-west monsoon. Raising of nursery and transplanting of rice to the field is also very much dependent on rainfall. If the monsoon fails, the result is decrease in rice production. Raising of seedlings is mainly done in the month of May or June when the monsoon started and transplant after about 30 days. The length of raising seedlings is also influenced at a considerable degree by temperature and moisture and rainfall of the area. Yet the time of transplanting influences the number of panicles, percentage of sterility etc.

After transplanting, the young seedlings are allowed to grow for about 4 to 5 months till harvesting time. Meanwhile, some care is given to the field, such as occasional weeding and thinning out the more crowded patches. In Champhai paddy field, the increase of the water level during the growing period coincides with the rainy season. If the amount of water in the fields falls short of requirement due to the less rainfall, adjustments are made by fetching water from the main river to obtain the desired level. The fields are drained dry just before the crop is harvested. The crop is harvested in the month of October and November when there is practically no rain.

In the hilly areas, the method of shifting cultivation is widely practiced which is in the hand of monsoon rain. The clearing of forest is done during the dry season and the cleared growth is allowed to dry on the fields. The dried growth as well as the trees standing in the clearance are set on fire in the month of March. The ashes are scattered over the ground and dibbling and broadcasting of seeds begin in March before the advent of pre-monsoon rain. At the advent of rains, the seeds begin to sprout. After sowing the crop, farmer pays attention to the crop and remove weeds from the field. The harvesting is done mainly during the dry winter season.

Thus, it is clear that the cultivators are very much depending on the rainfall for cultivation of jhum paddy and other crops. Monsoon is of immense importance for the cultivators because they practice dry farming which depends on the natural rain which comes from monsoon. The jhum is largely depended on the timely arrival of the monsoon. Some years due to untimely arrival of monsoon, the paddy crops die out due to drought. The late monsoon arrival means failure in the foodgrains production on which people are depended.

ENVIRONMENT AND RICE VARIETIES

Variety is the first requirement for achieving higher yield of rice. Selection of variety depends upon the agro-climatic situation of the region where its cultivation is to be done. One variety may not perform well even in the same region because of variation like temperature, altitude etc. The present status of

varieties found suitable for the study area are the traditional and local varieties such as Manipur, Buhsar, Vuitawia, Lalenga, Robuaia, Ralleng buh and Sanghnuni. Although varieties mentioned above satisfy most of the requirement, yet it is to be remembered that there is a great scope for improvement.

The varieties adapted to upland culture are usually medium tall to tall, with long pale green leaves, low to medium tillering, long and well exerted panicles and with a maturity period of 100-135 days. Most of the upland varieties have fair to good degree of drought tolerance(6).

Cultivation under lowland conditions, semi-dwarf to intermediate varieties with moderate to high tillering, stiff and erect culm, with erect leaves, resistance to blast and bacterial blight are needed. Since, high input technology is viable under lowland, it is necessary that the varieties are fertilizer responsive(7).

There are many factors which determine crop yield and variety is one of them. Varietal requirement itself would depend upon a number of environmental factors such as climatic conditions, soil conditions, altitude and topography. All these environmental factors may be beyond man's control, but development of suitable varieties can to a large extent, help

6. Abraham, M. J. : Rice Varieties for NEH Region - Needs and Improvement : A paper presented in State level Subject matter Training cum Discussion Seminar on Rice Production Technology 8-12 Sept. 1989. Organised by Division of Agronomy, ICAR Research Complex For NEH Region, Shillong - 793 004 pp.61.

7. op. cit. pp.62

overcome some of the yield constraints. The major considerations of environmental factors which would go to determine the varietal requirements in Champhai area as follows:

Rainfall

Champhai area is considered as high rainfall area. It is concentrated mostly from June to September when the monsoon is most active. The winter months are almost dry. The rainfall drops to 200mm to 300mm during October to December. During January to February, the area has only 25mm to 100mm rainfall. From March to May, the rainfall may vary from 400mm to 700mm. There may be crucial variation from year to year affecting the proper growth of crop plants. Although the total rainfall during the year may be sufficient, but its proper distribution and utilization is lacking. Many soils have less water retention capacity and so rains during November to April are insufficient to be effectively used by the plants. Even during the monsoon period, there may be small periods of drought causing temporary wilting of crops. The rainfall pattern and intensity affects the choice of varieties. The local and traditional varieties grown in Champhai area are varieties having growth periods suitable to rainfall pattern and varieties which may withstand temporary moisture scarcity in monsoon season.

Temperature

The average mean temperature during winter months ranges between 10-15 °C during summer months, the mean temperature may range from 23-26 °C. Frost is experienced in the area in winter.

Considering these points, it will be necessary to develop cold tolerant varieties for the area. Although snowfall is not there, it will be desirable if the varieties passes thermo-insensitivity to sudden variations in temperature within short periods. Cold tolerance is important especially at mid and higher hills. Cold tolerance may be required at Vegetative and reproductive stage depending upon the situation and sowing and flowering time etc.

Sunshine

It remains cloudy on most of the days. Number of sunshine hours per day on year basis may not be more than three to four. This may be one of the major factors limiting productivity in the region. Therefore, it will be necessary to develop photo-insensitive varieties with a high degree of photosynthetic efficiency.

Humidity

The humidity in the atmosphere remains high and varies from about 50 to 100% during the year. Seed dormancy would be required for 20-30 days in almost all the crops so that seeds in the freshly matured crop may not germinate in the field itself before they are harvested and dried. There may be genetic differences between varieties, which may be exploited to face the problems, although development of proper storage facilities to necessary.

Wind velocity

Lodging due to wind velocity is a problem in the area particularly on hill slopes. Dwarf varieties with stronger stem

may be desirable.

SOIL CONDITIONS

Most of the soils are poor in fertility. There is lot of soil and nutrient loss from the hills. Valley is comparatively more fertile. Soils on the hills are generally porous resulting in lot of leaching. In general soils are acidic with PH ranging from 4-5.5. Among the important nutrients, lacking are nitrogen, phosphorus, potash, zinc, boron, molybdenum, calcium, magnesium etc. Soil organic matter is also lacking especially on hills. Many soils also present problems of toxicity to iron and aluminum while it is possible to improve these soils through better management and application of manures, fertilizers and lime etc. It may not be possible to cover the whole area. As the area is generally backward, varieties suitable for low and medium fertility levels would be required. However, for valley lands, varieties which would respond favourably to high fertility condition would have to be bred.

The cultivated areas of Champhai area situated at varying altitude of 1287 to 1678.05m above mean sea level and varying slopes of zero to more than 100 per cent. The altitude mainly effect the temperature, but two areas with similar altitude need not necessarily have similar varietal requirement because of differences in agro-climatic factors and micro-environment which might occur. Differences in altitude may also affect the occurrence of pest and diseases. Differences in topography are also quite mark in the area. This effects the moisture and

fertility status and also the system of cultivation. It is, therefore, necessary to identify crops and develop varieties suitable for different altitudes and topographical conditions.

ENVIRONMENT AND AREA, PRODUCTION AND YIELD OF PADDY

The environmental factors have influenced the trend of rice production in the study area. In Champhai, rainfall, humidity, temperature and sunshine hours played important roles in limiting rice production. High rainfall and humidity favour the incidence of pests and diseases as well as create problems in harvesting, drying, threshing and storing. The climate is also favorable for prolific growth of weeds. The rainfall and cloudy sky reduce the total sunshine hour so essential for higher yields. Low light intensity prevailing during winter months not only limit the growing season but also leads to other problems such as longer growing period in early planted crop, grain sterility and non-flowering in late planted crops.

AREA UNDER PADDY

There has been a considerable increase in the area under paddy during the period 1980-81 to 1990-91 in Mizoram being slightly less than twice. It increase from 29 thousand hectares in 1980-81 to 51.3 thousand hectares in 1990-91. The area under paddy showed persistent upward movement extending over a span of 10 years. However, the area under paddy increased at the growth rate of 8 per cent per annum and this growth rate was highly significant.

Table - 4.1

DISTRICT-WISE AREA UNDER PADDY, MIZORAM
(Area in Hectare)

Year	Aizawl west	Aizawl East	Kolasib	Lunglei	Chhimituipui	Total
1990-91	9229	16505	11650	7272	6667	51325
1991-92	10285	16819	13150	8489	6896	55639
1992-93	10642	17429	16025	9441	7760	61297

Source : Directorate of Agriculture, Government of Mizoram.

The above table indicates that the area under paddy increase from 51323 hectares in 1990-91 to 61292 hectares in 1992-93. The over all growth rate of area under paddy is quite significant in Mizoram. The increase in area under paddy has been made possible mainly due to the change in psycho-cultural behaviour of the people towards the socio-economic problems faced by the country.

The district-wise distribution of area under paddy shows that the Aizawl East district has always the largest area under paddy and the growth rate is also quite significant. Lunglei and Chhimituipui districts have the lowest area under paddy but the increase of the area is tremendous. The growth rate is higher than that of the other districts.

The distribution of area under rice in different districts is greatly influenced by a set of physical environmental factors as well as socio-economic factor. Though the climatic factor also played a vital role, the topographic factors are far more important in this respect. The district of Aizawl East have have the largest area due to the availability of flat land. The

presence of Champhai valley and N.Vanlaiphai greatly contributed. It is possible to increase the area in the flat land areas and cropped more than once while in the hilly areas, the increase of area is possible but the introduction of multiple cropping is impossible due to the absence of irrigation facilities for upland. The climatic conditions and soil characteristics of Mizoram are suitable for rice cultivation. The factors which control paddy cultivation is physical features. The south and western parts of Mizoram were dominated by both jhum and wet paddy cultivation and the hill slopes were milder than those of the north-eastern parts. Wherever the cultivation is possible, jhum covered more lands due to the limited areas of flat land. The rugged terrain, narrow valleys and scarps greatly effect the extension of the area under cultivation. The rugged terrain were left uncultivated due to their difficulties to change into cultivable land. Almost all the narrow valleys which were drained by a small streams and its catchment areas were cultivated. These narrow valleys were comparatively more fertile than the hilly areas.

The Champhai valley is drained by Tuipui river which is the tributary of Khawchhak Tuipui. This valley occupies 1513 hectares of land and wet paddy cultivation is carried on.

Champhai has the largest flat land areas where permanent cultivation occupied 1513 hectares of land and account for 2.47 per cent of the states total area under paddy. The area under paddy in Champhai valley is increasing from 904.7 hectares in 1990-91 to 1513 hectares in 1992-93 (Table 4.2). The increase is

possible mainly due to the availability of flat land which were left uncultivated and fallow land were cultivated to increase production.

Table - 4.2

AREA UNDER PADDY IN CHAMPHAI
(Area in Hectare)

Name of crops	1990-91	1991-92	1992-93
Jhum paddy	703	698	763
WRC	151.7	670	690
HYV	50	50	60
Total	904.7	1418	1513

Source : DAO, Aizawl East, Govt. of Mizoram.

From the above table, it is very clear that jhum paddy occupied the largest area since jhum cultivation is prevalent in Champhai area. The area under jhum paddy decreased from 703 hectare in 1990-91 to 698 hectare in 1991-92 and increased again to 763 hectare in 1992-93. The area under wet Rice cultivation is also increasing from 151.7 hectares in 1990-1991 to 690 hectares in 1992-93. There is a good scope for increasing the area under wet rice cultivation. The flat land areas of Champhai occupied a little over 760.6 hectares of land. In 1992-93, the total cultivated area is 690 hectares only. Thus, the area can be increased by around 70 hectares. The area under High yielding varieties of paddy is not significant in Champhai area. It occupied only 50 hectares of land in 1990-91 and 1991-92 and it was increased to 60 hectares in 1992-93. The increase of area under HYV is very little because HYV is a newly introduced varieties to the

farmers. The farmers were uneducated and they were not aware of the advantages of the high yielding varieties of rice.

Six sample villages were taken to reveal the area and production of paddy of the study area. Area can be categorized into two groups. Area under irrigated and area under unirrigated. The Area under irrigated referred to the wet rice cultivation whereas the area under unirrigated presented jhum paddy cultivation. The following table shows the village-wise area under paddy for the year 1991-92.

Table - 4.3

VILLAGE - WISE AREA UNDER PADDY CHAMPHAI
(Area in Hectare)

Name of the village	Area irrigated	Area unirrigated
1. Zotlang	13.0	6.6
2. Ruantlang	8.1	46.6
3. Zote	14.1	6.4
4. Tlangsam	10.0	9.7
5. Hmunhmeltha	11.9	16.3
6. Champhai	24.3	18.0
7. Total	81.4	103.6

From the study of the above table, it appears that area under unirrigated covered more cultivable than that of the Area under irrigated in the study area. It would be clear that jhum cultivation occupied larger areas not only in the study areas but also in case of the whole Mizoram. Though not uniform in area, jhum paddy area dominated each and every village in Champhai and

this clearly indicated that Mizoram is still dominated by jhum cultivation.

PRODUCTION AND YIELD OF PADDY

There has been a considerable increase in the production and yield of paddy in Mizoram, though not uniform in each year, due to the vagaries of south-west monsoon on which the agriculture is depended on. The following table clearly shows the trend of production and yield of paddy in Mizoram.

Table - 4.4

AREA, PRODUCTION AND YIELD OF PADDY, MIZORAM
(Area in '000' hectare,
production in '000' tons-yield Kgs/hectare)

Year	Area	Production	Yield
1980-81	29.0	28.3	976
1981-82	29.0	28.3	976
1982-83	59.7	46.0	771
1983-84	47.7	36.7	769
1984-85	47.5	40.9	861
1985-86	49.0	45.3	924
1986-87	48.3	45.8	948
1987-88	48.5	49.2	1,014
1988-89	50.6	54.7	1,081
1989-90	53.0	59.2	1,117
1990-91	51.3	63.8	1,244
1991-92	55.6	70.9	1,275
1992-93	61.3	83.9	1,369

Source : Directorate of Economics and Statistics, Ministry of Agriculture, Government of India.

The production and yield of paddy has been increasing except in the year 1982-83 due to the untimely arrival of monsoon. The production increased from 28.3 thousand tons in 1980-81 to 83.9 thousand tons in 1992-93. The decline of production in 1983-84 was characterized by the agro-climatic conditions prevailed in Mizoram. The growth rate of production is quite significant though the people of Mizoram practiced shifting cultivation. The improvement in paddy yield in Mizoram also shows clearly the suitability of Mizoram for agriculture activities. The yield of paddy is increasing year by year. The yield per hectare of rice in Mizoram in 1992-93 is 1369 Kgs compared to the all India level of around 1200 Kgs.

The cultivation of paddy is determined by the agro-climatic conditions and the nature of the soil in different parts of Mizoram. Hence acreage, and production of paddy is not uniformly distributed throughout the state. Table 4.5 gives the district-wise area and production of paddy.

↻

The above table reveals that Aizawl East District had the largest area under paddy (28.3 per cent) and the production (25.2 per cent) in 1992-93 followed by Kolasib district in the acreage under paddy (26 per cent) and in the production Aizawl west (25 per cent). On the other hand, Chhimtuipui district had the lowest area under paddy (12.5 per cent) as well as the production (12.4 per cent) followed by Lunglei district in area claiming 15.3 percent and the production with 13.5 per cent.

Table - 4.5

DISTRICT-WISE AREA AND PRODUCTION OF PADDY, MIZORAM

(Area in '000 hectares, production in '000 tons)

Districts	1988-1989		1989-1990		1990-1991		1991-1992		1992-1993	
	A	P	A	P	A	P	A	P	A	P
Aizawl west	9.6	10.7	10.7	15.8	9.2	17.7	10.2	18.5	10.2	21.0
Aizawl East	16.5	20.0	16.6	19.1	16.5	19.5	16.8	20.2	17.4	21.2
Kolasib	9.5	9.5	11.6	12.9	11.6	13.8	13.1	16.5	16.0	20.8
Lunglei	6.2	6.3	7.0	5.1	7.2	6.8	8.4	7.8	9.4	11.4
Chhimituipui	7.4	6.2	6.8	6.2	6.6	5.7	6.8	7.7	7.7	8.6
Mizoram	49.3	63.0	50.9	59.2	51.3	63.8	55.6	70.9	61.3	83.9

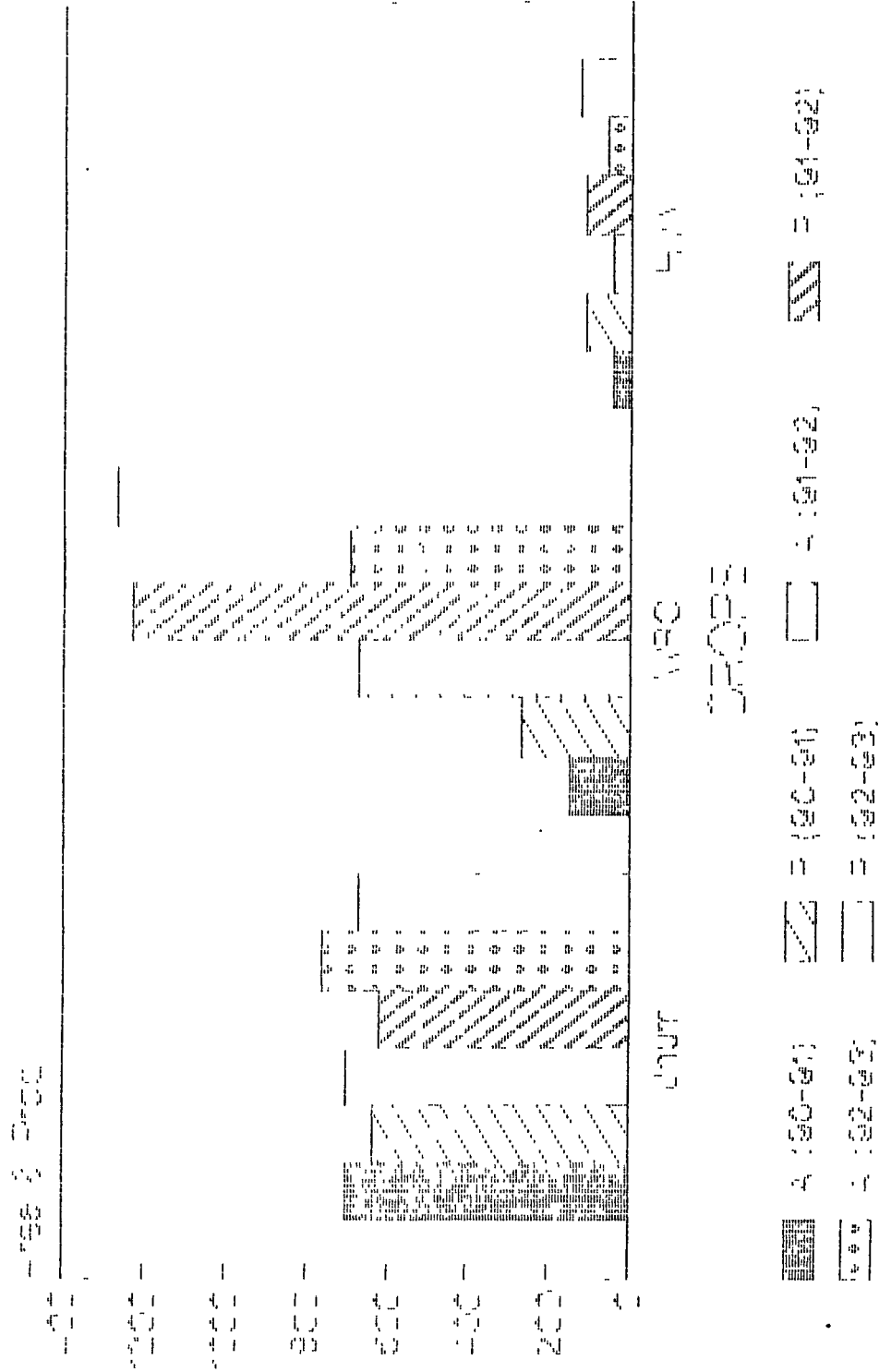
Source - Directorate of Agriculture, Govt. of Mizoram.

It would be interesting to note from figure 4.1 that only Champhai area accounts for 24.5 per cent of the states total production of paddy in 1992-93. The production of paddy increased from 1016.26 tons in 1990-91 to 2069 tons in 1992-93 (Fig - 4.1).

Out of the total production jhum paddy accounts for 632.7 tons in 1990-91, 616 tons in 1991-92 and 672 tons in 1992-93. The early variety occupied less areas due to the agro-climatic conditions and it accounts for only 103 hectares of land and the production is 92 tons in 1992-93. The late varieties suits the agro-climatic conditions and soils of Mizoram and it occupied larger area (763 l;hectares) and more production (672 tons).

The area under wet paddy cultivation increase from 670 hectares in 1991-92 to 690 hectares in 1992-93. There has been a considerable increase in production. The early varieties of paddy

AREA AND PRODUCTION OF PADDY CHAMPARA



Source: Office of D-40, Alizawi East, 1963
 Area in Hectares & Production in MT

Fig-4.1

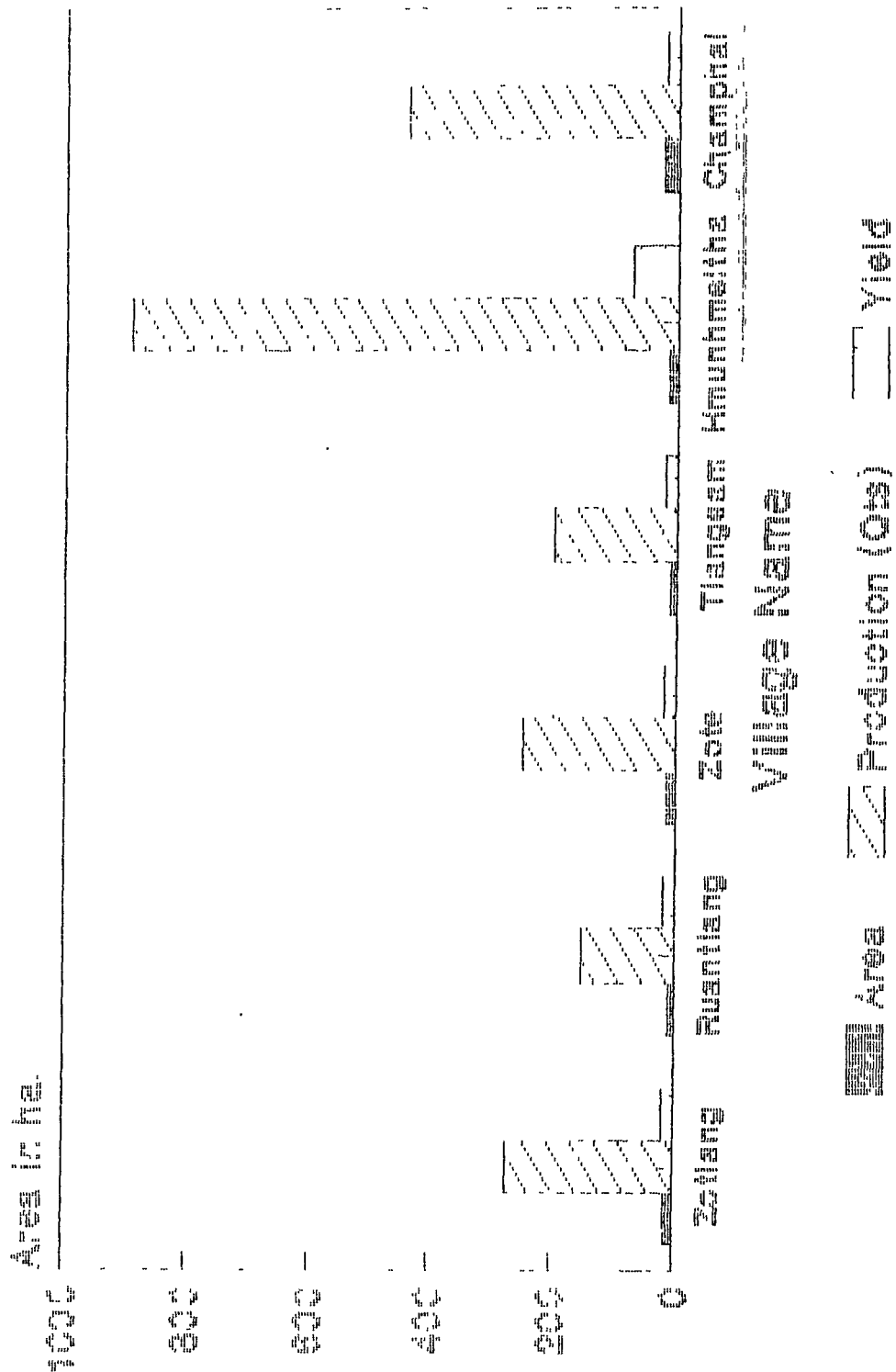
and High Yielding varieties were newly introduced and the acreage under these varieties are less significant. Early varieties occupied only 130 hectares of land and 60 hectares by HYV.

It becomes very clear from figure 4.2 that the study area is dominated by both jhum cultivation and permanent type of cultivation. Jhum area occupied more areas. But it appears that flat lands were more productive and the yield of paddy is higher than the hilly areas due to variation of agro-climatic conditions and soil fertility. The valley lands were productive because of the fertility of the soil.

The village-wise area land production of paddy clearly shows the uneven distribution of cultivable lands under jhum and wet paddy cultivation. The village which has more area under wet paddy cultivation obtained more production. These sample villages of the study area clearly evidence that jhum cultivation occupied the larger areas with low yield not only in the study area but the whole Mizoram also. The wet paddy cultivation is limited to the areas where there is a flat land in river valleys. The production and yield of paddy is influenced by rainfall soil fertility and topography in hilly areas whereas the valley lands were depending on soil fertility and climatic conditions and water management.

Of all the environmental factors, rainfall played the most important role as it determines the yield and production, and the growing season. The practice of jhum cultivation and wet paddy cultivation depends on the natural rain which comes from monsoon.

AREA PRODUCTION AND YIELD OF RICE CHAMPRA



1992-93

Fig-4.2.

The water received through rainfall is the main source for irrigation especially in the hilly areas. The traditional rice growing season starts with the onset of monsoon. The late arrival of monsoon means the failure of production. It is evidenced from figure 4.3 that the late arrival of monsoon is experienced in the year 1992. This influenced the production of paddy in the hilly areas and the production declines. In this year, monsoon started in the month of June. This also effects the growing season and its production of wet paddy cultivation also (Fig - 4.3).

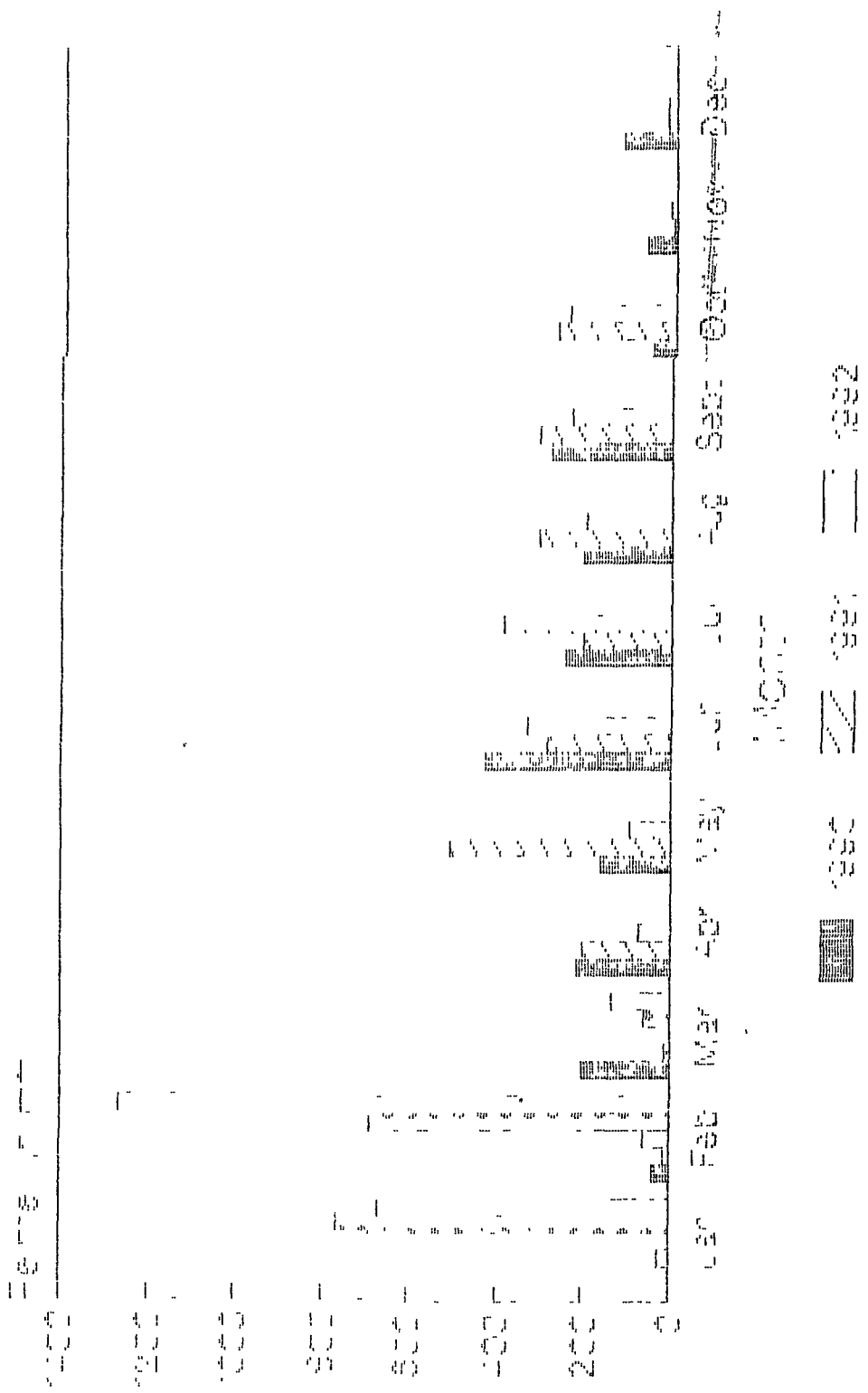
Therefore, optimum period of environmental conditions has to be delineated for achieving maximum yield of crop variety grown. The cultivation technique is to be adopted and perfected most suitably as per the requirement of the variety and the environment to exploit optimum yield of rice.

CONSTRAINTS OF PADDY PRODUCTION

From the environmental point of view, production of rice depends primarily on rainfall, temperature, solar radiation, relative humidity and wind. The performance of growth and yield of rice, grown at different places and times depends on the climatic conditions. Each of the climatic element effects differentially the rice growth and ultimately yield at different stages of growth.

The Champhai area is a high rainfall area with the precipitation ranging from 1200mm to above 2000 mm. Most of it is during the months of June to September. The winter months are pattern and intensity greatly constraint the growing season and

EXPORTS



Source: Directorate of Agriculture, Vietnam

Fig-4.3

the production and sometimes making the choice of varieties difficult. Even during the monsoon period, small periods of droughts are not uncommon creating the management constraints.

High humidity is conducive for the development and spread of diseases in an epidemic form, leading to great losses in crop. High humidity also affects seed drying and storage adversely.

The sunshine hours during the cropping season is very less due to cloudy weather. Maximum competition in rice is known to be for light, which is always a limiting factor in achieving higher yield.

Temperature is dependent on altitude, sunshine and geographical position of the area. The average mean temperature during winter months ranges between 10 - 15^o C. During summer months, the mean temperature may range from 25 - 28^o C. In high altitudes areas, cold susceptibility at re-productive stage and under bare cultivation at vegetative stage are reasons for low yields. Even under valley conditions, late planted crops suffers from cold at reproductive stage.

The traditional varieties with weak stem suffer losses from lodging due to high wind velocity especially on hillslopes. photosynthesis efficiency of such varieties is affected due to the disturbance in leaf canopy leading to mutual shading of the leaf area.

Apart from all these climatic factors, the altitude and topographic factor greatly limits the production of paddy. The

altitude of Champhai area is varied from flat land to hilly areas. The topography is undulating with hills and valleys. This variation in the study area present problems because of the necessity to identify varieties and technologies suited to the respective situation.

Soil conditions also greatly affected the production and yield of paddy. The soil in Champhai area is generally acidic in reaction. The soils of higher altitudes under high rainfall areas are strongly acidic imposing tremendous limitation to high productivity.

P-deficiency is wide spread phenomenon. It results in reduced tillering, stunted growth and decreased grain formation leading to poor yields in rice.

The aluminum toxicity is caused by excess water soluble and exchangeable aluminum. It limits growth in dry land rice on strongly acidic soils.

Presence of excessive iron is a problem met with especially in the wetland narrow valley soils. Symptoms are small brown spots on the lower leaves starting at the tips. Growth and tillering are depressed and the root system is coarse, scanty and dark brown.

From the biological point of view, diseases, pests and weeds greatly limits the production of paddy. Rice blast is the most severe disease problem. Both leaf and panicle blast are responsible for substantial yield reductions. Other important

diseases are bacterial leaf blight, leaf scald, sheath rot, brown spot, stem rot, sheath and grain discolouration.

Insects like rice bug, brown plant hopper, stem borers, ear cutting caterpillar, root aphid, crabs rodents and birds are responsible for the reductions of yield of paddy.

Since moisture availability is plenty, weeds are a serious problem. It becomes clear that more than 30 per cent of the constraint limiting grain yield in upland rice and flat land rice was weed problem. Weeds are also collateral hosts for many diseases and pests.

From the view point of management, the area is physiographically isolated which creates problems in the resources management. Agricultural inputs like quality seeds, fertilizers, pesticides and insecticides, agricultural implements often do not reach the sites of utilization at the right time. Since farming is subsistence oriented, resources management on a large scale becomes impossible.

Higher yields can never be obtained without proper crop management even if other inputs such as fertilizers, water and chemicals are used adequately. Raising of healthy seedlings, a timely sowing/transplanting, maintenance of optimum plant population per unit area with appropriate seeds rate, weeding and timely harvesting are important aspects of crop management.

The problems in water management in Champhai area is another constraint. Minor floods occurred when the heavy down pour of

monsoon has started. This minor flood is hazardous for the farmers for it damaged crop. The inadequate irrigation systems has been the major constraints for increasing production since long.

The problem of acidic and lateritic soils in increasing rice production have already been mentioned. The kind of fertilizer, quantity, time and method of application are all very important in determining efficient management of soil fertility.

Post harvest processes are of great relevance to production. Without sound post harvest technology, the harvested product may undergo deterioration, thereby making the production useless.

Variety has also played as a limiting factor for the production. A suitable variety is the first requirement for improvement of rice yield. Selection of variety depends upon the agro-climatic conditions where its cultivation is to be done.

Another important factors which limits the high production of rice is the practice of shifting cultivation. Shifting cultivation is practiced by most of the farmers. The yield of rice is very low as only indigenous varieties are grown without any scientific technology.

Thus, from the above discussion, it would appear that not only the environmental factors limit the production of paddy but also the biological factors and technological factors. For the improvement of yield of paddy, technological factors are responsible other than environmental factors. Man cannot change

his environment, so he has to adjust himself under the same environment by utilizing technology increase production of paddy.

ENVIRONMENT AND LAND USE

The nature of landuse in Champhai area has been under the influence of a set of environmental factors. The village-wise landuse pattern (Fig - 4.4) shows that permanent net sown are occupied the largest area. The permanent net sown area includes wet paddy cultivation and terrace cultivation. Next to permanent net sown area, forests cover the largest area. The plantation of tree crop also occupied a large area. Jhum lands, fallow lands and homestead orchard occupied more or less the same area of land. Thus from the study of the landuse pattern of the sample villages, it is evident that permanent net sown area is significant but the others classifications are less significant from the agricultural point of view.

It would appear from the study of the aerial-photo interpretation of the study area, Champhai that a set of environmental factors influence the landuse pattern. Temperature decreases with altitude owing to the rarefied air having low content of carbon dioxide, moisture and other particles. Consequently, the sun's rays pass through the air with less warming effect and high proportion of solar radiation reaches the grown surfaces at mountain tops which rapidly heat up. This in turn may cause extreme desiccation of soil. Conversely the surface soils loose heat rapidly in the free radiation at night. Therefore, soils at high altitude are desiccated as well as

VILLAGE-WISE GENERAL LAND USE DIFFERENCES

CHAMPAL

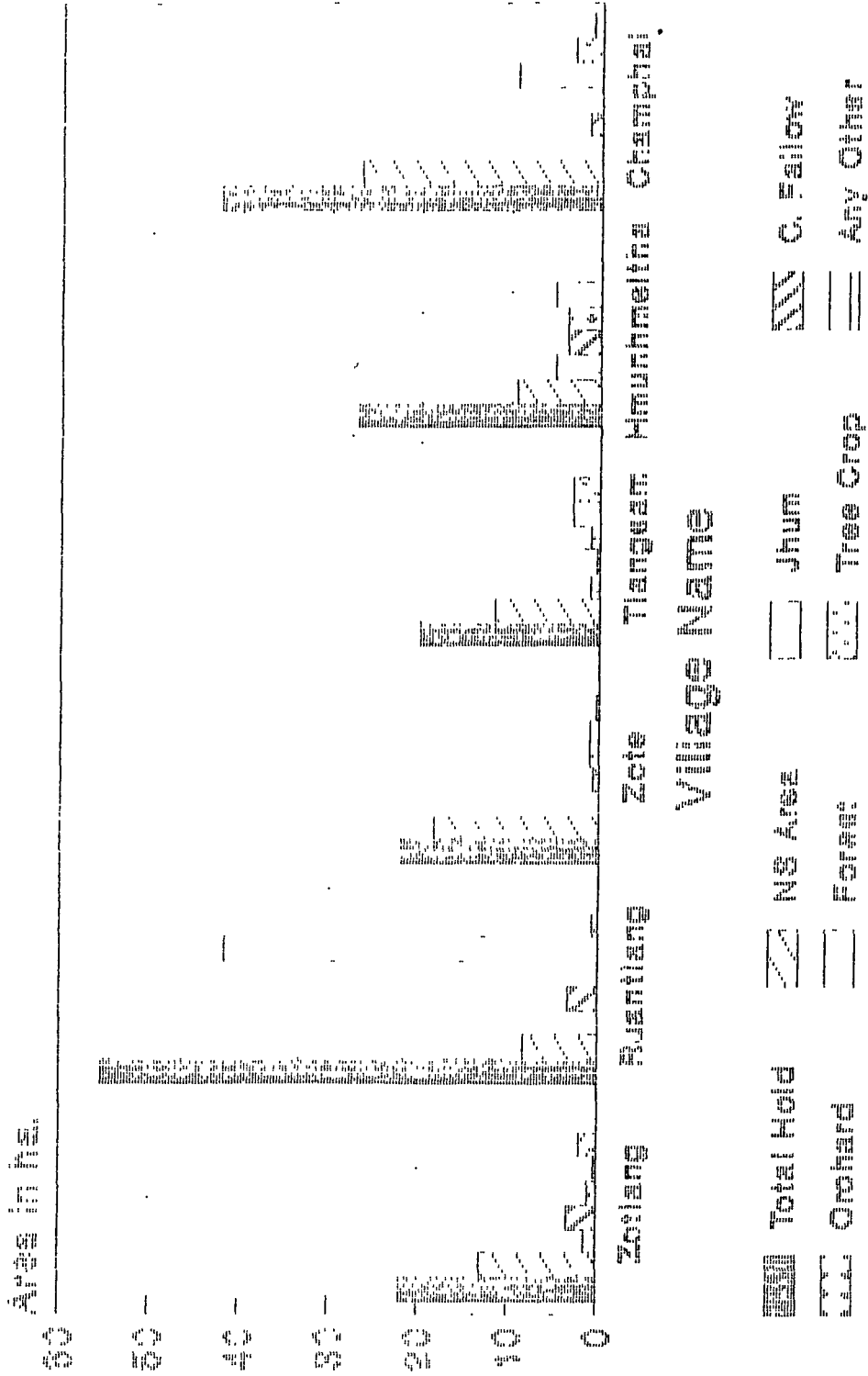


Fig-4.4

frozen thereby creating hazards for agriculture activity. The increase in precipitation with altitude is equally important for agriculture. The combination of high altitude and sufficient moisture results in snowfall which makes agriculture activity very difficult.

At the higher altitude, soil do not get properly matured because of the moderate chemical weathering, moderate mass movement, strong fluvial erosion significant wind action and low temperature.

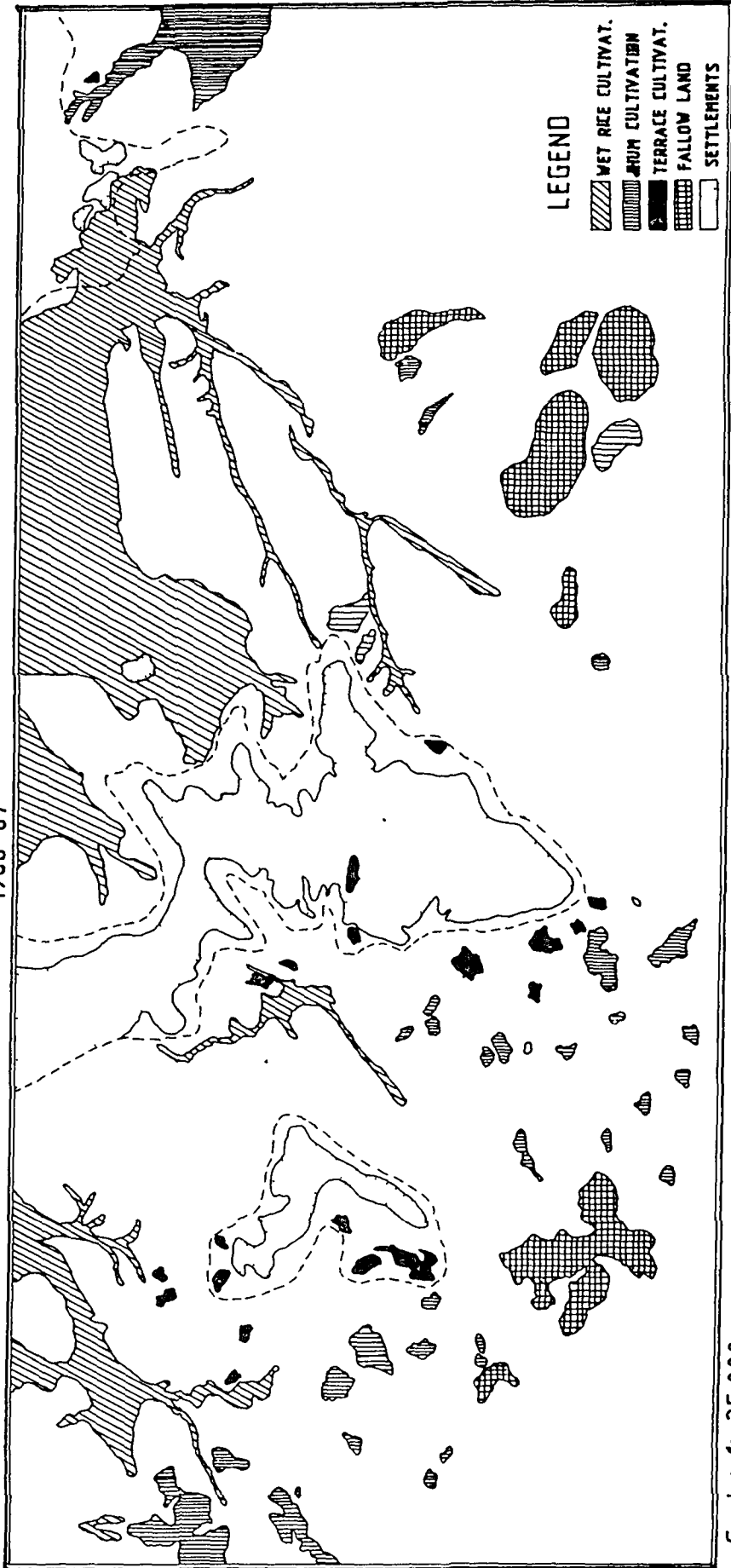
Therefore, rugged relief of an area determines the value of terrain for arable farming when roughness increases the agricultural potentialities decreases. Therefore, in hilly region, where roughness is more, agricultural land is less. The terrain is a prime factor in agricultural land use. Thus, most of the hills and dissected hills are forested land while the valleys have settlement and crop lands.

Slope of land is also the important physiographic aspects influencing the agricultural land use of the area. The effects of slope on agriculture may be both direct and indirect. The direct influence is in the form of restraint on cultivation and accessibility. It is a fact that two steep slope areas cannot be brought under cultivations.

With the increase steepness in slopes, even the very simple farm activity becomes difficult. Steeper slopes are avoided for cultivation unless population pressure is more. Accessibility is the most potent factor in agricultural land use in hilly areas.

The effects of slope direction on agricultural landuse is inseparable from physiographic conditions since at any altitude, the agro-climatic condition varies on different slopes. In regions of high relief, the contrast resulting from angled at which the sun's rays strike the ground surface is heightened by the difference between the number of hours of possible sunshine on different slopes (Fig - 4.5).

PART OF CHAMPHAI
LANDUSE/LANDCOVER
PREPARED FROM AERIAL PHOTOGRAPHS
1986-87



CHAPTER 5**SUMMARY AND CONCLUSION**

As the study area, Champhai presents immense potential for increasing agricultural productivity, it is necessary to increase the yield of rice. The improvements in yield will hold the key to further advances in production. The scope for further improvements in production is limited since the only major source of additional land will be increasing the area by cultivated new land and the area brought under multiple cropping. The main reasons for low yield apart from environmental factors are inadequate nursery care, poor plant population, untimely transplanting, inadequate and imbalanced use of fertilizers, almost complete neglect of plant protection measures, unsatisfactory water management. It is evident that the production of rice can be increased in two ways to help the rice varieties to achieve the maximum yield potential and to increase the inherent maximum yield potential and to increase the inherent maximum yield potential of the variety.

Three major systems of cultivation are followed such as jhuming, valley land cultivation and terrace cultivation. Rice covers all the valley land because the transplanted rice can be grown successfully. Low input low risk primitive technology based on sustenance farming is not conducive to high yield. This is the major constraint. Since the valley land is suitable for paddy cultivation, there appears to be a good scope for paddy to be concentrated in the valley land. With irrigation facilities, the

multiple cropping can be done in Champhai valley. Mixed cropping with rice as a principal crop is quite common on jhum lands which are generally monocropped. The yield of paddy is lower in jhum lands in comparison with valley land. The yield of paddy will be higher if the jhum land is minimised and concentrated on the valley land.

It would appear that due to several factors viz lack of irrigation facilities and proper water management in majority of the cultivated areas the pattern of rainfall which leaves the winter months almost dry, the low water holding capacity of the soil and hill slopes and the dominance of jhuming in the region, as a whole, the majority emphasis for increasing the productivity of crops. Plant would necessarily be for the crops which would fit in the period between April to November. However, with the increase in irrigation facilities and better water management practices, it may be possible to increase the intensity of cultivation and grow more than one crop successively per year in a given area. This would make it possible to increase the area and productivity of crops other than paddy. It is absolutely necessary to raise the productivity of the existing major food crops so that the pressure on land with these crops could be released. This would have many advantages. Firstly, the released area could be put under plantation crops and tree plantation of economic importance especially on higher elevations and steeper slopes; Secondly, the extent of jhuming could be minimised to that extent. This would make way for other crops which are in short supply.

It is evident that jhuming is the most prevalent which is done on hill slopes after cutting and burning the forest. The land is abandoned for few years after two to three years of cultivation. Under settled form of cultivation, there is valley land cultivation and terrace cultivation. The cropping systems of the study area are mainly depended upon the food habits, altitude and climatic conditions. The choice of crop is mostly consumption oriented and the system of their cultivation has stabilized in a low input-low risk -low yield technologies. Rice is the main crop of the area in cropping systems and is grown in the valley to hill top. The crops grown in the area are essentially grown as rainfed and the major constraints that limit crop yields are lack of appropriate variety for higher altitude (cold tolerant), moisture stress during germination and at reproductive phases, weed infestation, poor soil fertility.

The study area is still mono-cropped and rainfed. Double cropping is possible if irrigation facilities are available as there are practically no winter rain. After harvesting paddy crop, the crop which has cold tolerant and low water requirement like wheat, potato, mustard can be grown as the second crop. Some cultivators has started practising multiple cropping. The major constraint is lack of modern inputs, technologies and infrastructure.

Besides introducing double cropping, the increase in the productivity of monocropped areas either in pure or mixed crop stands would itself be a good breakthrough. The latter involved less labour and other investments and may even be more economical

in certain situations. Therefore, great emphasis has to be laid on developing high yield varieties of existing major crops irrespective of maturity period, which may suit the monocropped areas having no irrigation facility at present. It would also be a good idea to sow more than one crop on different dates either as mixture or as successive crops in a way as to utilize full period of favorable growing conditions. All these systems would involve breeding of varieties for specific purposes as the case may be. The varieties should also have better plant architecture for developing suitable crop mixtures and even for pure crops keeping in mind the plant density and soil fertility level etc. Varieties may also be developed having favorable growth periods which by adjusting the sowing time may escape the unfavorable weather conditions or incidence of pest and diseases. Looking at the agro-climatic conditions of the area, it would be advisable to breed varieties which are photo-synthetically more efficient as the number of sunshine hours are comparatively less.

The varietal requirements may vary from hilly areas to valley land due to the variation of temperature, altitude and soil conditions. High yielding varieties and improved technology are among the most important constraint for increasing the production. There is tremendous scope of increasing the yield by introducing cultivation of high yielding varieties with improved production technology.

Sometimes, inspite of the use of high yielding varieties, the yields remain stagnant due to various other factors including the unsuitability of the crop to the existing agro-climatic

condition. Therefore, it should be borne in mind that the high yielding varieties would be successful only if agro-climatic conditions are congenial for the crop and proper management practices are followed.

There is ample scope for developing suitable cropping patterns and package of practices for different agro-climatic conditions with the purpose of harvesting more economic yield per unit area per year without much deterioration in soil and its fertility. All these factors are very much dependent on identification and development of suitable varieties of crop plants. However, looking at the level of poverty of the area, the new technology has not only to be inexpensive but capable enough to ensure remunerative and stable returns. The varieties could be developed having high stability index both for low and medium fertility conditions. It is the area of lower altitudes and valley land where varieties would be required to be developed for double and even triple cropping if irrigation facilities are well-developed.

Although there is good scope for developing suitable varieties for the existing crops as well as for the introduction of new crops, care has to be observed that the good attributes of the locally grown cultivators which have acclimatized themselves in the region through years of cultivation may not be easily replaceable. Moreover, the farmers too have developed a taste for it. Any new material has to conform to the conditions of plant growth in the field as well as for consumption in the farmers homes. The crops do not have ready market will also not be

acceptable. Marketing and transport is a real problem hampering the growth of agriculture in the area. Many times, even the commodities which could be stored have to be sold at non-remunerative prices, what to say of quickly perishable items. It is therefore, clear that unless some incentive is there, farmers are not likely to invest much even if they are in a position to do so under such a situation, it seems in general, that such varieties should be developed which may yield more with the investment of non-monetary inputs as far as possible. With the passage of time as the monetary condition of the farmers improves and with greater support through government and other agencies, the need for development and adoption of high yielding varieties would be appreciated in the real sense.

The growing period i.e., April to November is very much depending on the arrival of monsoon means the failure in the agricultural production. Moreover, it is evident that for early maturity and early harvesting, high temperature with sunshine is necessary. It would appear from the observation of climatic conditions over a few years in Mizoram that the area which has warmer climate used to harvest earlier than that of the colder climate. Thus, the growing season is greatly influenced by a set of environmental factors. The traditional rice growing season starts with the onset of monsoon in jhum land as well as valley land.

It is clear from the study that the highly dissected terrains, the deep narrow valleys and scarps are the main factors which control the types and patterns of agricultural land use.

The difficult terrain with steep slopes were left uncultivated, covered by forests. The level land and gentle slopes were mostly cultivated and some areas were under current fallows. The agro-climatic conditions greatly limits the land use pattern of the given area.

A review of the grain yield data of our paddy crops clearly indicated that the present yield levels are far below the established potentials, suggesting thereby that severe constraints to crop growth operate in the study area. In the long run, we need to be able to identify all the constraints that operate in a system and to know which of these constraints can be successfully overcome by the use of appropriate crop varieties and technologies. The immediate need is to intensify the cropping systems and on the pattern of crop growth on soil and plant inter-relationships so that we can develop new concepts on the ways that constraints act and interact and on methods of identifying them as well as in quantifying their effects.

Therefore, to overcome successfully the constraints to yield and production of paddy, the following points were suggested:-

- 1) The traditional agricultural system i e., jhum cultivation is no longer able to meet the needs of our rapidly expanding population for increased supply of food. Therefore, reduction and replacement of jhum cultivation is an imperative need in the area.
- 2) Varieties play a pivotal role in increasing rice production. The yield may be doubled by introduction of high yielding modern varieties suited to agro-climatic conditions suitable varieties such as drought tolerant, photo-insensitive varieties and Dwarf varieties may be developed

- 3) With the increase in irrigation facilities and better water management practices, it may be possible to increase the intensity of cultivation and grow more than one crop successively per year. Hence, it is essential to increase irrigation potential as fast as possible so that a large part of the area can be taken up for double cropping.
- 4) There is a good scope for introducing some new high yielding varieties such as wheat. It is found that this crop can be grown successfully in the paddy as the second crop and into 1200 meters height in the hilly areas. But at present wheat cultivation has not been done due to lack of irrigation facilities. Not only wheat, crops like potato, and pulses also can be cultivated successfully. Paddy cum fishery has been successful in the paddy field and this also should be developed.
- 5) To achieve desired level of crop productivity in a cropping, fertilizer management is very important. The consumption of fertilizer is very low i.e., 9 kg per hectare as the all India average of 46 kg. This is so because of difficult terrain and prevalence of jhum cultivation, lack of irrigation facilities and shortage of fertilizers. The productivity of land is directly linked with application of adequate doses of fertilizers. Therefore, appropriate stocking points for fertilizers and chemicals and network of distributors should be created and it should be made available in time and the consumption of fertilizer should be increased.
- 6) Use of improved agricultural implements will facilitate introduction of multiple cropping and application of inputs. It is necessary to provide mechanized farm implements such as tractors, power tillers, sprayer, wheat hoe, water lifting device etc.
- 7) Minor floods occurred in the wet paddy field during rainy season which is one of the major problem of the farmers should be checked. In case if the rice production suffers to a great extent due to the weather fluctuations and natural calamities, in order to overcome this, contingency planning is required.
- 8) The technical knowledge so far available in the country has not reached the farmers to the deserved extent. This is a problem in this area and the position is more acute here due to transport and communication difficulties. The infra-structure built up for the development at present is also not adequate enough to meet the challenging situation of agricultural development. There is also a shortage of technically qualified local personnel at various levels. It is essential for

Government to take up suitable programmes for training a local people.

Thus the Government of Mizoram should try its best to build up the necessary infra-structure and a stable agricultural base that will set in motion the process of development in the field of agriculture in the region. But it has to be remembered that proper technology is not the only answer to increased production. Public policies, service to the farmers and technology must be moulded in a proper manner to achieve the desired result. Service to farmers, through proper extension programmes with adequate emphasis on socio-economic constraints must be strengthened, if farmers have to use proper technology. Similarly, public policies must create the conditions conducive for production.

In conclusion, it has to be said that in much of man's life today, the physical environment does not greatly constraint activity. In agriculture, however, the environment still has a greater and more direct effect. It is true that many effects of farming are similar on greatly contrasting soils in very different climates. It is apparent that climate and weather set broad limits to the types of agriculture that man may pursue in any region within these limits, relief factors imposed further limitations of our certain possibilities. The relief controls operate partly through the climate they create, high altitude being in some respects similar to high latitude and partly through angle of slope and irregularity of surfaces. The soil reflects both these major factors - climate and relief as well as vegetation and is found impact on man.

BIBLIOGRAPHY

1. Agricultural Guide Book of Mizoram, 1991 published by the Department of Agriculture, Mizoram.
2. Asthana, A.N. : "Agriculture in the North Eastern Hills Region", Agricultural situation in India, 1981, Vol. 35-36.
3. Basic Statistics of North-Eastern Region 1992, North Eastern Council, Shillong.
4. Census of India 1991, Provisional Population totals, Series 17, Mizoram paper 1 of 1991 supplement.
5. Dhan Narain : Studies on Indian Agriculture, Edited by K. N. Raj, Amartya Sen, CH Hanumantha Rao Oxford University Press 1988.
6. Desai, D.R. : "Analysis of Rice Production and Productivity in Eastern India" Agricultural situation in India, Vol.39, 1984.
7. Borthakur, D.N., Gupta, H.S. and Prasad, R.N.: "Problems and prospects of Increasing Rice production in North Eastern States" Journal of the North Eastern Council, Vol. VII, 1986.
8. Goh Cheng Leong, Gillian C. Morgan : Human and Economic Geography, 1987, Oxford University Press, Walton street, Oxford Ox26DP.
9. Haque, T. : "Factors Accounting for Low yields of Rice in West Bengal", Agricultural situation in India Vol. XL, 1985.
10. Jain, C.K. : Patterns of Agricultural Development in Madhya Pradesh published by Northern Book Centre, 4221/1 Ansari Road, Daryaganj, New Delhi - 2, 1988.
11. Jasbir Singh : Agricultural Geography New Delhi.
12. Kainth, G.S. & Mehra, P.L. : Rice Production - Potential and Constraints, published by M.C. Mittal, Inter-India publications wz-960, Raja Garden, New Delhi- 110 015, 1985.
13. Margaret R. Biswas & Asit K. Biswas : Food, Climate and man, A Wiley interscience publication, 1979.
14. Majid Hussain : Agricultural Geography, Inter India publication, Delhi, 1979.

