Impact of Terrain on Agricultural Development of North Bengal with Particular Reference to Darjeeling District

Thesis submitted for the Degree of Ph.D. (Arts)

By

Manju Das

Department of Geography and Applied Geography
UNIVERSITY OF NORTH BENGAL
2006

CONTENTS

PART TWO :
PROBLEMS AND PROSPECTS OF PHYSICAL ENVIRONMENT OF AGRICULTURAL RELEVANCE (DARJEELING)

PART THREE : APPLICATION IN NATIONAL ECONOMY

Preface

Agricultural scientists play a very important role in determining agricultural development and it is more so in the areas handicapped with natural calamities. By and large the development of agriculture is a constraint in terrain areas. Because all terrain areas are not suitable for cultivation.

Agricultural development means by and large an improvement of land productivity, with the application of higher degree of inputs. The main aim of agricultural development is to achieve increase amount of agricultural production and high rate of economic growth in order to bring about an improvement in the standard of living of the people. The development of this sector of economy, therefore, is a prime concern of planners, economists and geographers offers a challenge to them to find ways and means to achieve the goal.

More than 150 years ago Von Thunen's famous theory of location was concerned with agriculture. The era of agricultural geography as a new concept started only with the works of Jonasson (1925), Hartshorne Dicken (1935), Weaver (1944), Slam (1962) and Kostrowick (1957) opened new vistas of agricultural, geography. A review of geographical literature covering agricultural development in India reveal that rarely a distinction is made between the elements of agricultural development and the factors in agricultural development. Schwartzber (1962) concluded in his mapping of the levels of economic development in India, agricultural indicators of crop productivity, agrarian relations and institutional factor of members of agricultural credit societies per million of agricultural families. Ashok Mitra (1967) in his study included percentage of double-cropped area as an expression of intensity of cultivation. Nath (1969) maintained that agricultural development in India depends upon three factors – the growth rate of agricultural output, the use of modern inputs in agriculture and productivity per hectare. Sharma (1971) was of the opinion that

agricultural development should be assessed not only by agricultural production but also with reference to various physical inputs like fertilizer and extent of cultivated area.

Alma (1974) suggested six indicators such as percentage of gross irrigated area, gross cropped area and agricultural output per agricultural worker and per acre, canal irrigated and double cropped area. Moonis Raja (1978) in his study suggested as many as forty-one indicators of agriculture development grouped into four subsets of production conditions, productivity, agrarian relations and change in agriculture. Husain (1979) maintained that agricultural production of a region is determined by the combined influence of physiological, historical socio-economic, cultural and technological' forces. Husain also describes, "soil and their properties are also influenced directly and closely by topography relief and altitudes. Soils are also influenced by altitudes. The soils of mountains and valley very greatly over short distances." Das (1979) in his study of population pressure and intensity of cropping pattern pointed out that, the traditional mode of agricultural production with low out put from cultivated land has failed to support the overwhelming majority of rural population. Such population pressure on agricultural land has a tendency to intensify the cultivation of limited land with two or more crop sown during agricultural year in order to compensate the decrease in land man ratio" Chakraborty (1981) explained that the choices of crops to be cultivated by the farmers are governed by the compulsion posed by environmental endowments, satisfaction of hunger of the farmers and the demands of the metropolitan economy. Mukhopadhyay (1982) describes, "the improvement in irrigation and water supply have helped in reducing the degree of dependency on natural phenomena like hydro-meteorological conditions of the district. According to Safi (1984) "productivity is not fertility. It is generally used to express the power of agriculture in a particular region to produce crops without regard to whether that power is due to boundary of nature or to the effort of

man". Jana (1987) studied the cropped area of Darjeeling district and concentration of crops in different areas have been analysed. Bhattacharjee (1987) focused his study in net sown area and the area cropped more than once. The spatial analysis reveals that a core of high concentration of netsown area is surrounded by gradually declining net sown area. Das and Chakraborty (1988) have analysed the various ecological problems arising out of loss of vegetal cover in high fragile slopes of Darjeeling. Roy Choudhury and Mandal (1989) identified the zonal variations in soil, climatic parameters for a soil based agro-technological study. Mughal (2000) defined agro-forestry as multiple land use of an area simultaneously to meet diverse needs of the farmer. Sharma (2000) recognized agro forestry as a distinct discipline, which plays an important role in socio-economic transformation of marginal lands into more productive agrarian economy.

Singh (1994) in his study analysed the distance cost to explain spatial organization of agriculture at tube well service area. Malakar and Bews (1996) observed the steady improvement in agriculture during the last two decades, despite decline in net cropped area. In the same year Husain (1996) in his book describes "agricultural patterns are strictly dependent on the conditions of terrain, topography and altitude – while the paddy cultivators require leveled field, the tea planters perform well in undulating topography in which water does not remains standing". Vaid (1997) studied the temporal variations in landuse pattern and possible causes of changing land use are interpreted. Kothari, Kohli and Jain (1999) mentioned that regional disparities are not removed or controlled. These disparities exist mainly due to distinct geographical and topographical features, which ultimately lead to variations in demographic, social cultural and economic characteristics. Sahi (2001) suggested that heavy dependence on rice and wheat as is not appropriate and cultivation of coarse grains should be part of landuse. In the opinion of Verma and Singh (2001) agricultural development of landscape and improvement of productivity by ameliorating adverse conditions

through modern farm technology. Mifzur (2003) studied to determine the agricultural efficiency of Bihar by Kindall's method of ranking co-efficient. The study reveals that the district of North Bihar plain area attached to the Koshi river are not agriculturally efficient because of devastating floods and inadequate irrigational facilities. Prasad (2004) defined that changing landuse pattern of agricultural landscape and environmental development planning under spatio temporal framework. Taufique (2004) in his study assessed the spatial variation in the levels of agricultural productivity through out his study period. Walford in (2005) highlighted the size of individual holding of a farmer fluctuates with gains and losses even if the overall trend is for enlargement.

ACKNOWLEDGEMENT

At the very outset I would like to express my deepest gratitude to Prof. Anindya Pal (Retd.) Department of Geography & Applied Geography, University of North Bengal, Raja Rammohunpur, Siliguri for his valuable guidance, advice, suggestions and constant encouragement during all phases of my research work. I express my heartfelt thanks to Dr. Tapas Kumar Chatterjee, Registrar along with his colleagues in his department for their valuable help and co-operation in carrying out this research work.

Mention should be made with gratefulness of the Agriculture Office of Darjeeling, Land Revenue Office, Siliguri, Meteorological office, Alipur, Kolkata, Forest Office, Jalpaiguri, the teaching and non-teaching staff members of the Department of Geography and Applied Geography, North Bengal University for their help during my research work.

I express my thanks and indebtedness to the Surveyor General of Survey of India, Director. NATMO, and the official of number of Libraries, Directorates, institutes and individuals for helping me in various ways during the course of my research work.

I wish to place on record my appreciation and thanks to number of officers/officials, S.S.B., Ranidanga, who extended their helping hands in successful completion of this research work. Special thanks are conveyed to Mr. S.L. Mishra and Dr. V. Saha. I must thank Mr. R. Sharma for typing my research materials. Last but not the least I will be failing in my duties if I do not express my thanks to my husband Dr. S.R. Das, my daughter and son for providing me with a favourable working atmosphere at home and at the same time inspiring me constantly in completion of my research work.

Siliguri Dated, 3rd July 2006

Manju Das

Manju Das

LIST OF TABLES

LIST OF MAPS AND FIGURES

LIST OF PLATES

LOCATION MAP OF THE STUDY AREA

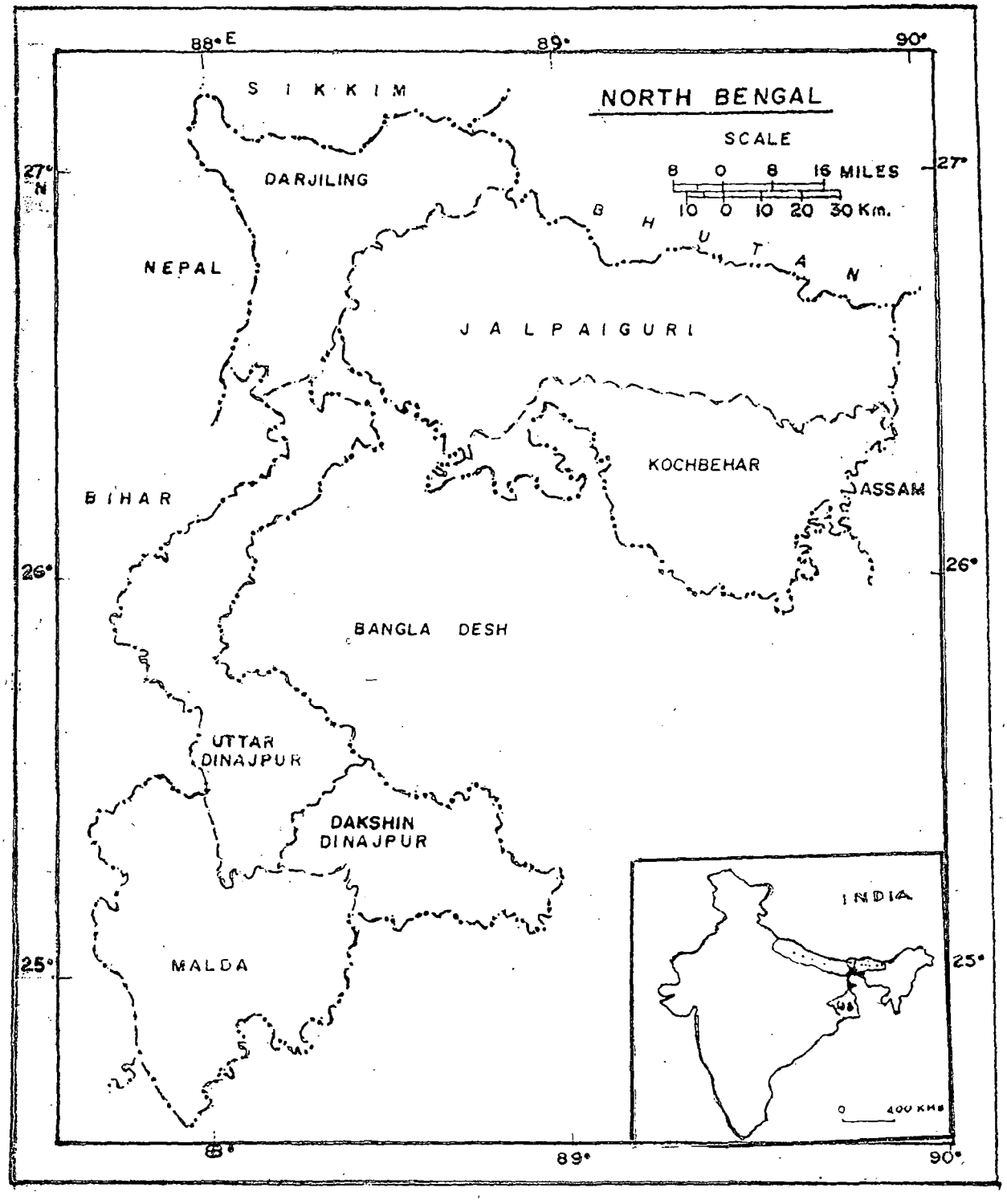


Fig. 0.1

INTRODUCTION

The northern most region of the state of West Bengal is known as North Bengal. The six districts that comprise of North Bengal are Darjeeling, jalpaiguri, Cooch Behar, Uttar Dinajpur, Dakshin Dinajpur and Malda. (Fig. 0.1)

North Bengal lies between 27° 13′ - 24° 40′ 20′′ North Latitude and 89° 5′ 35′′ East Longitudes. North Bengal is bounded by the river Ganga in the south, the state of Bihar and Nepal in the West, Sikkim and Bhutan in the North and Assam and Bangladesh in the east. Total area of North Bengal is 21854 square kilometers, which is 24.62 percent of the total area of the state of West Bengal. Jalpaiguri commands the largest area and Cooch Behar is the smallest district of North Bengal. North Bengal is a region of great physical inequalities with varied geological and topographical features.

The great differences in relief have brought about differences in climate, natural vegetation, drainage and soil character, which ultimately influence the agricultural practices of North Bengal.

The northern most part of the Darjeeling district is a mountainous region situated on the Himalayan chains. Jalpaiguri and Cooch Behar are characterized by their mixed hill and plain landscape. The southern districts, Uttar Dinajpur, Dakshin Dinajpur and Malda are completely riverine plains. Other plain areas comprise of southern parts of Cooch Behar, Jalpaiguri and Darjeeling district.

Historical Background

The historical background of North Bengal is very interesting. The tract of Darjeeling which is now the northern most district of North Bengal remained for a long time as a part of Sikkim. Captain Llyod who was in Government mission to deal with the border dispute between Sikkim and Nepal in 1829[1], was over-whelmed by its natural

[1] Dash. A.J. (1947) Bengal District Gazettes, Darjeeling, p. 37.

beauty and was charmed by its advantages as a site for its strategic location specially as a gateway to Nepal. Mr. Grant was also accompanying Mr. Llyod in that mission reported to the Government of India pleading on behalf of Darjeeling both as a center suited for being a sanitorium and a military base and recommended its occupation. According to the report a survey was conducted and negotiations with the Raja of Sikkim started and subsequently a deed was executed by the Raja of Sikkim in 1935[2]. Following the deed the tract of Darjeeling was presented to East India Company by the Raja of Sikkim. In the year 1941 the British East India Company granted Rs. 3,000 per annuam to Raja and subsequently increased ti to Rs. 6,000 per annum in 1846[3]. But following the imprisonment of Sir Joseph Hooker and Dr. Cambell, the then Superintendent of Darjeeling by Sikkim Government in 1849[4] the relation between Sikkim and East India Company reached to a climax. Though both of them were released unconditionally, but annual grant of Rs. 6,000 to Raja was withdrawn. Besides, the terai as well as the part of Sikkim hills 'bounded by the Raman and the great Rangit river on the north, by the Tista river on the east and by Nepal frontier on the west'[5] were annexed to the British territory. Since then Darjeeling remained as a part of British India included in the Bengal province.

(b) Jalpaiguri

The area comprising of the Duars of the district of Jalpaiguri has interesting political history. For a long time, great political tussel was witnessed between the princely state of Cooch Behar and Bhutan regarding the border rights. The Bhutanese were responsible for making lawlessness along the northern border of Darjeeling and Cooch Behar. To prevent Bhutanese, British India annexed Bhutan, Duars including some hill areas. As a consequence a treaty was signed at Sinchula between the Dev Raj of Bhutan and British Government in 1865[6]. Subsequently Raja of Bhutan handed over the British Government some hill territories (Dalimkote) now forming

[2] Ibid, p. 38
[3] Ibid, p. 39
[4] Ibid, p. 39
[5] Ibid, p, 40
[6] P.P., Karan, 1967 : Bhutan Press, University of Kentuckey, p. 93.

Kalimpong Sub-Division as well as Bhutan Duars and the passes. The later represented Bengal Duars and Assam Duars. A district was formed known as western Duars with Kalimpong included in it as a Sub-Division. In 1860[7] Kalimpong was transferred to Darjeeling district and in 1869 western Duars was annexed to the district of Jalpaiguri which now belongs to the state of West Bengal.

(c) Cooch Behar

During the region of Maharaja Nara Narayan (1556-1588)[8] Cooch Behar alone was an extensive Kingdom consisting of almost the whole of North Bengal, Bhutan, Sikkim and whole of Modern Assam and eastern states of India extending up to the coast of Bay of Bengal. Gradually Cooch Behar was reduced to a small district.

Cooch Behar remained sovereign upto 1772 and became a feudatory state under the British East India Company following a treaty of 1773 between the East India Company and Cooch Behar state. According to the third article of the treaty of 1773[9] Cooch Behar was annexed to the British territory. In 1947 India gained its independence but Cooch Behar remained as a feudatory state. From 1947 to 1949 Cooch Behar was out of the political map of West Bengal. It was on January 1950 Cooch Behar merged with Indian Union.

(d) Uttar Dinajpur and Dakshin Dinjapur

The district of Dinajpur was born as result of partition of India. At that time the district has only one Sub-Division named as Balurghat and was consisting of the western part of the old Dinajpur district of undivided Bengal. In 1948 Raiganj was formed into second Sub-Division. In the same year Hilli was added to the district of West Dinajpur. According to Bihar West Bengal Act of 1956, a tract of land was transferred from Purnia district of Bihar to West Bengal. At first this tract of land was annexed to district of Darjeeling. Subsequently however, the area consisting of

---

[7] Das, A.J., 1947 : op.cit, p. 41.
[8] Chaudhury, H.N., 1903, Cooch Behar and its Land Revenue Settlement, Chapter-V, p. 232.
[9] Ibid, p. 242.

Chopra, Islampur, Goalpokhar and Karandighi Police Station was added to the district of west Dinajpur. Again in 1956 the area lying to the north of Mahanada river was transferred to Darjeeling district and making the river as the northern limit of the district of West Dinajpur and a new Sub-Division was created in the name of Islampur

Thereafter, West Dinajpur was divided into two districts and are known as Uttar Dinajpur and Dakshin Dinajpur.

(e) Malda

Malda has a very rich historical past. In ancient time Malda was a part of the kingdom of Paundrabardhana ruled by Paundra the youngest son of King Bali. In third century A.D. Malda region was an important unit of Gupta Empire. Ishan Barman the King of Magadha attacked the area and ruled for sometime. During the rule of Sasanka the area was called Gaur and was powerful in the eastern region of the country. In 9th century during the rule of Pala Kings, the kingdom of Gaur flourished as a great power in Bengal. In 1215 and 13th century, during the rule of Sen Dynasty, Gaur as a state became very powerful. After the advent of Muslim period the kingdom of Gaur became an important center of trade during the medieval period of history of Bengal.

In 1680 British purchased one village near Malda and established a Kuthi from East India Company. In 1771 British made one fort near Malda and it came to be known as English Bazar. In 1813 Malda was created as a new district of Bengal. In 1815 the district was consisting of eight thanas or police stations curved out from different districts of Purnia, Dinajpur and Rajshashi.

The Problem

Agricultural development is very much important for the elimination of regional disparities and promotion of national integration.

The Indian sub-continent has become free from colonial rule with extreme regional variation in terms of development in agriculture. In post independence period

attention has been paid to remove all regional disparities and agricultural development was first priority to the Government of India. In spite of this fact some states in India even today appears to be developed in agriculture and economically more advance while others are relatively backward. Besides, with in each states some regions are observed to be more developed while others are more primitive.

In India population is also expanding at a high rate. With the growing population more and more lands are being brought under cultivation.

The development of agriculture does not necessarily mean full scale change nor does it involve expensive changes in the morphological features of the land. What is needed is better understanding of the geomorphic parameters of the agricultural field which includes the morphological characteristics of the terrain, sequence of the land, drainage characteristics, physical potential of the land and how different land form react to the external pressure.

The study area, i.e., North Bengal with particular reference to Darjeeling district in the state of West Bengal is acknowledged as agriculturally and economically backward region according to the indicators prescribed by different institutions to determine agricultural development of specific regions in India.

The North Bengal is a region of great physical inequalities with varied topographical features. The physical constraints can be divided into the following categories :

(i) Variations in topography;

(ii) Variations of soil fertility;

(iii) Problems of drainage;

(iv) Problems of frequent floods;

(v) Uncertainty and uneven rainfall and temperature;

(vi) Soil erosion and landslides;

(vii) Problems due to irrigation.

All these factors directly or indirectly wholly or partly stood in the way of development of agriculture in North Bengal in general and Darjeeling district in particular.

The geomorphology is the foundation and background of agriculture, influencing the entire agricultural structure of North Bengal specially Darjeeling district and have naturally brought to the fore from a number of research issues. What impact does the terrain has on the agricultural development of North Bengal ? What is the place of agriculture in the economic life of rural population ? What is the pattern of agriculture? What are the effects of climate on agriculture ?How soils and their properties are influenced directly by topography relief and altitudes ? What is the importance of forestry in this region. What are its impacts ? What is the magnitude of natural calamities ? What are the present problems of agriculture ? What role agriculture has if developed, plays in economic life of North Bengal as well as national economy ?

All these along with other related questions still remain unanswered as no comprehensive work on the influence of terrain on agricultural development of North Bengal specially of Darjeeling has yet been made.

In view of this, an attempt has been made in the present study to find out the impact of terrain on the agricultural development of North Bengal in general and Darjeeling district in particular.

Hence the study is expected to be very much important in the planning in the field of agriculture.

Scope of the study and its objectives

Keeping the above issues in view the following objectives have been framed in this study.

a) To reveal the geographical conditions of the North Bengal with special reference to Darjeeling district.

b) To find out the impact of climatic factors affecting agriculture.

c) To analyse nature extent and role of altitude and slopes in the region.

d) To analyse nature and fertility of soil.

e) To find out various physical constrains such as, soil erosion, landslides flood and drought in the way of development of agriculture.

f) To find out production, yield and cropping intensity of various agricultural crops of the region.

g) Analyse and study drainage and irrigational facilities.

h) To find out the application of fertilizers and its impact on agriculture.

i) To make an evaluation of the forest and its impact on agriculture.

j) To examine nature of rural settlement in the hill and plain areas of North Bengal.

k) Synthesis of problem associated with terrain agriculture both in plain mountains.

l) To explore the pattern of agriculture in Darjeeling.

Hypothesis

For the spatial analysis of the above problems the following hypotheses are proposed.

a) To know the various agricultural problems of the study area.

b) To study the impact of terrain on agricultural development in hills as well as plain areas of North Bengal.

c) To make the agriculture in North Bengal a viable preposition, it is necessary to introduce a new system, which would improve the

productivity and there by giving rise to better economic return to the cultivators and improve their economic conditions.

Methodology Adopted

For the purpose of carrying out this study with aforesaid objectives the following methodology may be adopted which will make the study an systematic one.

a) To start the work the consultation of similar works should be done at first instant. The methods and techniques used by the researches in the similar field of studies should also be consulted which may help in doing the present work an easier and comprehensive way. A bibliography is to be made including all similar works done so far for other areas previously.

b) Library work will be carried out to consult the available literature in the relevant topics.

c) To find out agricultural landuse and cropping pattern and secondary information relevant to the topic would be collected from different government departments, agencies and organizations.

d) Field work will be done in all the districts of North Bengal.

e) Primary data will be collected with the help of field notes, questionnaires, maps, ground photographs and personal observations.

f) Computer would be used to analyse the data.

g) Maps will be prepared with new cartographic techniques.

h) Lastly agricultural regions have been formulated with a view to tackling the terrain constraints for useful development of agriculture of the district of Darjeeling in particular.

Significance of the study

A study of the problems of agriculture in the North Bengal particularly Darjeeling district has a special significance. The future researchers in the field of agriculture will get more knowledge about the agricultural practices and patterns of agriculture which is greatly influenced by the terrain and other physiographic aspects of this region. Apart from academic significance this study will help planners and agricultural geographers to formulate developmental programme for cultivators.

The study will also strengthen national economy.

Organisation of Chapters :

The preface deals with works related to this work done by prominent geographers since 1925 till 2005. Introduction contains the geographical setting of the study area the statement of the problem, scope and objectives of the study, Hypothesis, methodology adopted and significance of the study.

The contents of the thesis are divided into three parts. Viz. part one general, part two problems and prospects of physical environment of agricultural relevance and part three applications in national economy.

The chapter one deals with the geology of the North Bengal.

Chapter two contains physical setting including relief and drainage system.

Various aspects of soil is analysed in chapter three.

Chapter four contains climate and its effects on agriculture.

Chapter five contains forest areas of the study area.

Chapter six purports to examine the population, settlement including agriculture.

Chapter seven presents the general landuse pattern in North Bengal.

The second part deals with the agriculture problem and prospects of the study area.

Chapter eight deals with geology, rocks composition, soil and agriculture of Darjeeling district.

Chapter nine is designed to exhibit the influence of climate on agriculture.

Chapter ten evaluates the impact of relief slopes, altitudes river system drought flood landslides and soil erosion an agriculture.

Chapter eleven examines the landuse pattern of Darjeeling.

Chapter twelve presents the forest and agro-forestry system in India.

Chapter thirteen deals with the population settlement and agriculture in the study area.

Chapter fourteen examines the comparative study of agriculture in the hill and plain areas of Darjeeling. Planning policy for agricultural development and agriculture in national economy, plan period and its future prospect through agricultural regions.

Chapter fifteen,agriculture in national economy, plan period and its future prospects through agricultural regions.

Chapter sixteen presents summary of the entire work and some suggestions and prognosis.

PART – ONE

GENERAL

CHAPTER – ONE

1.0 Geology

North Bengal is covered by diverse rock types ranging from the oldest Archaean metamorphis to sub-recent and recent alluvium. This region lies partly in the extra peninsular region and partly in the plain. The stratigraphic succession of the rock units in the area is indicated below :

Quaternary	Sub-recent to recent		Newar alluvium
	Pleistocene		Older
	..... Unconformity		
Tertiary	Mio-Pliocene	Siwalicks	Coarse grained sand stone silt stone and conglomerate
	..... Main Boundary Fault		
Palaeozoic	Permo-carboniferous	Gondowanas	Feldspatic and micaceous quartegetic sandstone carbonanceus slates with thin seams of crushed coal and pebble/boulder bed.
	..... Tectonic / Erosional contact		
Riphean (Algonhian)		Buxa formation	Ortho-quartzite variegate phyllite inter bedded with quartzite and dolostone (stromatolitic locally)
Pre-cambrian (Riphean)	Daling Darjeeling Group	Darjeeling formation	Garnet, biotite schist, staurolite-Kyanite sillimanite schist, garnet-biotite sillimanite gneiss and migmatites.
		Daling formation	Slates and phyllite phyllonite epidiorite chlorite sericite schist carponaceous mica schist and quartize

NORTH BENGAL

PHYSIOGRAPHY

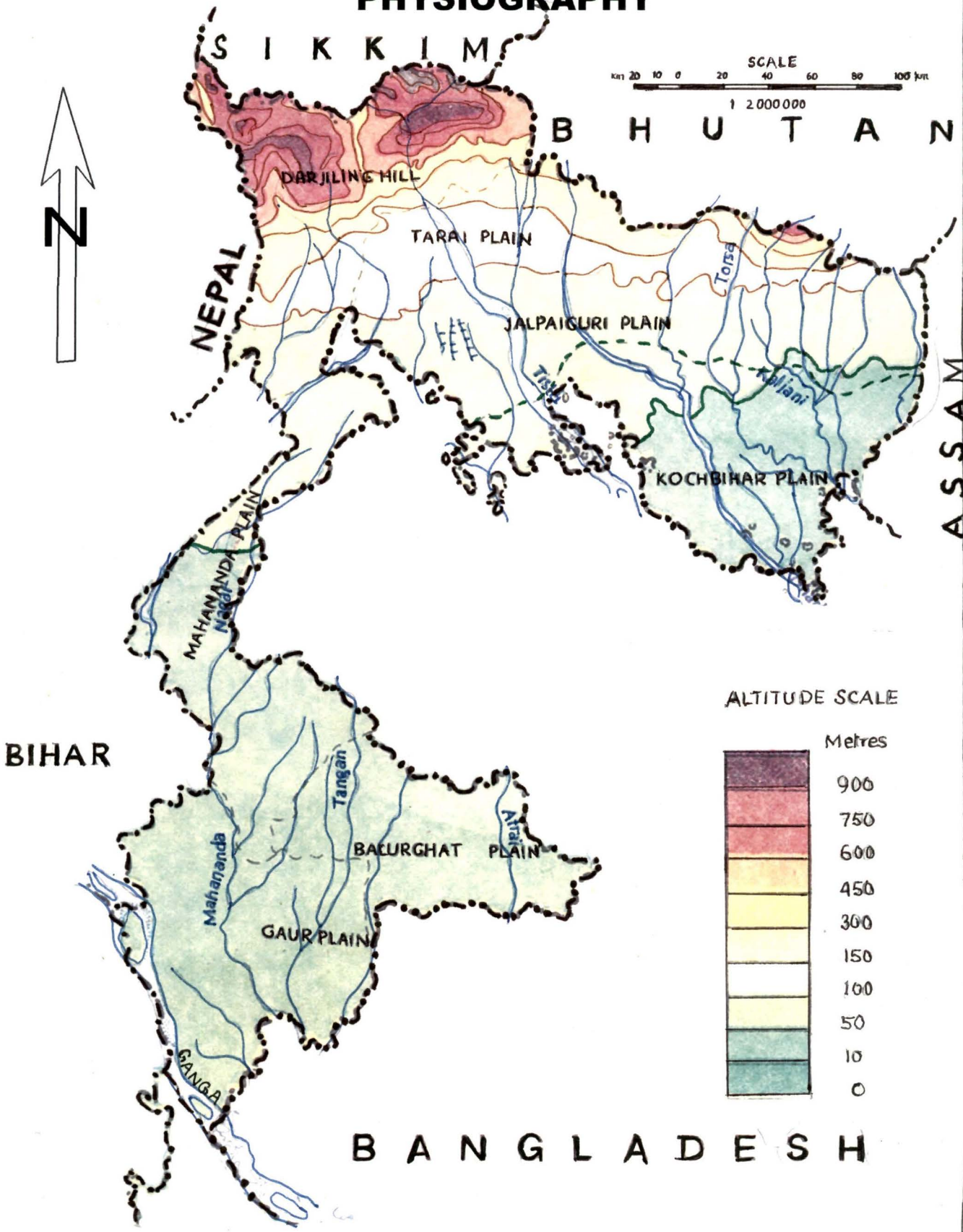


FIG 1.1

Source-NATMO, Kolkata

Fig. 1.1 Shows the physiography map of North Bengal.

The various rock formations of North Bengal is given below :

1.01 Daling Darjeeling Series

The mountainous tract of the Himalaya extends over the hilly areas of districts of Darjeeling and Jalpaiguri. This tract is characterized by folding thrusting and metamorphism with resultant inversion in stratigraphy. The siwalik formations are overlain by the Gondwanas along the main boundary fault followed by the Darjeeling formations. The Dalings are represented by state phyllite, phyllonite, epidiorite, quartizite and schists of different grades of metamorphism while the Darjeeling comprises of migmatites and variety of high grade schistose and gneissic rocks. The Daling series always underlies the Darjeeling series. The grade of metamorphism part over the Daling series.

The Dalings occupy a large area of about 13 kilometer wide in the Tista valley. Presence of graphitic material emplaced mostly within shear zones has been reported from Rakti river.

The Darjeelings are represented by golden and silvery mica schists, garnetiferous staurolite-kyanite mica and coarse mica gneisses and migmatites graphitic material has been reported to occur in these rocks along shear zones. The experts are of the opinion that both Darjeeling and Daling series belong to a Riphean age and a lower Paleozoic age.

1.02 Buxa Formation

It comprises predominant by of dolostone, phyllite and quartzite etc. occupying the northern part of Jalpaiguri district around Buxa and Jainti Hills. North of Buxa series lies the Daling series. A clear cut contact between the Daling and the Buxas cannot be demarcated even though the Dalings are argillaceous in nature while the Buxas are an admixture of argillaceous, arenaceous and calcareous facies. Besides, the presence of

hematite schist and banded hematite josper in the Buxas are also very distinctive feature. The rocks are assigned a Riphean age and some geologist consider them to be of a younger age.

1.03 Gondwanas

The Gondwana formation occurs in the district of Jalpaiguri and Darjeeling. These rocks as a tectonic unit sandwitched between the tectonically underlying Siwaliks and the overlying Dalings or Buxas. The thrust plane between the Gondwanas and the siwaliks is known as the "Main Boundary Fault". Gondwana rocks consist of pebbles, boulder slates, quartzites, quartzites slates and carbonaceous slates and coal seams. The whole assemblage of the Gondwanas including the coal has undergone intensed metamorphism giving rise to sandstones. The Gondwana sandstone shows normal bedding, but the upper part of it is interbeded with clay slates. Coal occurs in the band of Gondwana rocks, which runs from near Pankhabari to Dalimkote and with small gap up-to the Jaldhaka river. The Gondwana series is also noticed near Tindharia in Darjeeling district.

1.04 Tertiary Rocks

The Tertiary rock formation is noticed in the "Terai" region of Darjeeling district and northern part of Jalpaiguri district. These rocks consist of detritus material of coarse hard red sandstone, siltstones shale and pseudo conglomerate, belonging to the "Siwaliks". This formation occupies the foothill areas of Himalayas. It consists of fine grained sandstone at the lower level and basal red clay stone and pebbles in the upper layers. The lenses of lignite and fossil wood are commonly present in this formation.

1.05 Older and Newer Alluvium

The older alluvium is the Pleistocene deposit. It comprises generally unconsolidated sediments and consists of boulders pebbles and gravel along with sand silt calcareous and limonitic concretions. The older alluvium generally occupies high grounds forming raised-terraces and mostly covers the southern portions of foot hills and

forms part of the Gangetic alluvium in the area known as "Terai" Many such terraces have been identified in the "Terai" region.

The newer alluvium is of recent origin. The newer alluvium is mostly confined to the southern part of raised terraces and gradually merges with deltaic plains of south-undivided Bengal. It occupies the northern and western part of Uttar Dinajpur and Dakshin Dinajpur, western part of Malda.

CHAPTER – TWO

2.0 Physical Setting Including Relief and Drainage System

On the basis of elevation, morphological features and slopes of the terrain, North Bengal may be divided into four physiographic units :

(A) The northern hills;

(B) The Terai;

(C) The transitional zone between the Terai and the Duars

(D) The plains of Uttar Dinajpur, Dakshin Dinajpur and Malda.

2.01 The Northern Hills

The northern hills are the important physiographic region of North Bengal. This region corresponds with the three northern sub-divisions of Darjeeling district and the hills of the extreme northern region of Jalpaiguri district.

The whole of the mountainous tract is devoid of tableland or plain areas. It consists of the hills of the lower Himalayas, characterized by bold spurs. The hilly portion of the district of Darjeeling consists of complicated relief features with ridges and narrow deep gorges. Most of the ridges stretch from north to south. This zigzag alignments of the ridges give rise to a number of long spurs on either side of the ridges. The river courses also follow the north-south direction. In some cases the spurs also run from east to west.

The Darjeeling Himalaya consists of two important ridges stretching from north to south. The most important is the Singalia range which separates the district from Nepal. It has three highest peaks, Sandakphu(3630 metres) Sabargam(3543 metres) and Phalut(3596 metres). The other is the Darjeeling range rises abruptly from the

terai to the Senchal range. Ghum is a part of Senchal range. In the east a ridge stretches from Manibhanjan upto Ghum and then rises abruptly to the Senchal and Tiger Hills. The ridge then turns and descends southward up to Mahaldiram and Dow hills. A number of spurs branch down from this ridge on either sides, of which the most important are the Takdah and Peshok spurs. Darjeeling spur is situated on the north-stretching spur of the Manibhanjan-Senchal range. Other important spurs are Lebong and Tukvar spur. The highest ridge is Reshila. From here a ridge runs south east and another towards Labha. From here an important spur runs south west ward through Kalimpong and descends steeply into the Tista Valley. Five terraces consisting of gravel have been traced to the east of the river. The hilly portion of Jalpaiguri district comprises the part of the Bhutan hills. The Sinchula range divides the Indian territory from Bhutan. In Buxa Duars lies the highest peak of the area called Chola Sinchula(1699 metres). Some terraces have been found on the eastern side of the river Jaldhaka. This river has made a down cutting through the Nagrakata terrace. At Nagrakata a tableland has been developed, and is known as Nagrakata Plateau.

2.02 The Terai and the Duars

The area extending southward from the foot hills of Darjeeling and Jalpaiguri districts has been divided into Terai and Duars by the Tista river. The area lying west of the Tista river is known as Terai and area lying east of the river is known as the Duars. The Duars is a flat land averaging 30 to 20 kilometer in width and covered almost by forest and dry sandy river beds. The area belonging to Duars is disectd by numerous rivers and hill streams in every direction.

The Terai region lies about 100 meters above sea level. It is an intermediate zone between the hills and the plains.

The Terai in Darjeeling, geographically a part and parcel of this region, pleads its geological neutrality. It is composed of alternating beds of gravels sand and boulders,

brought down from the hills and deposited by the torrential rivers on reaching down to plains where their velocity and carrying capacity are miserably lost.

2.03 The Transitional Zone between the Terai and the Duars

This is the plain of Cooch Behar. This area has an average elevation of about 90 meters above the sea level. It is a triangular shaped plain area, which remains waterlogged during the rainy season. This area is intersected by numerous rivers and streams flowing southwards.

2.04 The Plains of Uttar Dinajpur, Dakshin Dinajpur and Malda to the South

This region includes the whole of the districts of Malda, Uttar Dinajpur and Dakshin Dinajpur districts. The region forms a part of "Ganga Brahmaputra Doab"[1], the parts of which lies in Bangladesh.

This large plain mainly composed of old and recent alluvium, sandy loams drained by many large and small rivers, characterized by recent floods. The altitude is insignificant here, varying from 300 meters to 100 meters from north to south.

Uttar Dinajpur and Dakshin Dinajpur are mainly flat in appearance, but there is a difference between the north and south districts. The south district consists of law ridges, the highest of which does not exceed 30 meters. The topography of both the districts is generally undulating. The general slope of both the districts are from north to south, which is indicated by the south flowing rivers.

The topography of the district of Malda is also flat in nature. The river Mahananda divides the district into two parts – the Rarh and the Barind. The eastern part of the river Mahananda is known as Barind and western part is known as Rarh. The Barind tract is generally elevated, varying from 15 meters above the level of Ganga. Apart from the Barind tract the rest of the district is generally plain land. The Barind tract is

[1] Spati, O.H.K., 1967 : India Pakistan - The Bengal Delta, Chapter 9 (Region XII), p. 571.

divided by the rive Kalindri into two parts. The northern part of the river Kalindri is known as 'Tal', which is subjected to deep floods. The meandering courses of the river give rise to swamps. South of the Kalindri river lies the fertile tract of the district.

2.05 Drainage System

North Bengal is drained by many large rivers with their numerous tributaries and distributaries. The varied physical and geological characteristics of the region have profoundly influenced the drainage pattern of the area. In the district of Darjeeling rectangular drainage is observed. In other plain areas of North Bengal dendritic drainage pattern is noticed. Fig. 2.1 depicts drainage system of North Bengal.

The large rivers of North Bengal are the Tista, the Torsa, the Jaldakha, the Sankasa, the Raidak, the Mahananda, the Mechi, the Balason, the Atrai, the Punarbhaba, the Jangon. Only the Ganga and the Tista and some other tributaries have their origin in glaciers. Other rivers rise from the drain outs of the precipitation in the different parts of the Himalayan range and these rivers become dry in the dry season. Some of the rivers of the North Bengal are falling in the Ganga and others are falling in the Brahmaputra.

A brief description of the rivers of North Bengal are given below :-

The Tista

The most important river of North Bengal is the Tista with its many tributaries and distributaries. There is a controversy about the source of the river Tista. According to some sources it rises from the Chitamu lake in Tibet. Other maintains that the river rises below Kanchanjungha. Tista was flowing into Ganga till 18th centry, but due to the devastating flood of 1787 it changed its course and joined the Brahmaputra.

The Tista drains the three northern districts of North Bengal such as Darjeeling Cooch Behar and Jalpaiguri. In Darjeeling district the river flows through a deep gorge

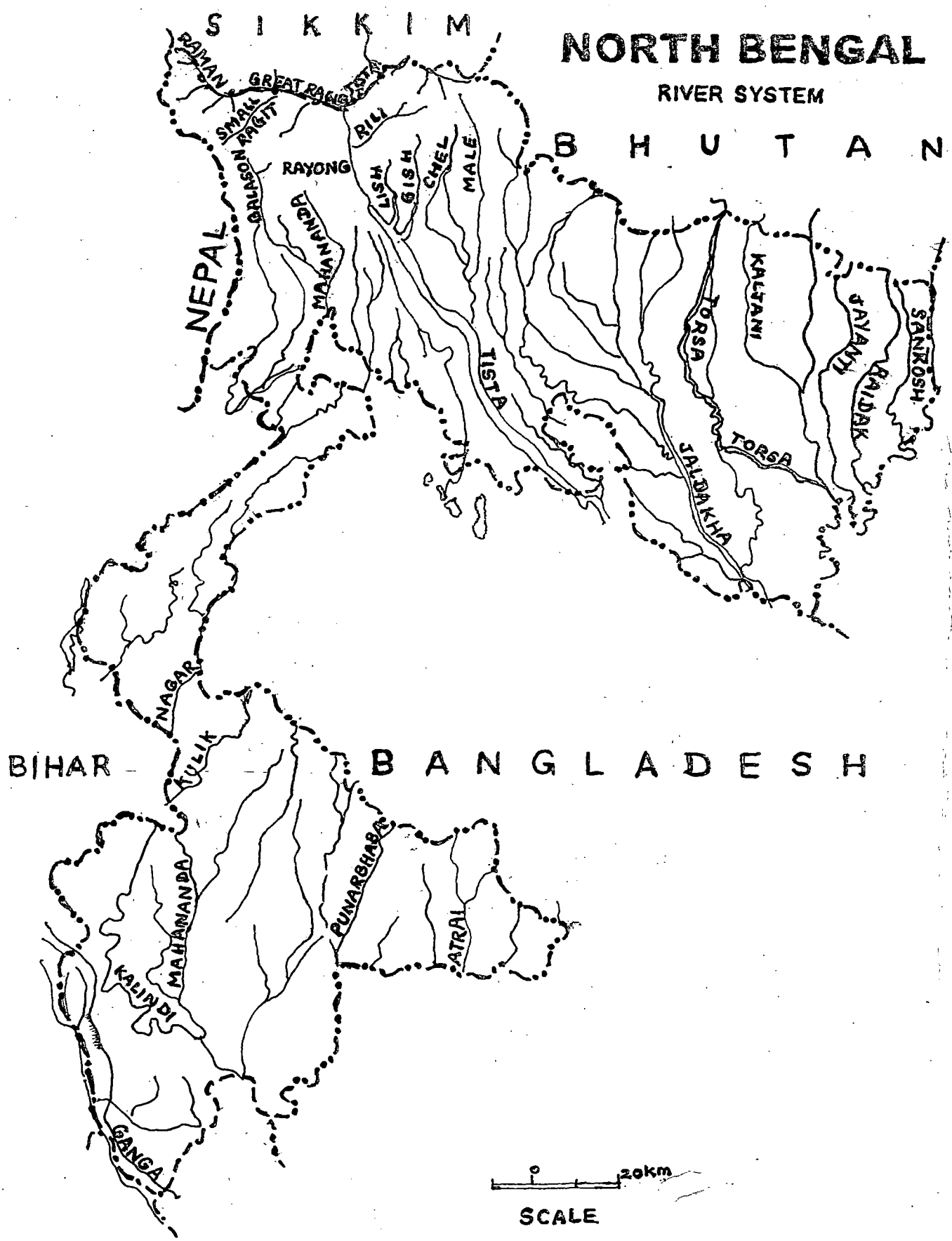

NORTH BENGAL
RIVER SYSTEM
SIKKIM
BHUTAN
NEPAL
BIHAR
BANGLADESH
RAMAN
GREAT RANGIT
TISTA
SMALL RAGIT
RILI
RAYONG
LISH
GISH
CHEL
MALE
GRAISON
MAHANANDA
TISTA
TORSA
KALTANI
JAYANTI
RAIDAK
SANKOSH
JALDAKHA
TORSA
NAGAR
KULIK
MAHANANDA
KALINDI
PUNARBHABA
ATRAI
GANGA
0
20km
SCALE

FIG.- 2.1

known as Sivok Khola pass. In hilly areas its drainage area is 4800 square kilometers. The hill tributaries of the river are Rangpo, Rangit, Ranjo, Raying Rambi and the Sevok. In the plain areas Lish, Ghish, Saldanga, Karla, Dhalk are the tributaries of the Tista. The Bara Rangeet river joins Tista at the northern junction of Darjeeling and Kalimpong Sub-Division. Near Sivok the river comes down the plains. After a short course in the Darjeeling district the river Tista enters Jalpaiguri district and flows across the district of Jalpaiguri and finally enters the Mekliganj Sub-Division of Cooch Behar district. Here the river flows for about 11.30 kilometers and thereafter it enters Bangladesh and joins the river Brahmaputra.

The Mechi

The Mechi river rises in the Rangbang spur in the Singalila range in Nepal. The river flows in a north south direction. It flows along the eastern border of Darjeeling district. Near the western boundary of Siliguri Sub-Division it eventually joins the Mahananda in the Purnia district of Bihar.

The Jaldakha

The Jaldakha is called in the upper course as Di-Chhu. It receives Ni-Chu in the north-eastern part of Kalimpong Sub-Division. The combined river flows southward with the name Jaldakha and forms the boundary of Darjeeling district and Bhutan. In Jalpaiguri district the river flows southward at the extreme south of Cooch Behar district. The river finally enters Bangladesh and joins the Brahmaputra. The tributaries of the Jaldakha rivers are Diana, Murti, Khanabati, Mujnai and Dharala etc.

The Torsha

This river has originated from the Bhutan hills below the Tung pass. It flows through the Chumbi valley of Bhutan and then enters the Jalpaiguri district. The river eventually enters the Cooch Behar district in a north-south direction, splits up into two branches. The western one joins the Brahmaputra after a course of 392 kilometers and the eastern one flows into Raidak.

The Sankosh

The river rises in the Bhutan hills. Sankosh separates Jalpaiguri district from Assam. It flows through the north-eastern portion of Cooch Behar district and receives a branch of Raidak. The combined river is known as Gadadhar which finally falls into the Brahmaputra.

The Mahananda

The Mahananda has its source near Mahaldiram range a few kilometers east of Kurseong in Darjeeling district. It flows in a southerly direction and reaches the plains in Siliguri Sub-Division. Here it changes its course a little to the west and forms the boundary line between the Terai and Jalpaiguri as far as Phansidewa in the extreme south east of the district. The Mahananda separates Darjeeling district from Uttar Dinajpur and enters Bihar. It however enters West Bengal from the northern part of Malda district and flowing through the district and finally enters Bangladesh to join the river Padma. The Mahananda receives a number of hilly streams, the most important being Balason.

The Balason

It originates from Lepcha Jagat and turns southward having several small streams rising in the valleys, west of Kurseong, join together to form Balason which ultimately joins with the Mahananda river in the lower reaches.

The Nagar

The Nagar rises at the south Dinajpur and flows southward and joins the Mahananda river.

The Kulik

The Kulik has originated in Bangladesh. It is the principal tributary of Nagar.

The Punarbhaba

This river flows in a north-south direction. The Punarbhaba enters the district of Dakshin Dinajpur from Bangladesh on the north of Gangarampur Police Station. Leaving the district of Dakshin Dinajpur it touches the north eastern boundary of Malda district and then enters Bangladesh.

The Atrai

It enters the district of Dakshin Dinajpur on the north of Kumarganj Police Station. It also flows in a north south direction and enters Bangladesh.

The Tangon

This river flows through the district of Dakshin Dinajpur and enters Malda at the junction of Gazole and Bamongola Police Station. It joins Mahananda river at Malda district. A branch of the river Tangon named Tara Tangon flows for several kilometers and joins the parent river near Bamongola.

The Kalindri

The Kalindri is taken as an off shoot of the eastern branch of the Ganga. Actually it is a branch of the river Mahananda.

The Ganga

The Ganga flows through the south-western boundary of Malda district. There is a big island or 'char' in its bed known as 'Bhutni diara' or 'Bhutni Chak'. The river flows through two channels lying north and south of this island, the main channel being on the Rajmohal side.

CHAPTER – THREE

3.0 Soil

Development of different types of soil is the result of climate, the nature of parent material, the topographic feature of parent material, the topographic feature and the time. The depth of the soil in North Bengal is rather low and the soil is principally derived from tertiary rocks. The texture of the soil is mainly from sandy loan to loam and the colour of the soil is yellowish. These soils are mainly parous and have faced acute erosion. These are not very fertile but responsive to fertilizes is noticeable.

The soils of North Bengal (Fig. 3.1) are generally poor in organic matter and as well as in nitrogen content. Organic matter is decomposed quickly in the soils. With the loss of organic matters other physio-chemical properties of the soil deteriorates. Therefore, the percentage of nitrogen and phosphorus content is very low. Soils of the hilly areas are immature than the soils of the plain areas, moreover hill soils are constantly disturbed by the process like soil creep.

The analysis of the soils of these region shows that the soils have low to medium nitrogen, potash and phosphate contents. Nitrogen content is markedly low in the districts of Darjeeling, Jalpaiguri and Cooch Behar. Potash and Phosphate contents are almost same in the six districts of North Bengal. The average pH value is between 4.5 to 6.4 and there is no problem with salt content (T.S.S. or total soluble salt) in the soils of North Bengal. In some areas of North Bengal the soils contain high organic matter and as a result soils are slightly dark in colour.

The following table 3.01 will gives an idea about the types of soil availability of Nitrogen Potassium, Phospate and pH as well as total soluble salts as found in the soils of different districts of North Bengal.

NORTH BENGAL
SOIL

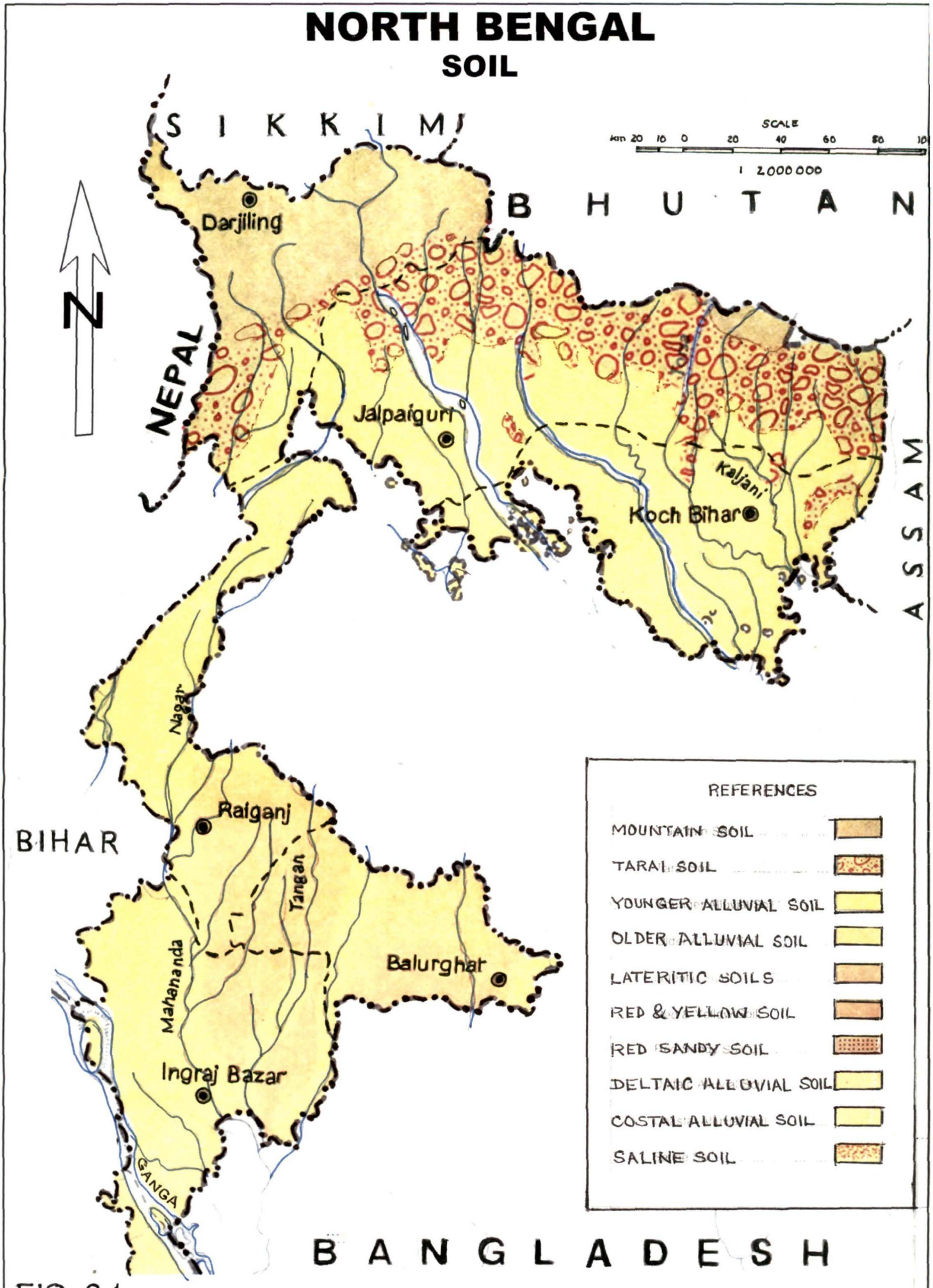


FIG. 3.1

Source- NATMO, Kolkata

Table 3.01

Textural Classification of Soils of North Bengal

Sl.No.	District	Darjeeling	Jalpaiguri	Cooch Behar	Uttar & Dakshin Dinajpur	Malda
	Soil Type	Sandy Loam	Sandy Loam	Loam and Clay Loam	Loam and Clay Loam	Loam and Silty Clay Loam
1	pH-Acid	94.5	94.0	100.0	47.6	14.4
2	Normal	5.5	4.0	-	52.4	85.6
3	Tending Alkaline	-	-	-	-	-
4	T.S.S. Normal	100.0	100.0	100.0	94.5	100.0
5	Germination Critical	-	-	-	-	-
6	Growth Critical	-	-	-	-	-
7	Nitrogen					
	Low	15.5	20.0	18.7	68.3	78.8
	Medium	68.9	74.7	80.2	30.3	21.2
	High	15.5	5.3	1.1	1.4	-
8	Phosphorus					
	Low	38.8	51.4	19.1	60.0	56.8
	Medium	31.1	35.3	39.9	24.2	13.6
	High	30.2	13.3	41.9	15.8	29.3
9	Potassium					
	Low	4.2	80.0	-	66.7	25.7
	Medium	52.0	20.0	-	33.3	41.0
	High	43.8	-	-	-	33.3

Sources : 1. Dept. of Agriculture, W.B. 2. Dept. of Agriculture, Soil Division, Siliguri, 2000.

Taking all the factors into consideration, following broad classification of soils of North Bengal may be made. Table 3.02.

(a) Hill soils (podzol).

(b) Terai soils

(c) Alluvial soils and

(d) Red soils

Table 3.02

Types of Soils in North Bengal

Types of soil	Area
Brown Hill / Forest Soils (Palehumulls)	Hilly areas of Darjeeling district.
Terai soils or Tista Alluvium (Haplaquolls)	Jalpaiguri, Cooch Behar, Uttar Dinajpur and Dakshin Dinajpur
Alluvial Soil Gangetic Alluvium (Haplaquents)	Malda
Red soil	Eastern part of Malda and South Eastern Part of Dakshin Dinajpur

Source : Directorate of Agriculture, Govt. of West Bengal (Soil Conservation) 2001.

3.01 Hill Soil (Podzol)

The hill soils occupy the large forest belt of the district of Darjeeling. The nature of the soils changes with the altitude. For example, it is black and alluvial soil in the Siliguri Sub-Division but higher up it is rather reddish or white in colour and less fertile. In the northern part of Darjeeling soils mainly consists of boulders, pebbles and sands. Reddish soil is found in some tracts of Kalimpong and Gorubathan Police Stations of Darjeeling district. In Kalimpong Police Station clay soil with high acid content is available. Grey brown soils are found in the hills of North Bengal. This soil is rich in Nitrogen and calcium content. Podzolization is evident in this soil and genuine Podzol soils are found here.

3.02 Terai Soil

The terai soil is the soil of the region. The best quality of land is occupied by the tea gardens of terai region. The terai soil have been classified into three broad groups; (i) Grey sand loam, (ii) Yellow Sandy Soils and (iii) Red Earth.

(i) **Grey Sandy Loams :** This type of soils occupies the reverine tracts of the terai and the duars. The soil is composed of grayish sands formed of gravels and sands. This is the most fertile agricultural tract of North

Bengal. This type of soil is highly acidic but the organic composition of the soil is lower.

(ii) **Yellow Sandy Soil :** This type of soil occupies extensive areas between the rivers Torsa, Tista and Dima. This soil has developed by the action of rivers of the terai and the Duars. These rivers are the Mahananda, the Mechi, the Balason, the Tista and the Torsa. Yellow sandy loam soil is rich in organic matter but the clay content of the soil is remarkably low, the ultimate result of which is leaching. All the organic matter are transported downward. In this way all the acid and iron components are accumulated in the lower layer. This soil is Chemically rich due to podozolization. (Banerjee 1954) [1]

(iii) **Red Earth :** The read earth occupies the transitional zone between the Darjeeling hills and the plains. This soil occupies the areas from Rhohini and long view to the plains, in the Duars, the soil is found between Lehti and Diana rivers. This typical soil has high percentage of clay, alumina and iron oxides. This soil has the highest percentage of clay fractions followed by coarse sand, fine silt etc. But this soil is differentiated from water borne soils.[2]

3.03 Alluvial soil

This type of soil occurs in the southern part of the district of Jalpaiguri, Cooch Behar and western part of Uttar Dinajpur, Dakshin Dinajpur and Malda. In the district of Jalpaiguri, the alluvial deposits spread over a heap of sand resting on a irregular rock formation of uneven height. The alluvial layer consists of coarse gravel near the hills and sandy clay and sandy loam further south. A path of hard black clay has developed in the areas between the Jaldhaka and the Tista. The highland of the district is mostly sandy, whereas low lands consists of clay with small portion of sand. Alluvium soil

[1] Banerjee, B : The Soils of West Bengal. Geographical Review of India, Vol. 14, No. 3, p. 4
[2] Ibid, p. 5

occupies the greater part of Cooch Behar district. In some places loam and clay loam are noticed. Again some parts of the district contains light loaming soil with moisture holding capacity. The layer of fine loam is thin and fine sand is available in the sub-soil followed by coarse sand. Black loamy soil is found in the eastern part of the district. The high lands are generally sandy and medium lands contains ash coloured loamy soil. The soil of the north-western portion of Uttar Dinajpur and Dakshin Dinajpur of the river Tangon and Punarbhaba are sandy loam. A greater proportion of sand is found in this type of alluvial soils. The alluvial soils of the district of Uttar Dinajpur and Dakshin Dinajpur may be classified as old alluvium, alluvium and new alluvium. The texture of old alluvium varies from heavy clay to clay loam with slightly acidic in reaction. This type of soil occurs in Balurghat, Tapan, Kumarganj, Gangarampur, Bashihari, Itahar and parts of Hilli, Kushmandi, Kaliaganj and Hemtabad. Old alluvium soil is poor in organic matter and phosphate content.

The soils of Raiganj, Karandighi, parts of Hilli Kushmandi, Kaliaganj, hemtabad and Gelpukur-II belong to alluvial group. These types of soils are from clay loam to sandy in texture, mostly slightly acidic to acidic in reaction and internal drainage capability is medium. The remaining parts of the both Uttar and Dakshin Dinajpur occupies new alluvial soil. It is mostly found in the areas of Islampur sub-division. The soils are acidic and very acidic in reaction and sandy loam in texture with fair drainage capability.

The above mentioned three types of alluvial soils have low nitrogen with medium phosphate content.

The soils of the western part of Malda is loam and silty clay loam. On the bank of the Ganga mixture of mud and fine sand is found.

3.04 Red Soil

The eastern part of Malda and south eastern part of Dakshin Dinajpur consists of quasilateritic alluvial soil. It is the result of the wathering of metamorphic rocks. The

colour of the soil is red to reddish black. The texture of the soils coarse and poor in organic matter and plant nutrients. The soil is acidic in nature.

At present all available normal soils are utilized for agricultural purpose and hence defective soil regions may be utilized after necessary ameliorations. Acid soils in N.B. are found in the districts of Darjeeling. Jalpaiguri Malda. Acidity of the soils of this state varies between pH 5.0 & 6.5; though in some areas like Darjeeling it is even less than 5.0.

Table 3.03

Acidity of soils

Name of the districts	Soil pH
Darjeeling	5.0
Jalpaiguri	6.4
Malda	6.1
Cooch Behar	6.0
Uttar Dinajpur	6.1
Dakshin Dinajpur	6.1

The acidic character of the soils makes them less suitable for agriculture most of the plant nutrients become poorly available of the major nutrients, nitrogen and phosphrous tend to become available in lesser amounts below pH 6.0 without sufficient supply of these nutrients plant cannot thrive well. Hence to get good yield of crop soil pH requires rectification. The best means of checking soil pH is to use burnt lime or indigenous material like shell of snail oysters etc. which contain sufficient lime which is however released to the soil very slowly.

CHAPTER – FOUR

4.0 Climate and Its Effects on Agriculture

Agriculture implies settled population and can therefore, be carried on only if the yield is sufficient to support more or less a permanent settlement. The limits of cultivability are set by topography soil, rainfall and temperature. Moreover the extent to which agriculture is practised depends on the relative factors of human behaviour, cultural tradition and pressure on population.[1]

Success or failure of farming is very intimately linked up with the prevailing weather conditions. Farming in India is largely a gamble in weather condition. A sound knowledge of climatic factors and effects of weather on crop growth and yield is therefore essential for every farmer.

The North Bengal has two distinct tracts – the hills and the plains.

The mountainous portion of the north-east and the area bordering the Himalayas in the north experience lower temperature mainly due to the effects of elevation. The west extension of the Himalayas effectively bars the influence of cold polar winds, on the other hand annual range of temperature does not show continental character due to the influence of the Bay of Bengal. **Fig 4.1** reveals the climate of North Bengal. Table 4.01 shows annual range of temperature in North Bengal.

[1] The Indian Geographical Journal 1993, Vol. 68, No. 2.

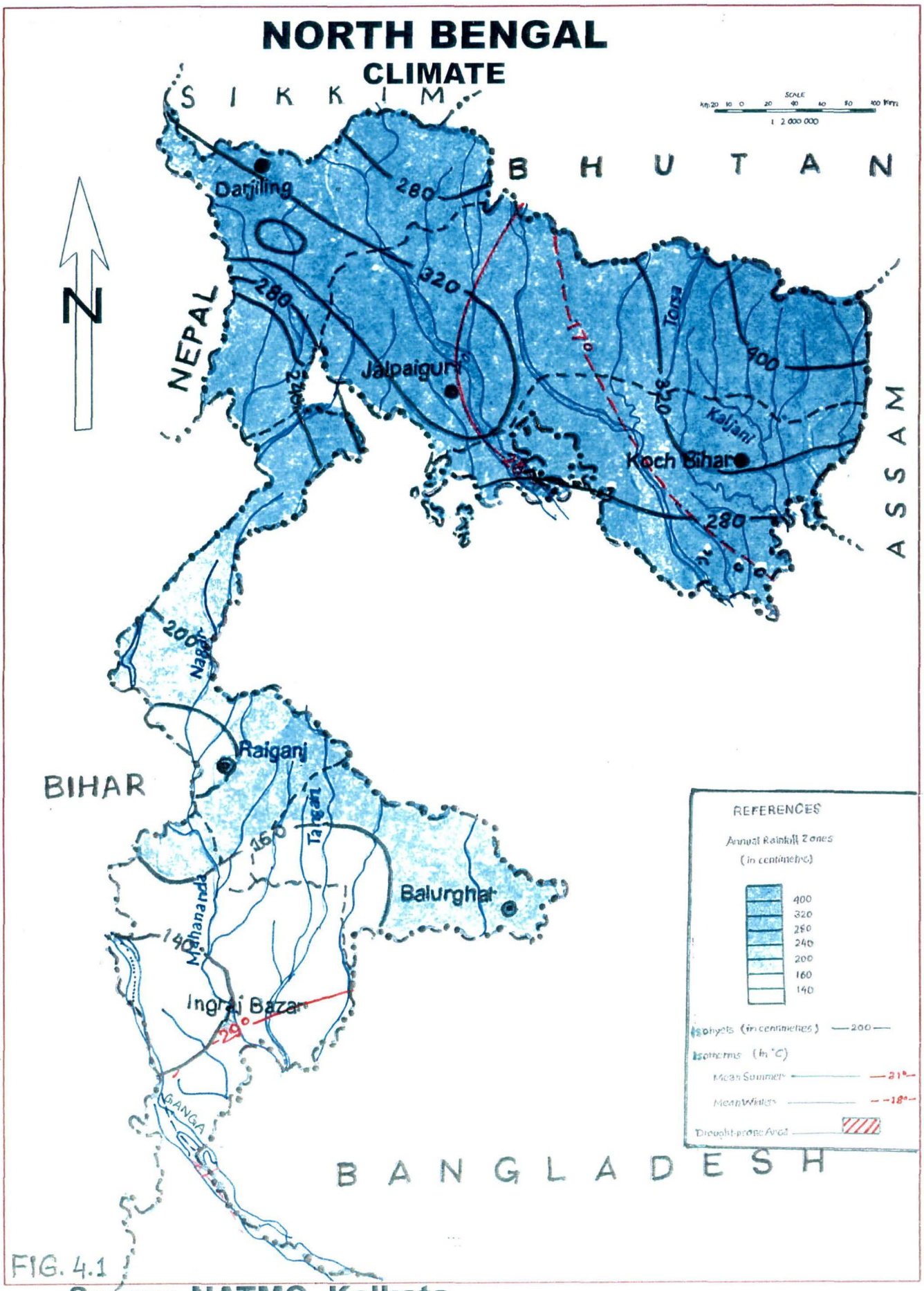


FIG. 4.1

Source-NATMO, Kolkata

Table 4.01

Annual Range of Temperature in North Bengal (1997-2001)

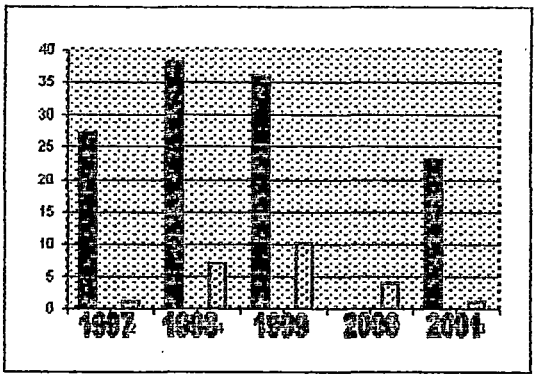
District	1997		1998		1999		2000		2001	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
Darjeeling	27	1	38	7	36	10	-	4	23	1
Jalpaiguri	37	6	39	8	37	8	37	7	37	1
Cooch Behar	36	7	39	8	39	8	37	7	36	7
Uttar Dinajpur	40	7	39	7	37	7	38	7	39	6
Dakshin Dinajpur	40	7	39	7	37	7	38	7	39	6
Malda	41	9	43	8	42	9	40	8	41	7

Source: Meteorological Department, Govt. of West Bengal, 2002.

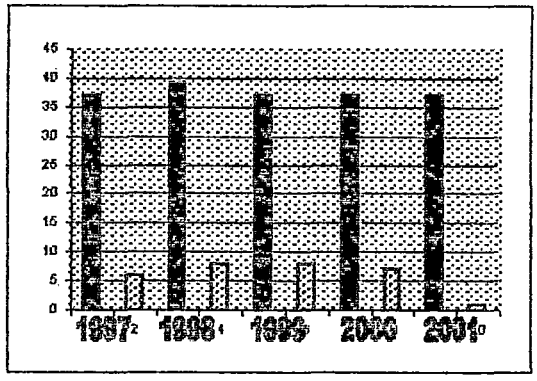
January is the coldest month of the year in North Bengal. The east west trend of isotherms specially in the north reveal the influence of mountains on temperature distribution. The temperature in hills both at night and day is higher during monsoon. The mean daily maximum and minimum temperature in the month of January varies between 1° to 9° Celsius respectively.

In the remaining parts of North Bengal the average annual temperature is almost uniform. May is the hottest month of the year with a greater range of temperature. In the district of Jalpaiguri, Cooch Behar, Uttar Dinajpur and Dakshin Dinajpur the summer temperature is more or less the same and increases upto 38° Celsius and above. The temperature continues to increase further southward crossing the mark of 43° Celsius in the Malda plains. This district experience very hot summer. A similarity in winter temperature is observed in Jalpaiguri, Uttar Dinajpur, Dakshin Dinajpur districts and between the districts of Cooch Behar and Malda. January is the coldest month of the region. (Fig. 4.2)

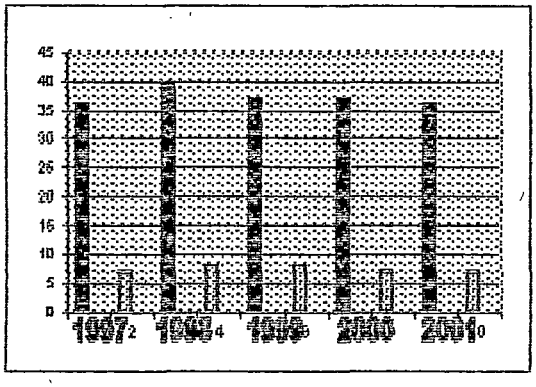
The winter of North Bengal is characterized by clear and almost stable atmospheric conditions.



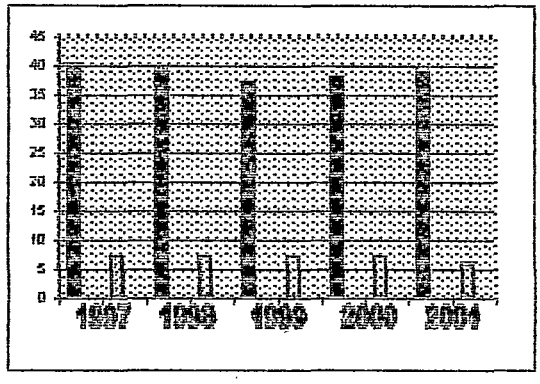
Darjeeling



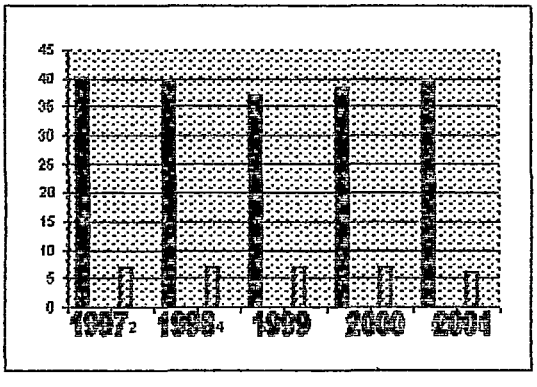
Jalpaiguri



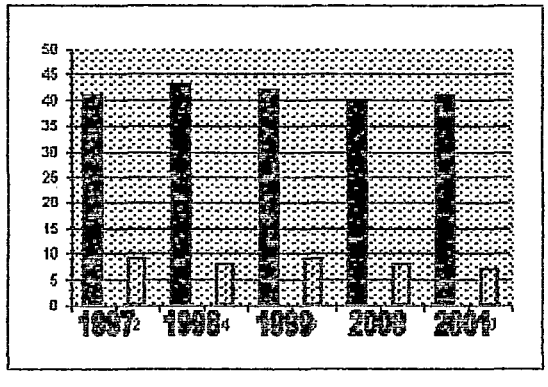
Cooch Behar



Uttar Dinajpur

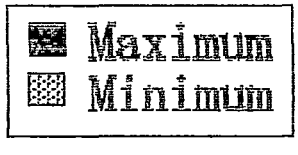


Dakshin Dinajpur



Malda

Annual range of temperature in North Bengal
Fig. 4.2 (tempt. in degree Celsius)



The relation between temperature and cultivation cannot be established without taking rainfall into consideration. Like temperature, rainfall plays an equally important role in the production of crops. But it is rather difficult to specify the ideal requirements of rainfall for each variety of crops. Apparently it appears that there is no such upper limit of rainfall at which the plant might cease to grow. The highest amount of rainfall is restricted to the northern-most part of the region at higher altitude and it decreases southward. Table 4.02 shows rainfall in six districts of North Bengal.

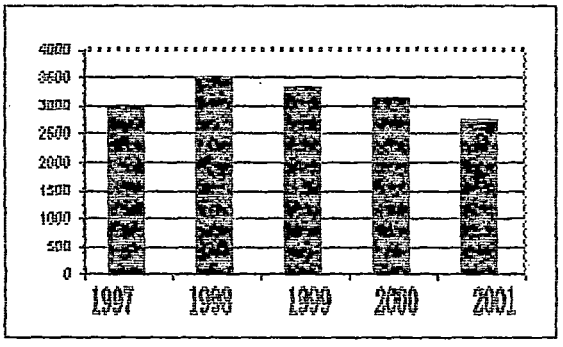
Table 4.02

Annual Rainfall in Six Districts of North Bengal (in millimeter)

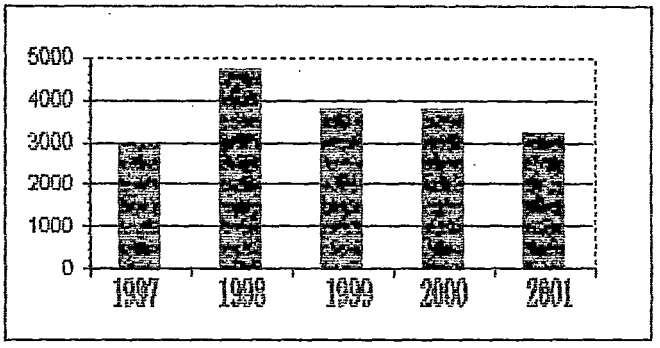
District	Normal	Actual				
		1997	1998	1999	2000	2001
Darjeeling	2961	1966	3474	3323	3123	2727
Jalpaiguri	3571	2935	4698	3736	3733	3205
Cooch Behar	2898	2530	4141	3182	2961	2526
Uttar Dinajpur	2085	2027	3026	2811	1955	2259
Dakshin Dinajpur	1625	1464	2267	2306	1455	1656
Malda	1661	1418	1719	2059	2141	1557

Source: Meteorological Department Govt. of W.B., India, 2002.

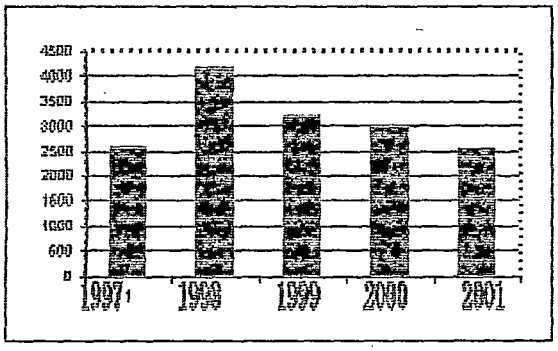
In higher altitudes rainfall is well distributed from February to October. About eighty percent of the total rainfall is received during the months between May to September. During this period there are more than twenty rainy days in each month. This region has an average of one hundred twenty rainy days in a year. The rainfall in general is heavier in the southern slopes may get 4050mm while Kalimpong in the north gets 2254 of rainfall. Siliguri subdivision gets around 3000mm of rainfall annually. In other parts of the district of Jalpaiguri and Cooch Behar, decrease in the amount of rainfall is almost gradual. The rainfall in these area ranges between 2500 to 4000mm in a year. The total amount of rainfall decreases in the southern districts of Uttar and Dakshin Dinajpur. The average annual rainfall is between 2000mm to 1600mm.



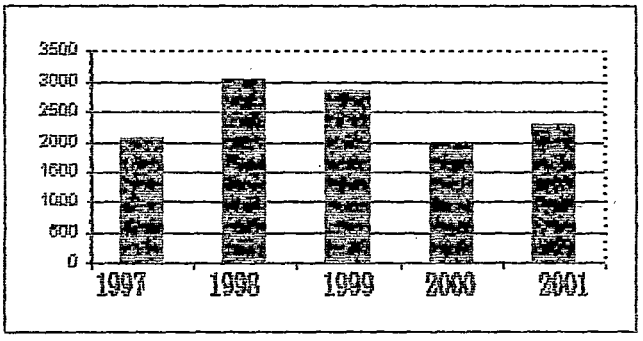
Darjeeling



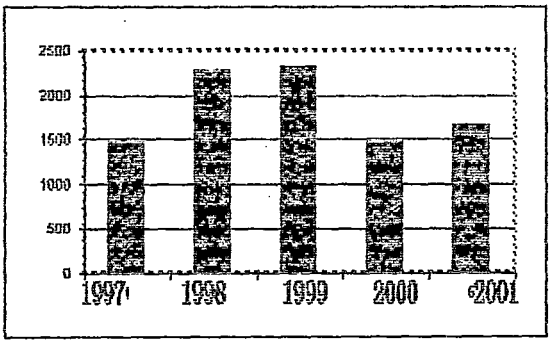
Jalpaiguri



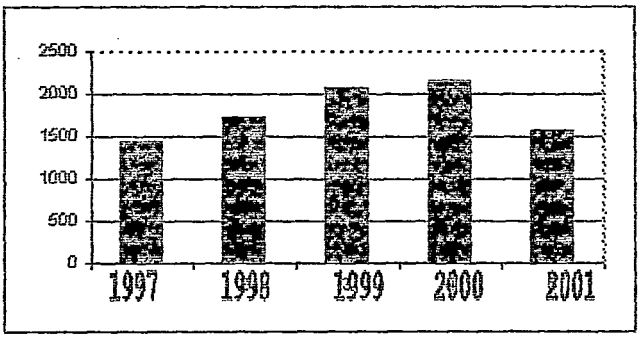
Cooch Behar



Uttar Dinajpur



Dakshin Dinajpur



Malda

Fig. 4. 3 Annual rainfall in six districts of North Bengal (rainfall in mm)

Rainfall further decreases in Malda and annual rainfall ranges between 1600 to 2000mm.

Fig.-4.3 Showing rainfall variation in six districts of North Bengal

It has been observed through experience that the yield of crops usually increases with an increase in rainfall. But if the heavy rainfall continues for a long time, the production of crops falls. This may be attributed due to the non-availability of sunlight during the growing period. Excessive rainfall generally occurs from the period of mid June to September. This is due to combination convergence of wind system and orographic effect.

The moisture content present in the air mass is also another factor affecting the crops. The air-mass in North Bengal usually contains 85 to 90 percent of relative humidity. It may be mentioned here that generally, heavy rainfall is favourable for the cultivation of jute and rice in plain areas, but excessive rain causes flood and water logging and damages standing crops. Extreme low rainfall in some hilly tract of North Bengal needs artificial watering. Hailstorms also occur in many areas of North Bengal and also damages crops.

Productivity of crops depends very much on the total amount of light which plant receives in varying degree with seasons. Strong wind and cyclone, which usually occurs in some areas of North Bengal damage crop by breaking fruits and branches of trees. In such cases wind break belts and selection of protected sites become helpful.

CHAPTER – FIVE

5.0 Natural Vegetation (Forest)

North Bengal is gifted with a large area of forest in its mountainous terrain and adjacent valleys. Table 5.01 shows the area and percentage of forests in North Bengal.

Table 5.01

Area and Percentage of Forest in North Bengal, 2002

District	Total area according to D.L.R., W.B.	Forest area according to state forest deptt.	Percentage of forest to total area of the district
Darjeeling	325.470	1245.75	38.27
Jalpaiguri	622.70	179.00	28.74
Cooch Behar	331.38	3.15	0.95
Uttar Dinajpur	312.467	0.579	0.18
Dakshin Dinajpur	221.908	0.932	0.41
Malda	371.05	16.8	0.45

Source: Directorate of Agriculture Govt. of W. B., 2002.

In the districts of Darjeeling and Jalpaiguri 38.27 percent and 28.74 percent of the geographical area to the total area of the respective districts are under forest cover. Fig. 5.1 depicts the forest areas of North Bengal.

The forests of Darjeeling and Jalpaiguri districts, which comprise the forests of Duars and Terai consist of North tropical moist deciduous forest. In the hilly areas, northern tropical wet hill forests and Himalayan moist temperate forests and their various sub-types are found. The following diagram 5.2 showing the percentage of forest in different districts of North Bengal.

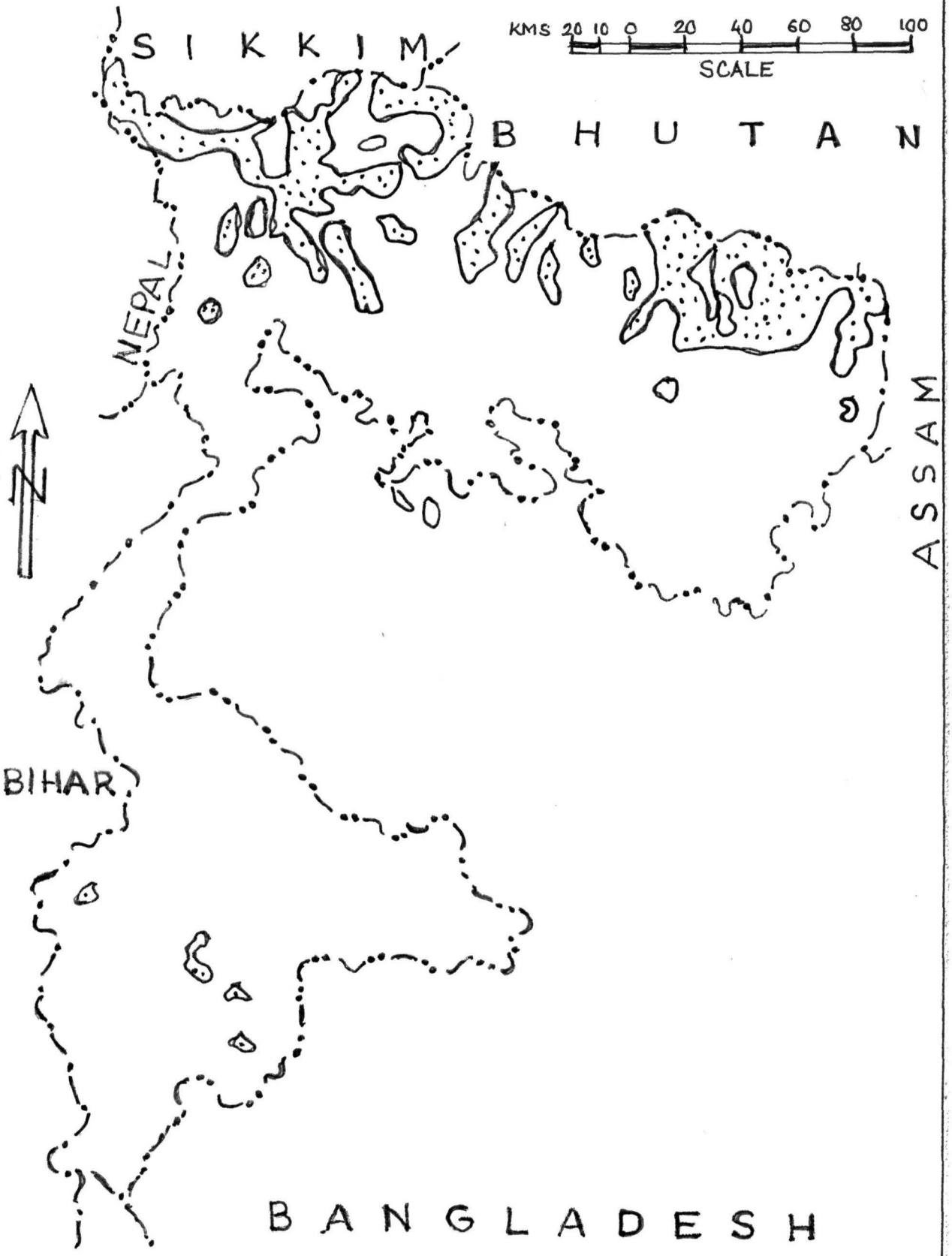

NORTH BENGAL
FOREST AREA
KMS 20 10 0 20 40 60 80 100
SCALE
SIKKIM
BHUTAN
NEPAL
ASSAM
N
BIHAR
BANGLADESH

Fig. 5.1

These forests are covered with valuable trees such as sal, simul, panisay, paccasy, gamari, oodal, lali, kadam etc. Such forests, a bounty from nature to the mankind provide fuel and raw material for several industries. Valuable timber available in the forests of North Bengal are mainly used for the manufacture of furniture and plywood. Plywood is used in manufacturing of tea chests packing boxes.

Prior to independence more than 63 percent of total area of Darjeeling and Jalpaiguri districts were covered with dense forests. But due to pressure of population and large-scale immigration after independence from the bordering states forests covers are rapidly decreasing. There is no forest worth mentioning in the district of Cooch Behar. The area under forest cover is only 0.95 percent of the total area of the district. In Malda, Uttar Dinajpur and Dakshin Dinajpur forest area is 0.45, 0.18, 0.41 percent respectively. Table 5.02 shows classification of forests in North Bengal.

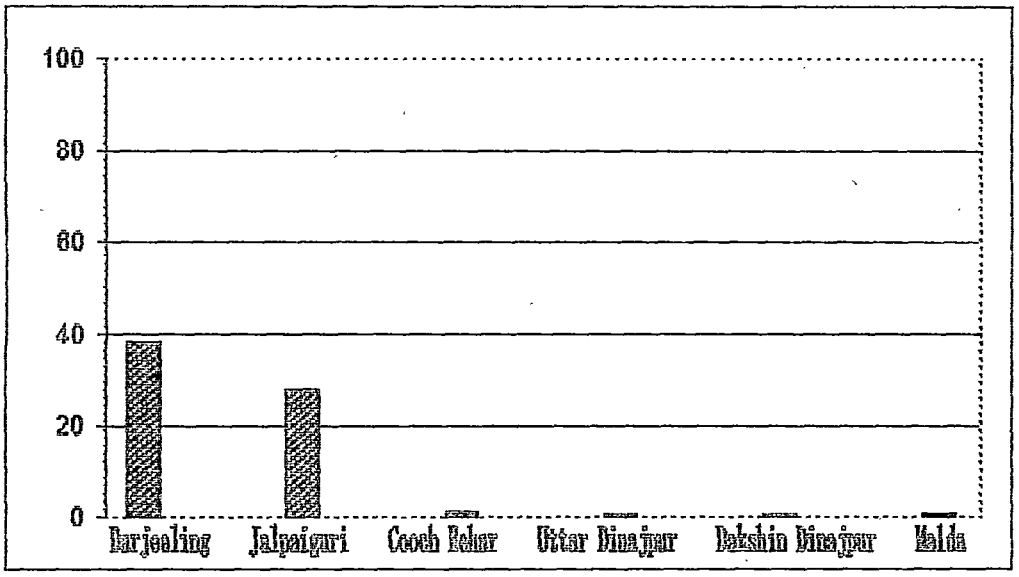
This vast forest area is not uniform in nature in all the tracts of the district of Darjeeling. There exists wide variation in the types of forests. The variation is mainly due to the variation of altitude and climate. The most remarkable feature of the forests of Darjeeling is the wonderful variety of species that they contain. There are in fact probably few places in the world in which so many different types of the forest exist within so small area.

Table 5.02
Classification of Forest Area in Six Districts of North Bengal (2001-2002)

(area in hect.)

District	Reserved forests	Protected forest	Unclassed state forest	Khas forest	Other
Darjeeling	104373.00	1752.30	5759.87	-	
Jalpaiguri	138784	18313	5779	1421	
Cooch Behar	-	4127.43	340	16.14	2847.14
Uttar Dinajpur	349.96	66.37	162.85	-	517.12
Dakshin Dinajpur	549.34	157.31	145.11	-	245.25
Malda	806.50	378.00	284.62	-	509.80

Source: Divisional Forests Office, Raiganj, Cooch Behar, Jalpaiguri, Malda, D.F.O., Kurseong, Kalimpong.



Percentage of forest in North Bengal (area in p. c) (2001-02)

Fig. 5.2

Forests of North Bengal are classified into (1) reserved forest, (2) protected forest, (3) unclassed forest, (4) Khas forest, (5) Vested waste land forest, owned by corporate bodies and (6) forests owned by private individuals. Jalpaiguri has 138784 hectares of reserved forests and Darjeeling has 104373.00 hectares. Cooch Behar does not have reserved forest. The area of reserved forest in Uttar Dinajpur, Dakshin Dinajpur and Malda are 349.96, 549.34, 806.50 respectively. Protected forest covers 18313 hectares in Jalpaiguri district. Protected forest covers 1752.30 and 4127.43 hectares of Darjeeling and Cooch Behar district other southern districts have very less protected forests. Uttar Dinajpur, Dakshin Dinajpur and Malda have 66.37, 157.31, 378.00 hectares of protected forest respectively. Darjeeling has 5759.87 hectares of unclassed state forests followed by Jalpaiguri 5779 hectares. Cooch Behar has 340 hectares of unclassed state forest. The district also contains 16.14 hectares of Khas forest. Jalpaiguri district also has 1421 hectares of Khas forest are. Uttar Dinajpur, Dakshin Dinajpur and Malda have 162.85 hectares, 145.11 hectares and 284.62 hectares of unclassed state forests respectively. There are some private forests and corporate forests in the districts of Uttar Dinajpur, Dakshin Dinajpur and Malda.

CHAPTER – SIX

POPULATION, SETTLEMENT INCLUDING AGRICULTURE

6.0 Population

Agricultural land resources have played a vital role since time immemorial engaging highest percentage of population of the world India, the most populous country of the world is primarily an agrarian country, since the dawn of civilization. Agriculture is the most important source of occupation in rural areas of North Bengal.

The distribution of rural and urban population in North Bengal is plotted in Table 6.01.

Table-6.01

Distribution of Rural and Urban Population in North Bengal, 2001

(Number)

District	Total Population	Urban Population	Rural Population	P.C. of Rural Population to total population
Darjeeling	1605900	520877	1085023	67.56
Jalpaiguri	3403204	603847	2799357	82.26
Cooch Behar	2478280	225506	2252774	90.90
Uttar Dinajpur	2441824	294471	2147353	87.94
Dakshin Dinajpur	1502647	196643	1306004	86.91
Malda	3290160	240915	3049245	92.67

Source: Census of India, 2001.

The distribution of population in North Bengal is shown in Fig. 6.1

NORTH BENGAL
DENSITY OF POPULATION

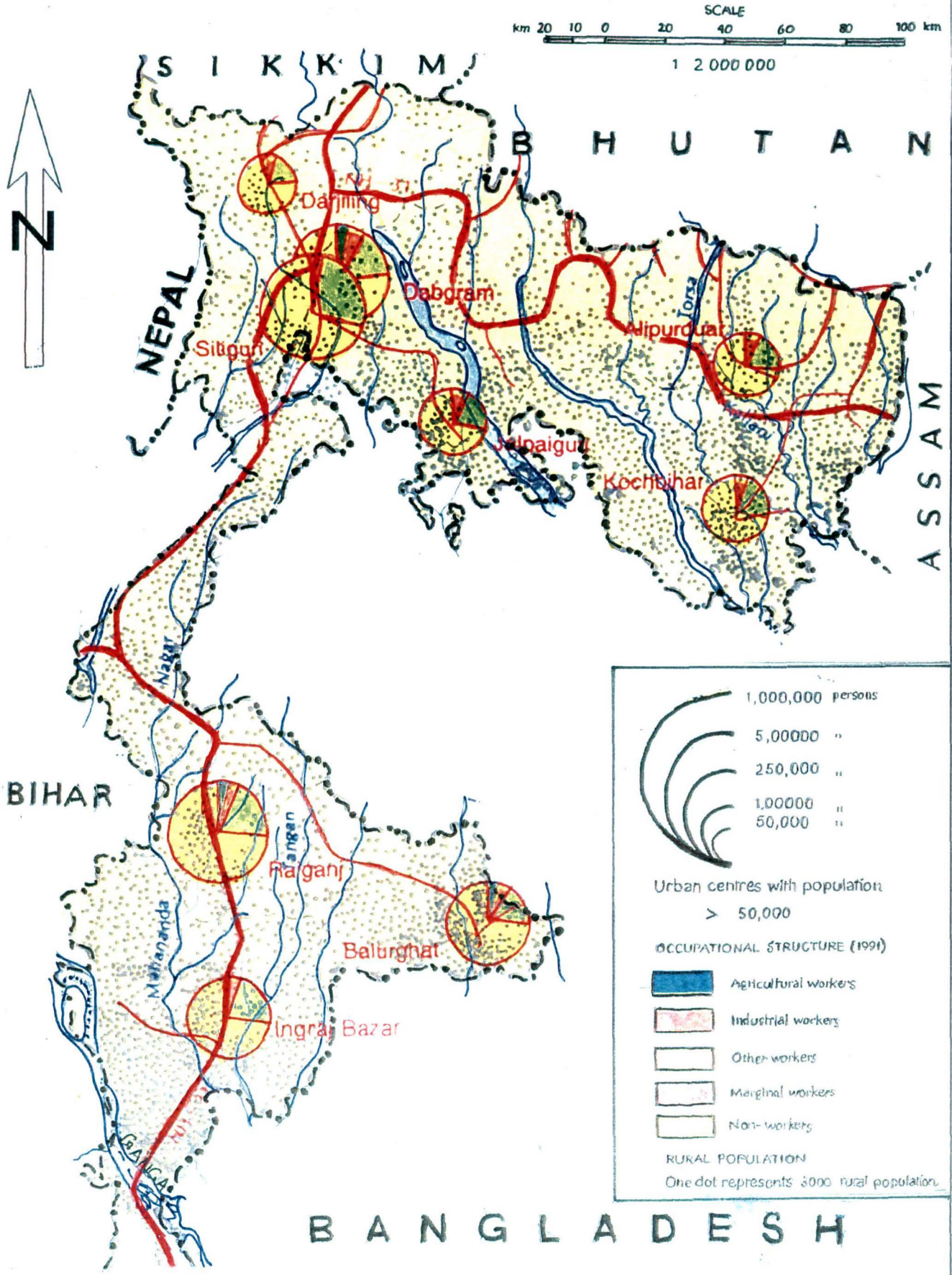


FIG. 6.1

Source- NATMO, Kolkata

6.01 Distribution of Urban and Rural Population

According to 2001 census of India the district of Jalpaiguri has the highest number of population in North Bengal (Table 6.02). Total number of person in the district is 3403204, rural and urban population is 2799357 and 603847 respectively. The second highest populated district in North Bengal is Malda and total number is 329016. Urban and rural population is 240915 and 3049245 respectively. A little more than 92 p.c. people live in rural areas. Next highest populated district is Cooch Behar followed by Uttar Dinajpur. Cooch Behar has 2478280 population, rural population is 2252774 and urban population in 225506. The district has 91 p.c. of rural population. Uttar Dinajpur has 2441824 number of total population 87.93 p.c. are inhabitants of rural areas. Darjeeling district has 1605960 total population, urban population is 520877 and 1085023 people live in the rural areas. Dakshin Dinajpur is less populated as compared to other districts of North Bengal. Total population of the district is 1502647, urban and rural population of this district is 196643 and 1306004 respectively. As high as 92 p.c. of population live in rural areas. Density of population in six districts of North Bengal reveals the concentration of population in this region (Fig. 6.2).

Table 6.02

Area and Density of Population

District	Area in sq.km.	Population number	Density per sq.km.
Darjeeling	3149.00	1605900	510
Jalpaiguri	6227.00	3403204	547
Cooch Behar	3387.00	2478280	732
Uttar Dinajpur	3140.00	2441824	778
Dakshin Dinajpur	2219.00	1502647	677
Malda	3733.00	3290160	881

Sources: Census of India, 2001.

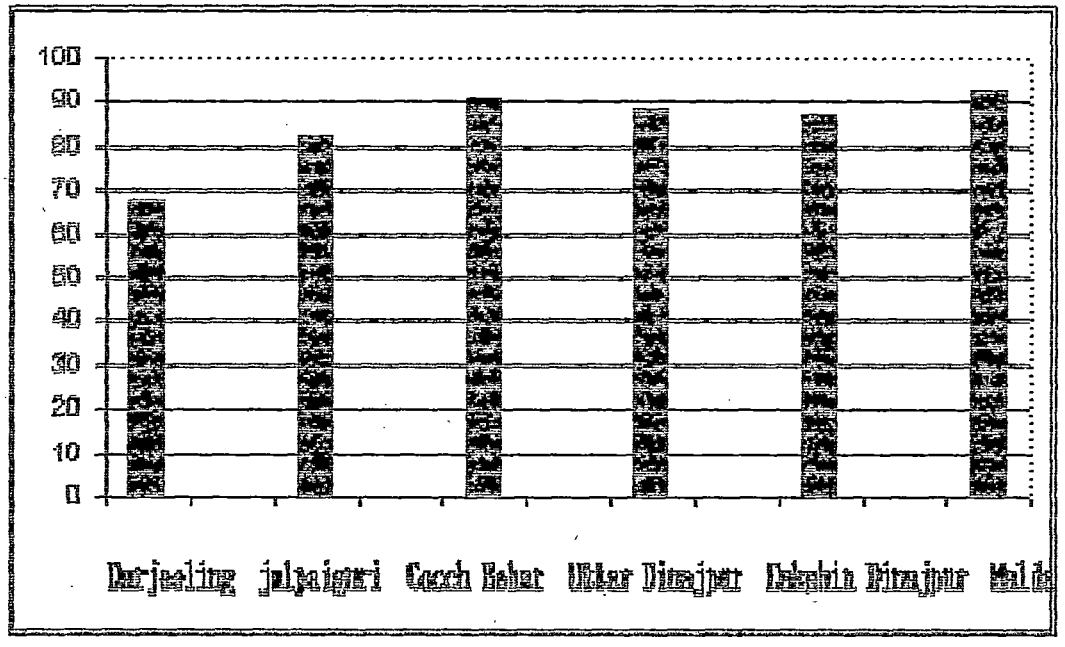


Fig. 6.2 Percentage of Rural Population to Total Population in North Bengal

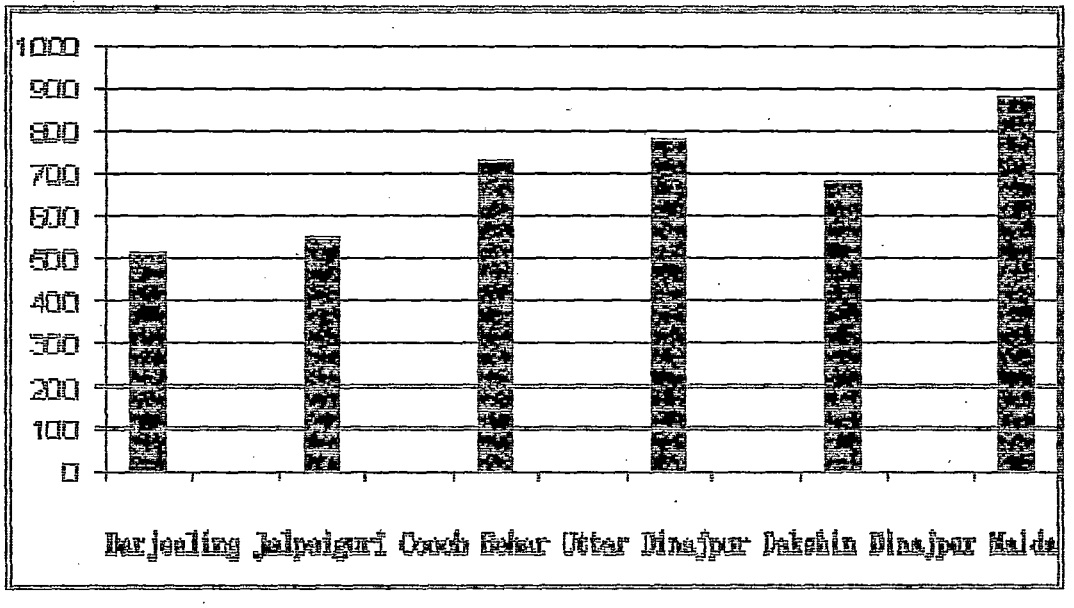


Fig. 6.3 Density of population in North Bengal
(density per sq. km.)

Table 6.02 gives us an interesting picture about the density of population (Fig.-6.3). The southern districts such as Malda, Uttar Dinajpur and Dakshin Dinajpur are densly populated compared to northern districts of North Bengal. It may be mentioned here that plain area is agriculturally developed and attracts people than the hill areas. Malda is densely populated district in North Bengal and 881 persons live per square/km. Uttar Dinajpur ranks second followed by Cooch Behar and density of population is 778 and 732 respectively. The density of population in other districts are Dakshin Dinajpur 677, Jalpaiguri 547 and Darjeeling 510 persons per/sq.km. The percentage distribution of cultivator and agricultural labourers in North Bengal is plotted in table 6.03.

Table 6.03

Percentage Distribution of Cultivators & Agricultural Labourers, 1991 & 2001.

District	1991				2001			
	Cultivators population	P.C.	Agricultural labourers	P.C.	Cultivators population	P.C.	Agricultural labourers	P.C.
Darjeeling	108426	8.34	51782	9.98	82677	5.15	57829	3.60
Jalpaiguri	277052	9.89	165995	5.93	265068	8.24	230241	7.16
Cooch Behar	337818	15.56	184765	8.51	362148	14.61	285137	11.51
Uttar Dinajpur	254208	13.40	229670	12.11	276625	11.33	371081	15.20
Dakshin Dinajpur	184644	15.00	131162	10.66	189462	12.61	222054	14.78
Malda	360924	11.6	318602	12.08	277741	8.44	411437	12.50

Source: District Census Hand Book 1991 and 2001.

Table 6.03 shows a growing imbalance between the population number and natural resources, particularly land resource. It has been found that the percentage of cultivators and agricultural labourers are decreasing sharply in Darjeeling district. In other districts of North Bengal the percentage of agricultural labourers and cultivators remained same or decreased marginally. Because plain area is more suitable for cultivation than hill areas.

6.02 Settlement Pattern

The aspect of relief appears to have been the most important criterior in influencing the growth and distribution of settlement patterns in North Bengal. The physiographic conditions, availability of natural resources, economic conditions and communication systems all together have a direct influence in the distribution and concentration of settlement patterns.

The size and concentration of rural settlement in North Bengal is generally not determined by different service centres such as post office, health centres, educational institutions and communication system.

Agriculture is the main economic activities of the majority of rural population. By and large the rural settlements in North Bengal have remained at the most initial stage of their development. In urban areas, commercial areas occupy the two fronts of the main roads. Roads play a vital role in distribution and development of residential areas. The residential houses are found in the areas served by lanes, bilanes and in some areas the residences are built by the side of the main roads. Recent changes in all sphere of life have negligible or marginal influence on rural settlements. Settlement pattern of different districts of North Bengal are as follows.

Darjeeling

In hilly areas of Darjeeling district there is no general pattern in the distribution of different functions and no concentration is generally found in these settlements. Dispersed settlements are found in agricultural lands.

In plain areas of Darjeeling district a number of houses are found to be clustered together in one place consisting one hamlet. This is separated from similar hamlet by a tract of agricultural land.

Jalpaiguri

The northern part of the district of Jalpaiguri is covered by the forest of Duars region. The presence of forests in the district has made large settlement gaps. Dispersed type of settlement is observed here because of the low density of population. River valley settlement near the Tista and Torsha is also low because of the devastating floods that occur in these rivers almost every year. There are some large villages in the district which are developed. The market centres and weekly hats have given rise to large settlements in some areas. According to 1991 census there are 734 inhibited villages in Jalpaiguri district. There are 265068 cultivators and 230241 agricultural laboures live in these villages, according to 2001 census of India. The percentage of cultivators and agricultural laboures are 8.24 and 7.16 in the district.

The urban centres have developed along the main roads with rural centres around them. There are some forest villages in Buxa forest division of Jalpaiguri. All the forest villages are not situated in the fringe areas of forest, some have interior location. Some settlements are located along the railway lines, road ways or river banks.

Cooch Behar

More than 85 p.c. of the total workers of the district is engaged in agricultural activities. According to 1991 census there are 1139 inhibited villages in the district. The rural settlement is more or less scattered and farmers live in their own agricultural field surrounded by other agricultural labourers. Settlements are found on the concave side of the river and in some areas linear settlement patterns are noticed. Markets centres are located by the river Jaldakha and Torsha. Important urban settlements are Cooch Behar sadar and Dinhata.

North Dinajpur and South Dinajpur

These two districts are basically covered by large agricultural fields. The soil of these districts are fertile and about 12 p.c. of the total population are farmers. There are 1511 inhibited villages in Uttar Dinajpur and 1534 in Dakshin Dinajpur. In these districts large settlement gaps are observed mainly due to the presence of large agricultural fields. Homestead type of settlement is found in both Uttar Dinajpur and Dakshin Dinajpur districts. Miniature villages of 10 to 15 huts are clustered together in some areas. In small towns, cross road settlements are observed. Linear settlements are found by the side of the railway lines, national highways. Markets centres have clustering of small settlements. Linear type of settlement has developed by the side of the river Mahananda.

Malda

The majority of the people in the district live in rural areas. The district consists mainly of low-lying plains, sloping towards the south with undulating areas on the north-east. The Malda plain divided into nearly two equal parts by the river Mahananda flowing north to south. The western part of the district is more developed and has given rise to number or agricultural villages. The eastern part of the district is not developed and has less concentration of settlement. Linear type of settlement is observed by the side of the rivers. Market areas have more concentration of settlements. Settlements are also found by the side of the railway stations, road and in other semi-urban areas. There are many large villages with big and small hamlets.

It is worthwhile to mention that as the percentage of agricultural population is not uniform in all the districts of North Bengal. The regional variations in agricultural density depends upon various aspects of physiographic condition which have governed the mode of agriculture to a large extent.

CHAPTER – SEVEN

7.0 General Land use (Including Agriculture)

Among all the natural resources, the land resource seems to be the most important. The concept of landuse is a wide and complex one. Land with its varied topography, slope, field pattern, soil, temperature, precipitation, natural cover and countless creatures have to be planned to engrave an economy where man can maintain a standard of existence.

It is on this land that man cultivates, crops, builds houses, roads, railways, develop forests, dig reservoirs, canals, wells etc. Hence the various uses of land may be divided into two broad categories –

Lands which are used for agricultural purposes and

Lands which are used for non-agricultural purposes. The present chapter is concerned with agricultural landuse patterns of North Bengal.

In the past land was mostly used for agricultural and residential purposes. With gradual push in socio-economic development the simple land-use pattern changed into complicated one. Due to successive increase in other economic activities relating to secondary and tertiary sectors the demand for land for non-agricultural uses also enhanced. Optimal use of land became part and parcel of over all development policy.

The agricultural land use in North Bengal is not uniform because of the differences in soil fertility, relief, climatic condition etc. There is no clear demarcation of various agricultural regions in the study area and factors that contribute to the regional difference in agriculture are varied. The great regional variation in agricultural resource base is primarily due to varying physio-ecological conditions, level of socio-economic development, demographic and cultural pattern.

NORTH BENGAL

LANDUSE AND CROPPING PATTERN

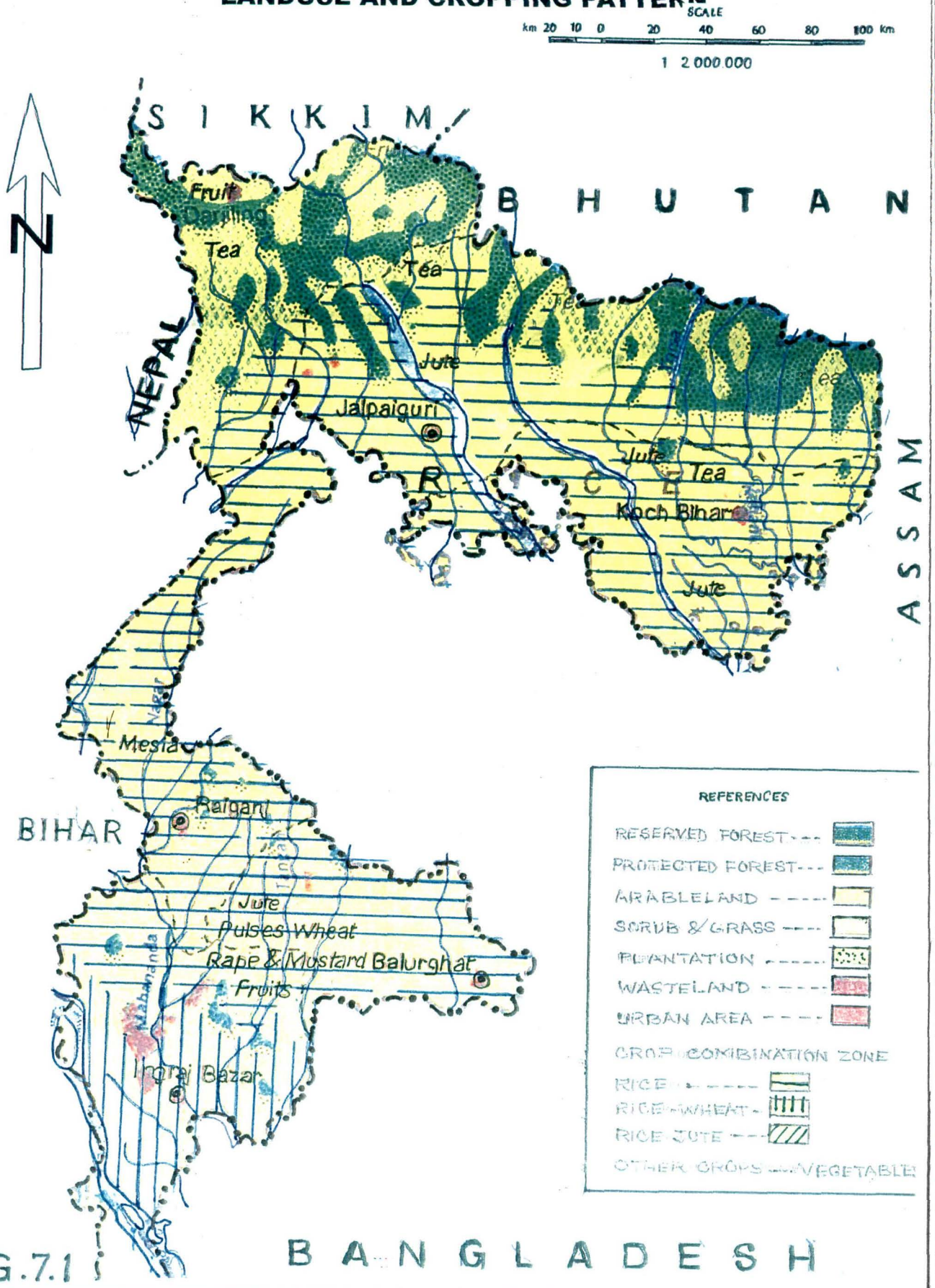


FIG.7.1

Source-NATMO, Kolkata

In North Bengal it has been observed that the pattern of landuse is governed by the relief, morphometrics and morphological characteristics of the area. It is generally found that most of the hilly terrain ridges, domes, rocky table-lands are either under forest or pasture according to climatic condition of the area. Landscape recognised as valleys, alluvial fans, flood plains, outwash plains and loess plains are under intensive agriculture because of low climatic and various physical constraints.

A detail study of the landuse of six districts of North Bengal is as follows : (Fig. 7.1)

7.01 Darjeeling

The district of Darjeeling lies between 27°13′ N and 26°13′ N latitude and 88°53′ E and 87°59′ E longitude and covers an geographical area of 3149 square kilometers. The study area comprises three hill sub-divisions viz.- Darjeeling sadar, Kurseong, Kalimpong and lastly Siliguri sub-division which is a plain land.

The land use pattern of Darjeeling district is closely related to its physical environment which includes climate, relief, altitude, degree of slope, soil and availability of water.

The present study of land use in the Darjeeling district is based on the five years data from 1997 to 2002. Table 7.01.

Table 7.01
Land Utilisation in the District of Darjeeling

Year	Total area according D.L.R., West Bengal	Forest according to state forest department	Current fallow	Other fallow other land than current fallow	Net cropped area
1	2	3	4	5	6
1997-98	325.469	124.574	8.626	4.272	144.709
1998-99	325.469	124.574	8.676	4.167	141.670
1999-00	325.469	124.574	8.631	5.939	147.986
2000-01	325.469	124.574	8.804	4.009	136.880
2001-02	325.469	124.575	9.477	4.438	146.454

Source: Directorate of Agriculture, Government of West Bengal, 2002.

The land use of Darjeeling district has some peculiarities not found in other districts of North Bengal. Net sown area in the district was 44.46 percent in 1997-98 which is lowest among other districts of North Bengal. There was a slight increase (0.03 percent) in the net sown area after a gap of five years. The forest occupies 38 percent of the total land area of the district. A little more than 15 percent of land is under tea cultivation. Barren, pasture, grazing land and uncultivable land account for 12 and 10 percent respectively in the Darjeeling district.

The table 7.01 indicates that there has been a slow and steady increase in current fallow land. For any agrarian development net cultivated area, pastures and grazing ground should increase. But in case of Darjeeling district the picture is just reverse.

Agriculture in the plain areas of Darjeeling is distinctly different from hill areas. Plain topography of Siliguri sub-division ensures continuity of cultivation and facilitates use of modern machinery. All activities related to agriculture is easier in plain areas. Siliguri sub-division because of its low gradient assures irrigational facilities. As the particular study area is Darjeeling district land use pattern of the district would be discussed in chapter eleven.

7.02 Jalpaiguri

The district of Jalpaiguri extends over an area of 6227 square kilometers in the shape of an irregular rectangle lying length wise east to west between 27°N and 26°16′N latitude and between 89°53′E to 83°25′E longitude. (Fig. 7.2)

The district of Jalpaiguri is known as western Duars which is submontane and covered almost by forest and dry sandy river beds acting as one of the main gate ways to Bhutan. The northern part of the district is undulated high and low deep plain. Small hillocks can be found in plenty in the north eastern part of the district. The major part of the district is formed with riverine plain. The land use pattern of the Jalpaiguri district is shown in Table 7.02.

Plate-1 SuknaForest in Siliguri P.S.

Plate-2 Tea cultivation in Darjeeling

Table 7.02

Land Utilisation in the district of Jalpaiguri (Area in thousand hact)

(area '000 hect.)

Year	Total area according D.L.R., West Bengal	Forest according to state forest department	Current fallow	Other fallow other land than current fallow	Net cropped area
1997-98	622.70	179.00	4.0	0.39	333.83
1998-99	622.70		3.2	0.39	322.93
1999-00	622.70	179.00	3.9	0.25	322.93
2000-01	622.70	179.00	3.20	0.25	336.51
2001-02	622.70	179.00	3.57	0.27	366.92

Source: Directorate of Agriculture Govt. of West Bengal, 2002.

The majority of the people of the district are engaged in agriculture. There are 241026 hectares of agricultural land where intensive farming is practiced. The economy of the district of Jalpaiguri is mainly dependent on agriculture and plantation activities. Tea is the most important plantation crops of this area. There are 163 tea gardens located in the eastern portion of the district. In Jalpaiguri 118707 hectares of land is under tea plantation. Timber is the most important forest product. Tobacco is produced in the middle portion of the land between Tista and Jaldakha rivers. Orange is another important plantation crop of the district. Net cropped area of the district is 59 p.c. (Fig. 7.3)

Table 7.03 shows area under principal crops in the district of Jalpaiguri. The following table 7.04 gives the picture of production of principal crops.

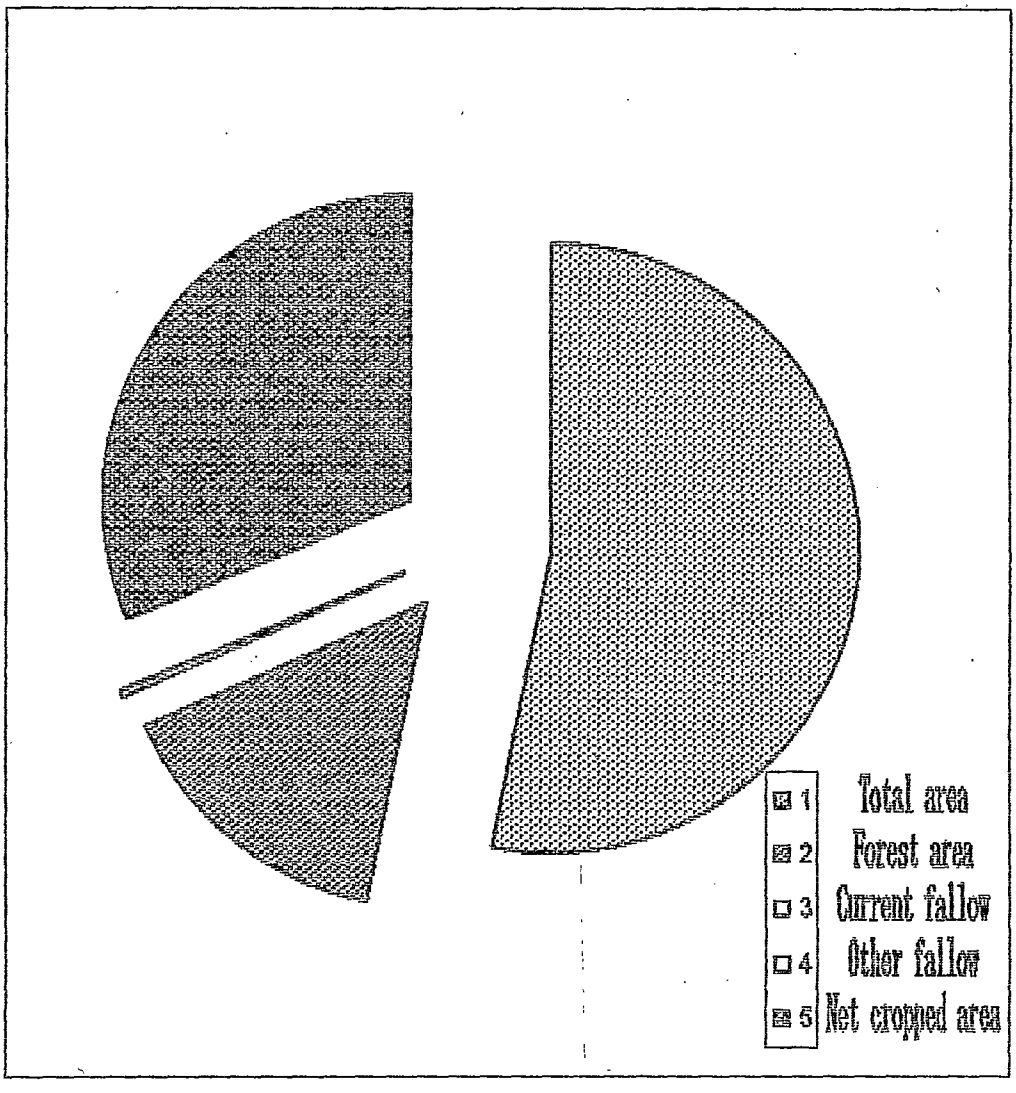


Fig 7.3 Some classification of land utilisation statistics in the district of Jalpaiguri(2001-02)

Table 7.03

Area Under Principal Crops (in '000 hact.) in Jalpaiguri

Crops	1997-98	1998-99	1999-00	2000-01	2001-02
Total Cereals	271.2	275.3	286.2	290.0	285.3
Total Pulses	6.7	6.0	6.1	6.6	3.8
Total Foodgrains	277.9	281.3	292.3	296.6	289.1
Total Oil Seeds	12.5	11.5	11.5	12.3	11.4
Total Fibre (Jute and Mesta)	50.4	47.4	48.9	44.8	46.7
Total Miscellaneous Crops	24.5	23.9	23.9	21.3	95.4

Table 7.04

Production of Principal Crops (Production in thousand tones) in Jalpaiguri

Crops	1997-98	1998-99	1999-00	2000-01	2001-02
Total Cereals	356.8	333.5	435.7	437.1	460.1
Total Pulses	4.4	2.7	8.4	4.3	1.9
Total Foodgrains	361.2	336.2	439.2	441.5	462.0
Total Oil Seeds	5.6	6.6	6.4	7.6	6.3
Total Fibre (Jute and Mesta)	400.4	409.7	412.4	404.9	514.0
Total Miscellaneous Crops	272.7	297.6	358.9	316.5	454.1

Source: 1. Directorate of Agriculture, Govt. of West Bengal.
2. Bureau of Applied Economics and Statistics, Govt. of West Bengal, 2002.

Fig. 7.4 and 7.5 showing area and production of principal crops.

In Jalpaiguri district paddy jute potato are produced in large quantity. Pulses, sugarcane, tobacco are other important crops of the district. Table 7.05 shows yield rate of some important corps of Jalpaiguri district.

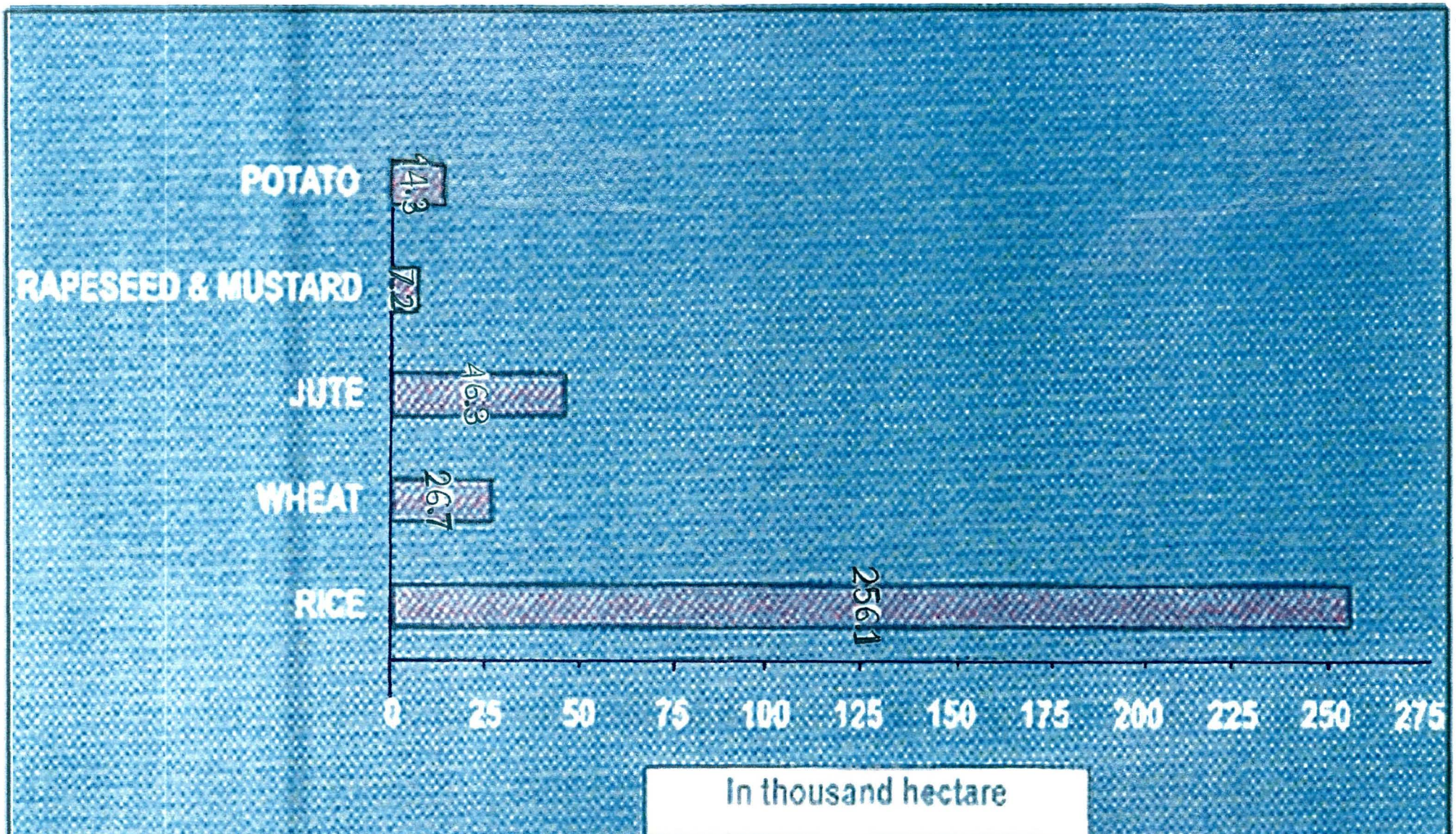
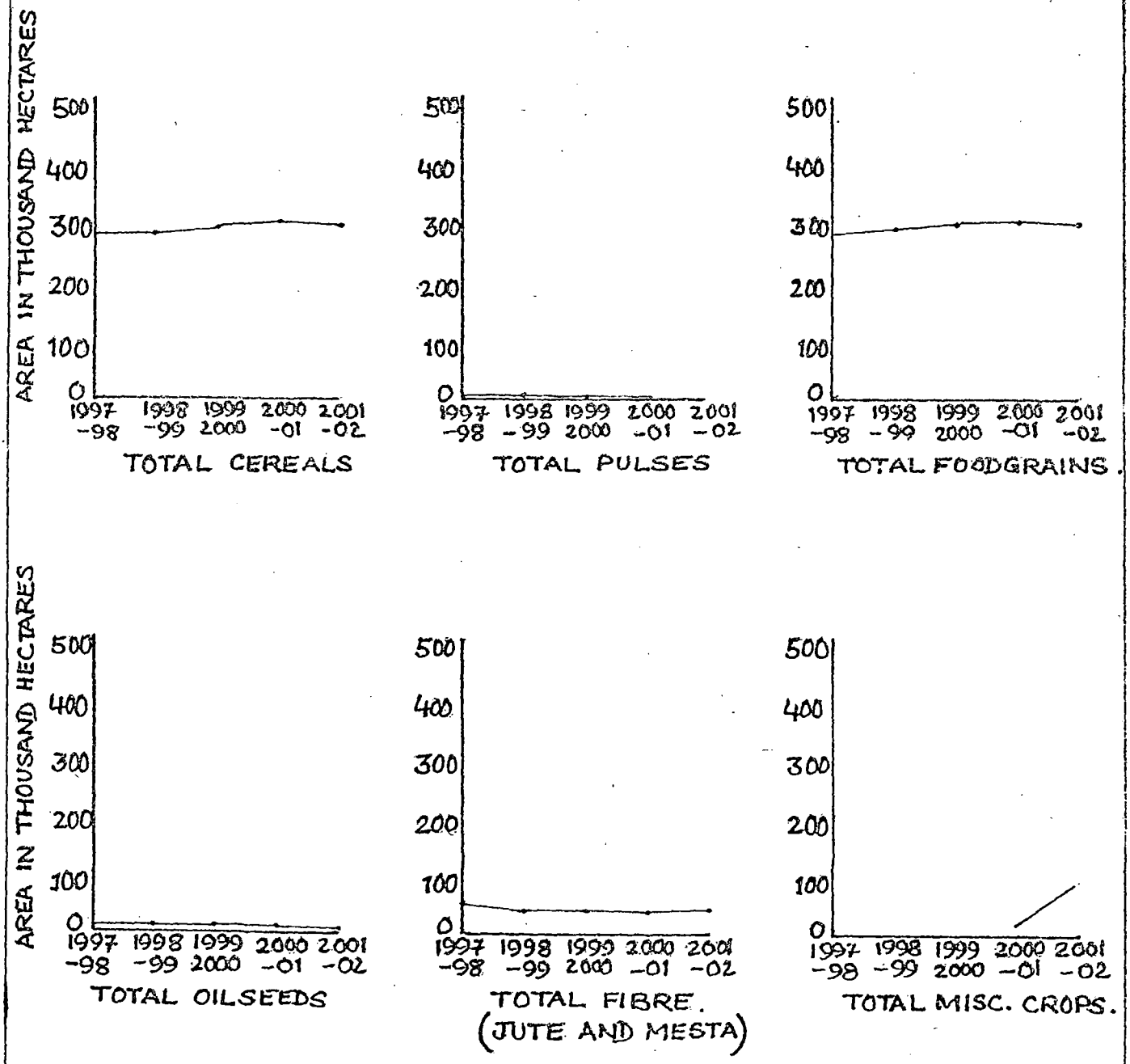
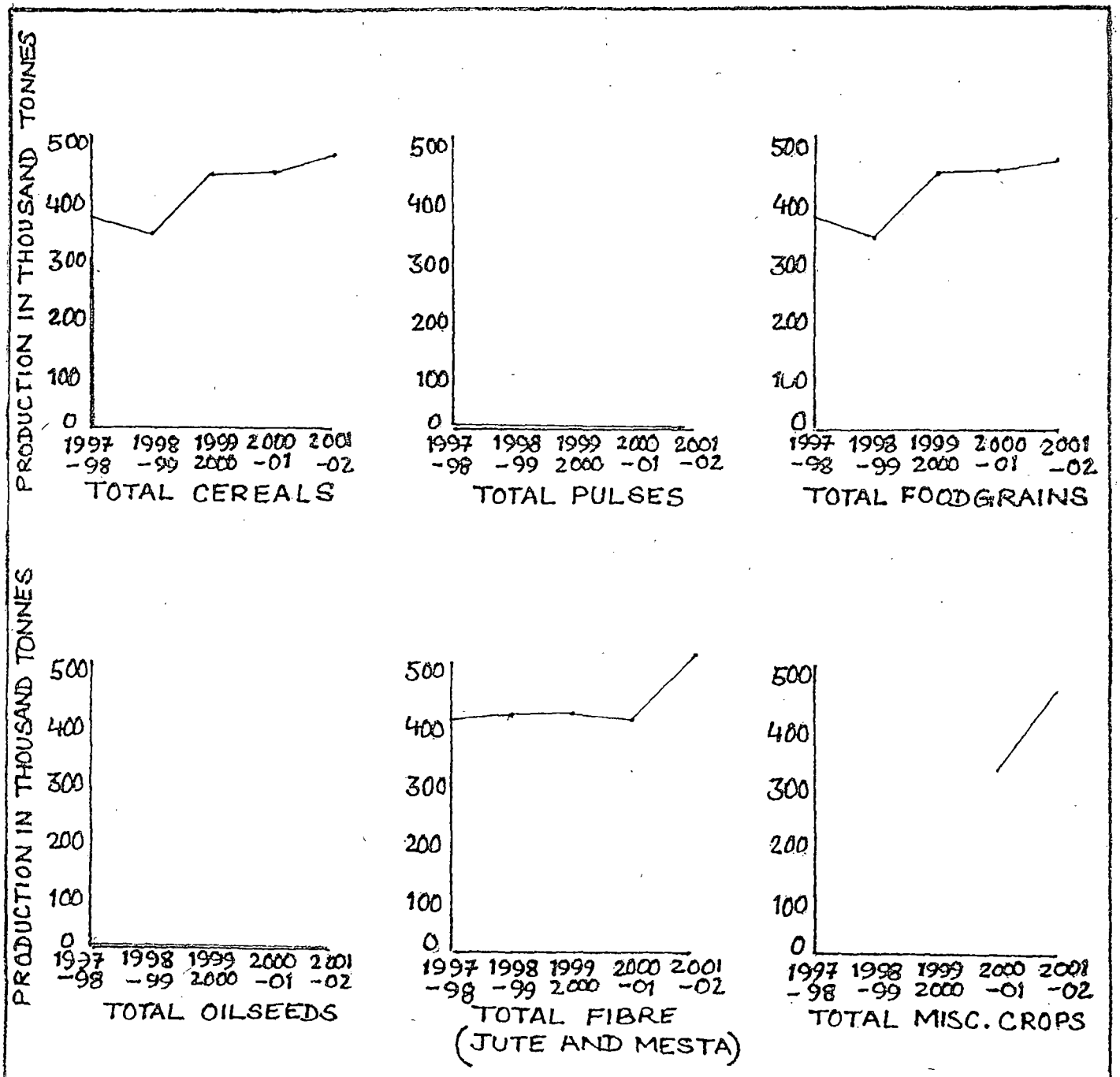


Fig- 7.6 Bar diagram showing area of Rice, Wheat,Jute, Rapeseed & Mustard and Potato in Jalpaiguri District in the year 2001-2002



Area under principal crops in the district of Jalpaiguri.

Fig. 7.4



Production of principal crops in the district of Jalpaiguri.

Fig. 7.5

Table7.05

Yield Rate of Some Selected Crops in the District of Jalpaiguri (in kg./hectare)

Crops	1997-98	1998-99	1999-00	2000-01	2001-02
Rice	1268	1162	1471	1473	1601
Wheat	1730	1523	2054	1769	1766
Gram	-	677	-	-	-
Jute	1440	1548	1530	1638	1980
Rapeseed and Mustard Seed	436	581	548	572	551
Potato	19021	17901	22718	21638	22040
Tea					

Source: Bureau of Applied Economics and Statistics, Government of West Bengal, 2002.

The yield rate of rice has increased substantially during the period form 1999 to 2002. In 2002 the yield rate of rice per hectare was as high as 1601 kg./hect. Another important crop potato is also showing increasing yield rate. In 2002 the yield was 22040 kilograms per hectare whereas it was 21000 in 1997-98. In 1997-98 the yield rate of jute was 1440 kilogram per hectare where as in 2002 it was 1980 kilogram. The yield rate of wheat is not showing any substantial increase with a little exception for the year 1990-2000. (Fig. 7.6)

In plain areas of Jalpaiguri irrigation is carried out by different sources of irrigation which is mentioned in Table 7.06.

Table 7.06

Area Irrigated by Different Sources in Jalpaiguri

(area in '000 hectares)

Year	Area Irrigated by							
		Tanks	HDTW	STW	PLI	ODW	Other sources	Total
1997-98	46.19	1.90	0.67	2.55	2.28	0.55	1.55	55.69
1998-99	48.45	2.20	1.16	2.55	8.22	0.55	6.50	69.63
1999-00	52.37	2.20	1.16	2.55	8.22	0.55	6.50	72.55
2000-01	57.71	1.90	2.25	3.12	11.58	0.54	6.82	84.22
2001-02	57.76	2.25	2.29	3.14	9.92	0.54	8.80	84.70

Note: HDTW : High Capacity Deep Tube well.
STW : Shallow Tube well.
RIL : River Lift Irrigation.
ODW – Open Dug Well.

Sources: 1) Irrigation and Waterways Directorate.
2) Principal Agricultural Office, Jalpaiguri.
3) Assistant Engineers Agri. Mech. Agri Irrigation, Jalpaiguri.

The availability of water is a crucial factor, which alone is responsible to enhance the agricultural productivity as well the levels of economic development. During the period 1997 to 2002 agricultural yield rate has undergone major changes owing to expansion of irrigational facilities. The upward trend of the figures of total cultivated area in majority of the cases reveals the mounting pressure on land or the increasing intensity of cropping. The infrastructure of irrigation system as available in 1997-98 indicates that the total area under irrigation in Jalpaiguri district was only 8.9 percent. There is an increasing trend of irrigated areas as shown in Table 7.07.

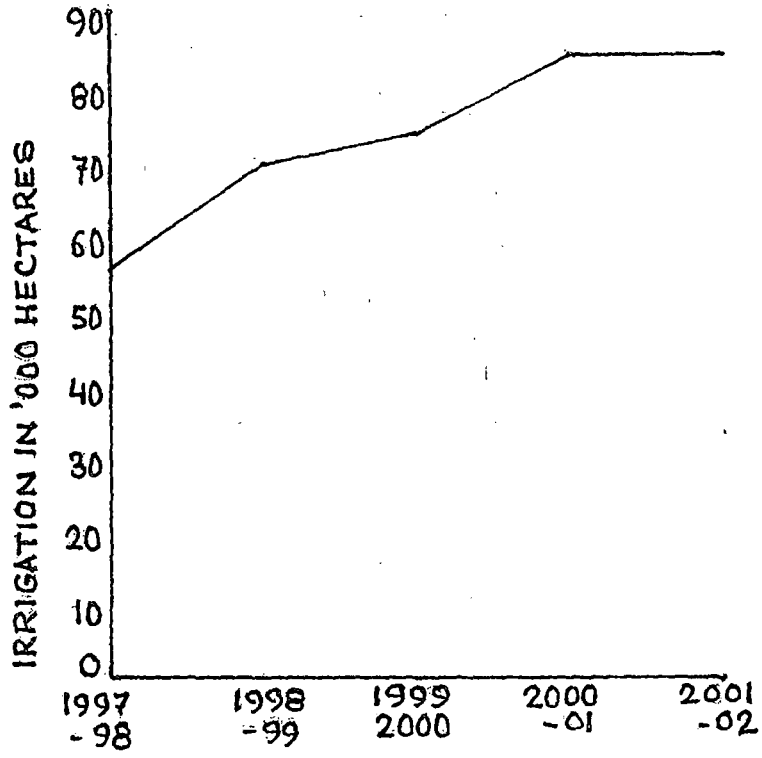


Fig. 7.7 TOTAL AREA IRRIGATED IN THE DISTRICT OF JALPAIGURI

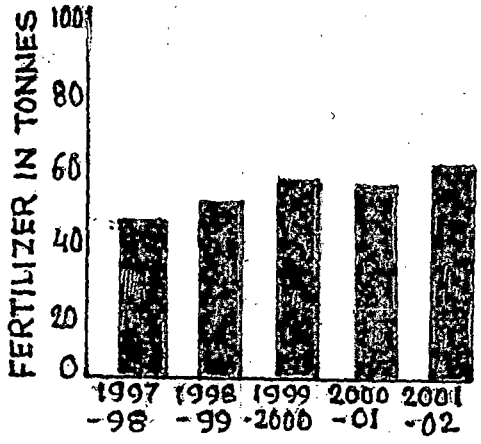


Fig. 7.8 FERTILIZER CONSUMED IN THE DISTRICT OF JALPAIGURI

Table 7.07

Percentage of Area Irrigated in Jalpaiguri District

Years	Total Percentage of Area Irrigated
1997-98	8.9
1998-99	11.1
1999-00	11.8
2000-01	13.5
2001-02	16.3

Source: Principal Agricultural Office, Jalpaiguri, 2002.

However, irrigation has played a vital role in raising the yield rates of certain crops such as rice, potato, jute and mustard seeds. Some other factors such as use of fertilizer and application of improved varieties of seeds and change in the technical inputs are collectively responsible for the improvement in the productivity level of some important crops. It may be mentioned here that irrigation has been practised since quite a long time in some areas of the district.

The Fig. 7.7 shows increasing trend of irrigated areas in the district of Jalpaiguri.

Chemical Fertilizer has high agriculture productivity per unit cropped area.

Table 7.08 indicates consumption of fertilizer in the district of Jalpaiguri.

Table7.08

Fertiliser Consumed in the District of Jalpaiguri

('000 tones)

Year	N	P	K	Total (N+P+K)
1997-98	25.00	11.90	6.10	43.00
1998-99	26.4	14.7	7.2	48.3
1999-00	29.5	17.3	9.0	55.8
2000-01	27.8	17.2	8.8	55.8
2001-02	28.8	18.8	10.7	55.3

Note: N = Nitrogen
P = Phosphate
K = Potassium

Source: Directorate of Agriculture, Govt. of West Bengal, 2002.

With the increase in yield rate of crops consumption of fertilizer also increased in Jalpaiguri district. Forty three thousand tones of fertilizer was used in 1997-98 and the figure continued to increase till 2002 and the consumption was 58.3 thousand tones. Therefore we can conclude that like irrigation, application of increased rate of fertilizer has a direct effect on the production of some important crops, which were mentioned earlier. Fig. 7.8 depicts fertilizer consumed in the district of Jalpaiguri.

The distribution of agricultural land in the district is not uniform. By and large most of the farmers in the district of Jalpaiguri belong to the small farmers group having less than five hectares of land under their possession. The distribution of farm size in Jalpaiguri district has been given in Table 7.09.

Table7.09

Distribution of Operational Holding according to Size Class in Jalpaiguri

Year	Marginal		Small		Semi-medium		Medium		Large		Total		Average
	No. of Holding	Area of Holding	No. of Holding	Area of Holding	No. of Holding	Area of Holding	No. of Holding	Area of Holding	No. of Holding	Area of Holding	No. of Holding	Area of Holding	Size of Holding
1990-91	243389	129558	69998	110684	30276	92892	6841	39931	261	121931	350765	494896	1.41
1995-96	304326	168136	76266	123095	29920	84129	5807	30760	248	121080	41567	527200	1.27

Source: Agricultural Census, West Bengal, 2002.

Note: Marginal: Below 1.0 acre.

Small: 1.0 acre and above but less than 2.0 acres.

Semi medium: 2.0 acres and above but less than 4.0 acres.

Medium: 4.0 acres and above but less than 10.0 acres.

Large: 10.0 acres and above (1 acre = 0.404686 hectare).

A plain geomorphology ensures continuity of cultivation. Such topography assures extensive irrigation and harvesting is easier in plain areas. Successful agriculture is possible only on reasonably level ground if climatic conditions and some other related factors such as soil, labour, capital marketing and institutional facilities are favourable for the agricultural development in the district.

Table 7.10

Roads Maintained by PWD, Zilla Parishad and Panchayat in the District of Jalpaiguri

(in kilometer)

Year	P.W.D.			Zilla Parishad			Gram Panchayat and Panchayat Samity		
	Surfaced	Unsurfaced	Total	Surfaced	Unsurfaced	Total	Surfaced	Unsurfaced	Total
1997-98	1284.93	11	1295.93	466.39	156.00	622.39	623.57	3676.50	4300.07
1998-99	1284.93	11	1295.93	488.99	177.50	666.49	673.57	3626.50	4300.07
1999-00	1295.93	11	1295.93	497.00	221.00	718.00	703.59	3595.50	4300.07
2000-01	1295.93	-	1295.93	508.67	209.53	718.00	743.57	3556.50	4300.07
2001-02	1295.93	-	1295.93	508.67	209.53	718.00	743.57	3556.50	4300.07

Sources: 1. P.W.D. (Roads), 2. Zilla Parishad. 3. Panchayat Samities, 4. Gram Panchayat, Jalpaiguri, 2002.

The district of Jalpaiguri has a total of 4300 kilometers of roads both surfaced and unsurfaced maintained by the P.W.D., Zilla Parishad. In 1997-98 there were only 622 kilometers of both surfaced and unsurfaced roads. So it can be maintained that communication network is being developed every year.

7.03 Cooch Behar

Geographical location of the Cooch Behar district is between 26°32′20″ N to 25°57′40″ N latitude in north-south direction and 89°54′34″ E to 88°47′40″ E longitude in east-west direction. (Fig. 7.9) Cooch Behar is situated in the sub Himalayan territory which is commonly known as 'terai' in West Bengal. Cooch Behar is more or less a plain district with a slight slope from north-west towards south-east direction. There is no mountain peak or hill in this district. There is a small forest in the North-eastern region of the district. The district is also replete with small arrca nut and groves. Table 7.11 shows land utilization in the Cooch Behar district.

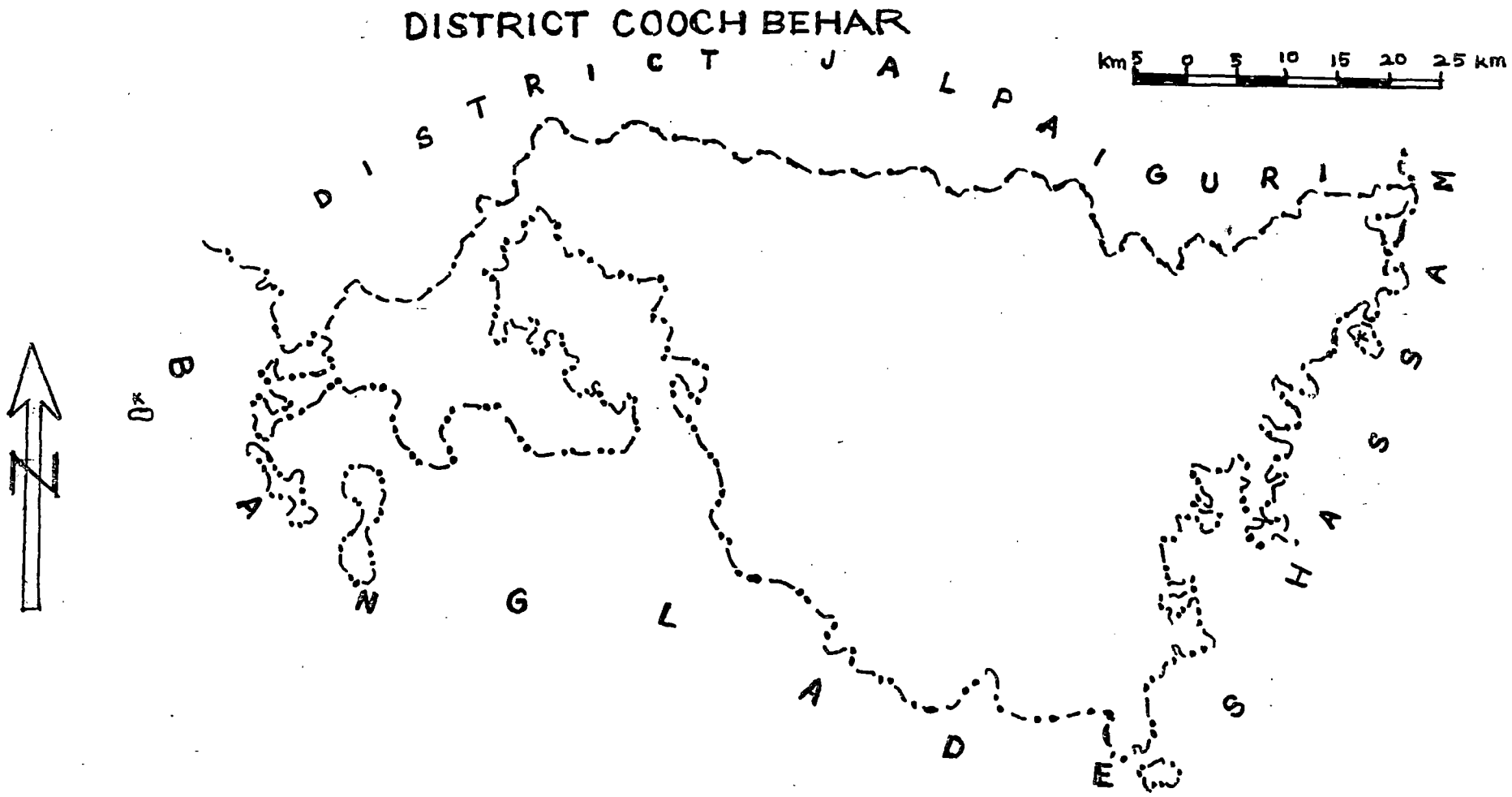

DISTRICT COOCH BEHAR
DISTRICT JALPAIGURI
km 5 0 5 10 15 20 25 km
BANGLADESH
N

Fig. 7.9

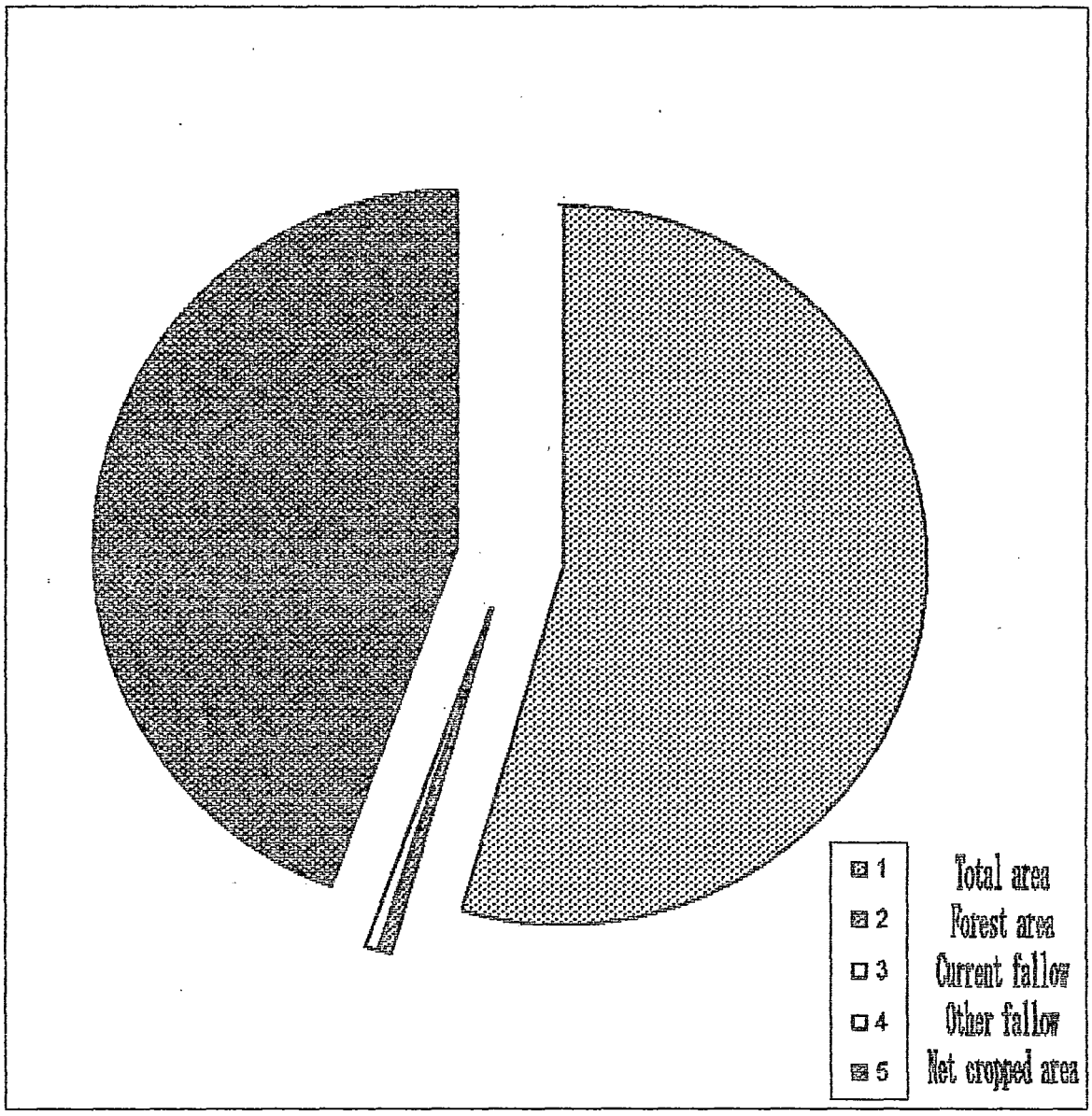


Fig 7.10 Some classification of land utilisation Statistics in the district of Cooch Behar

Table 7.11

Classification of Land use in the District of Cooch Behar

(Area in '000 hect.)

Year	Total area according to D.L.R., W.B.	Forest according to state forest deptt.	Current fallow	Other fallow and other than current fallow	Net cropped area
1997-98	331.80	5.70	2.70	0.44	249.10
1998-99	331.82	5.73	3.87	0.37	248.07
1999-00	331.82	5.73	4.30	0.52	246.12
2000-01	331.38	3.15	5.64	0.19	264.92
2001-02	331.38	3.15	3.55	0.59	270.03

Source: Directorate of Agriculture, Govt. of West Bengal.

Total land area in the district of Cooch Behar is 331.38 thousand hectares of which net cropped area is 81 percent. Forest area is less than one percent.

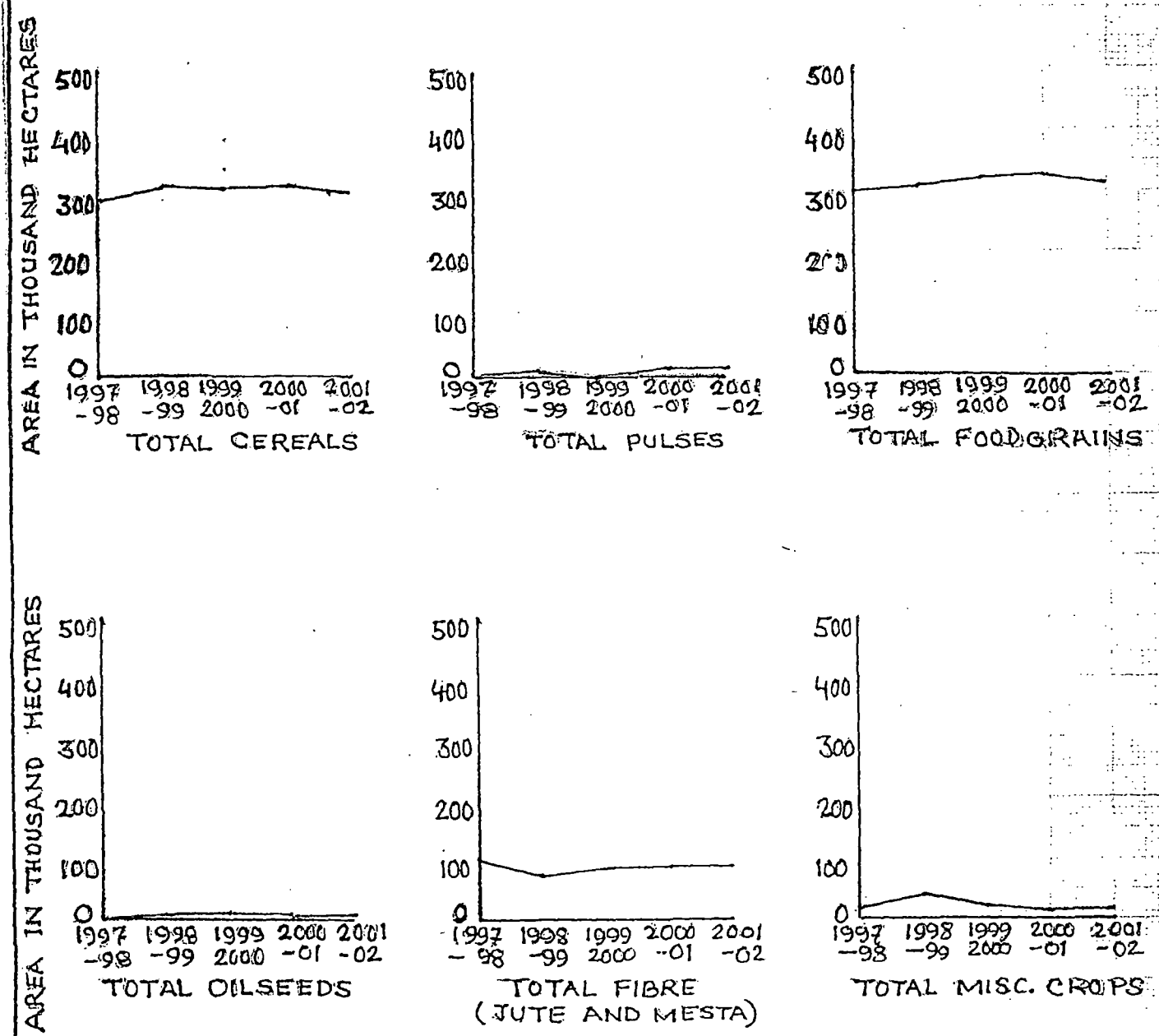
Fig. 7.10 depicts land use in the Cooch Behar district. Soil of the district is fertile and alluvial in nature. About forty percent of the total area of the district is 'danga' or high land and suitable for cultivation. Cooch Behar is primarily a rural district. Table 7.12 and 7.13 indicate the area and production of principal crops in the district of Cooch Behar.

Table7.12

Area Under Principal Crops in Cooch Behar

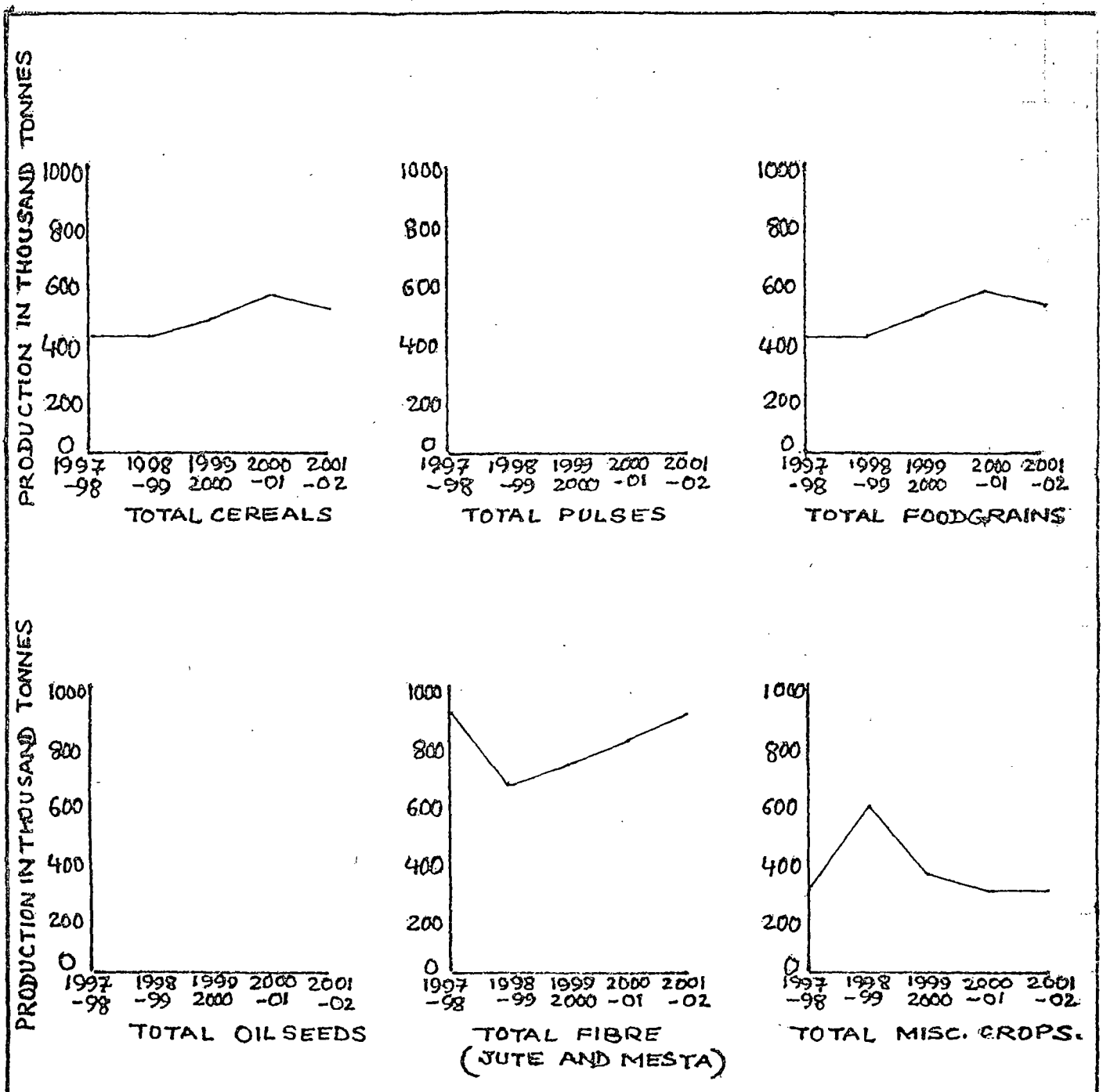
('000 hectare)

Crops	1997-98	1998-99	1999-00	2000-01	2001-02
Food Grains					
Total Cereals	295.5	302.7	309.3	317.8	305.6
Total Pulses	7.8	11.8	8.9	10.5	11.3
Total Foodgrains	304.3	314.5	318.2	328.3	316.9
Total Oil Seeds	14.0	12.9	14.0	12.6	13.8
Total Fibre (Jute and Mesta)	103.8	75.6	82.6	86.3	86.9
Total Miscellaneous Crops	27.7	40.3	28.5	26.4	25.7



Area under principal crops in the district of Cooch Behar.

Fig. 7.11



Production of principal crops in the district of Cooch Behar.

Fig. 7.12

Table7.13

Production of Principal Crops in Cooch Behar (Production in tons)

('000 hectare)

Crops	1997-98	1998-99	1999-00	2000-01	2001-02
Food Grains					
Total Cereals	402.8	401.3	474.3	567.6	514.2
Total Pulses	4.9	5.7	6.0	7.0	5.7
Total Foodgrains	407.7	407.0	480.3	574.6	519.9
Total Oil Seeds	6.1	6.7	9.1	7.7	7.2
Total Fibre (Jute and Mesta)	905.6	640.9	722.1	800.7	916.1
Total Miscellaneous Crops	267.9	593.7	347.4	292.6	286.9

Source: Directorate of Agriculture, Govt. of West Bengal.

More than 80 percent of the net cropped area is devoted to rice cultivation followed by jute crop. The district has witnessed a total increase in net sown area during the study period.

The graphs (Fig. 7.11 and 7.12) for the period 1997 to 2002 depict one common characteristics, the upward trend in the production of all the crops with the exception of pulses. The production of total pulses decreased from 7 thousand to 5.7 thousand tones in the year 2002.

Year wise yield rate of some selected crops of Cooch Behar district in Table 7.14 gives us a clear picture of agricultural situation for the study period.

Table7.14

Yield rate of some selected Crops in Cooch Behar

(Yield kg/ha)

Crops	1997-98	1998-99	1999-00	2000-01	2001-02
Rice	1349	1306	1505	1772	1672
Wheat	1506	1630	2089	1981	1832
Gram	-	677	-	-	-
Jute	1566	1530	1584	1674	1908
Rapeseed and Mustard	390	549	819	627	515
Potato	18204	22714	23556	23031	24522

Source: 1. Bureau of Applied Economics and Statistics, Govt. of West Bengal.
2. Directorate of Agriculture, Govt. of West Bengal.
3. Tea Board, 2002.

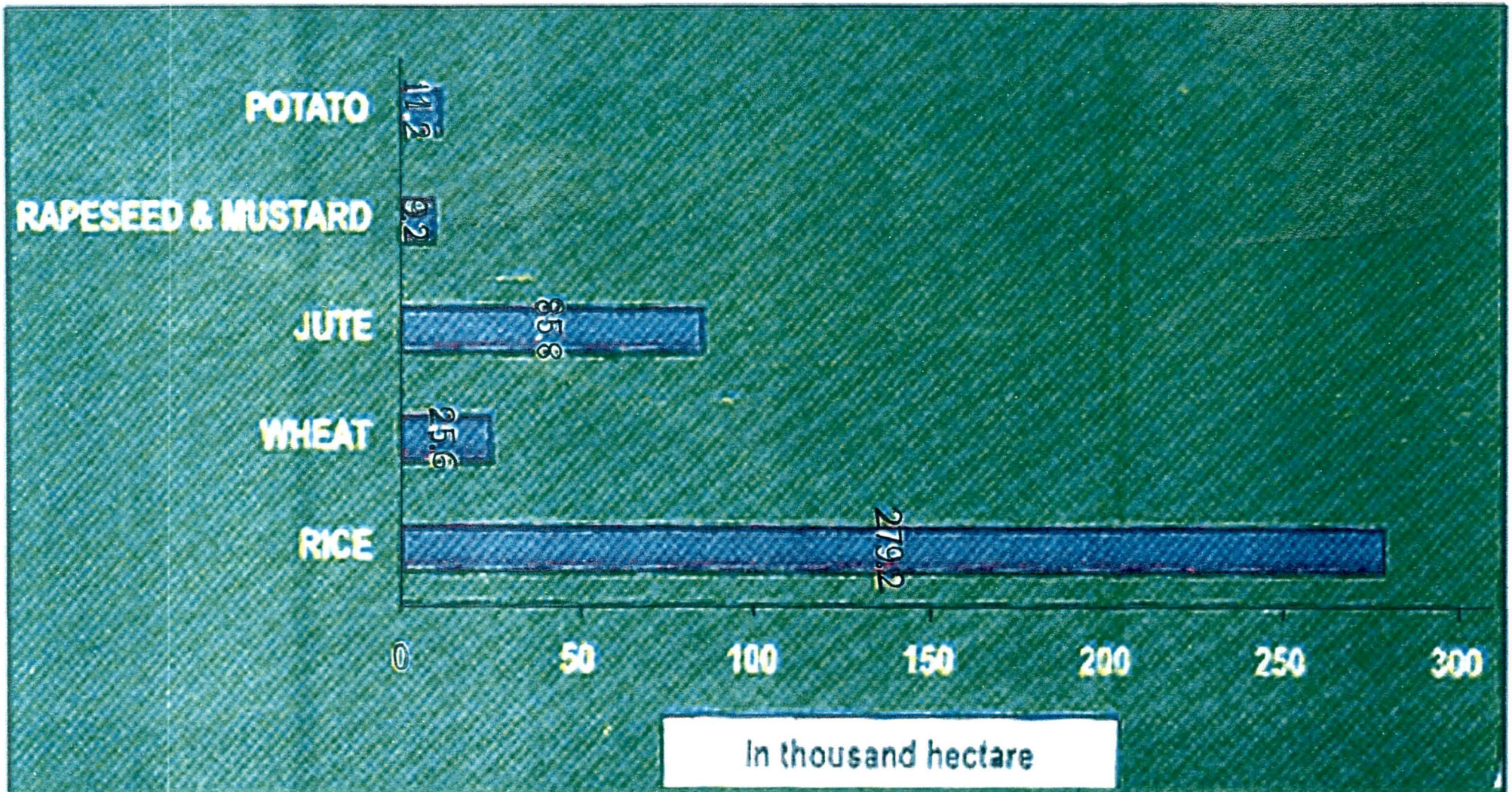


Fig-7.13 Bar diagram showing area of Rice, Wheat, Jute, Rapeseed & Mustard and Potato in Coochbehar District in the year 2001-2002

In Cooch Behar the yield rate of rice and potatoes have gone up dramatically. Other important crops such as wheat, jute, mustard and rapeseeds are also showing increasing trend in production. The upward trend of production of some selected crops are depicted in Fig. 7.13.

Table7.15

Area Irrigated by Different Sources in Cooch Behar

('000 hectare)

Years	Area Irrigated by								
	Govt. Canals	Tanks	HDTW	MDTW	STW	RLI	ODW	Other sources	Total
1997-98	0.50	3.38	7.41	2.11	10.18	11.77	3.45	8.00	46.80(R)
1998-99	0.50	5.75	16.45	4.18	12.72	11.94	3.60	8.35	63.49(R)
1999-00	0.75	5.75	16.45	4.18	12.72	11.94	3.60	8.50	63.89(R)
2000-01	1.65	5.85	16.50	4.23	13.96	12.00	3.80	10.59	68.58(R)
2001-02	1.70	5.85	17.03	4.25	15.60	14.05	4.27	12.15	74.90

Note: HDTW – High Capacity Deep Tubewell.
MDTW – Middle Capacity Deep Tubewell.
STW – Shallow Tubewell.
RIL – River Lift Irrigation.
ODW – Open Dug Well.

Sources: 1) Principal Agricultural Office, Jalpaiguri.
2) Assistant Engineer (Irrigation)
3) Assistant Engineers (Agri. Mech.), Cooch Behar, 2002.

The total area irrigated by different sources in the district of Cooch Behar (Fig. 7.14) has increased from 46 thousand hectares to 75 thousand hectares from 1997-98 to 2001-02 respectively. High capacity deep tube well and shallow tube well are popular sources of irrigation.

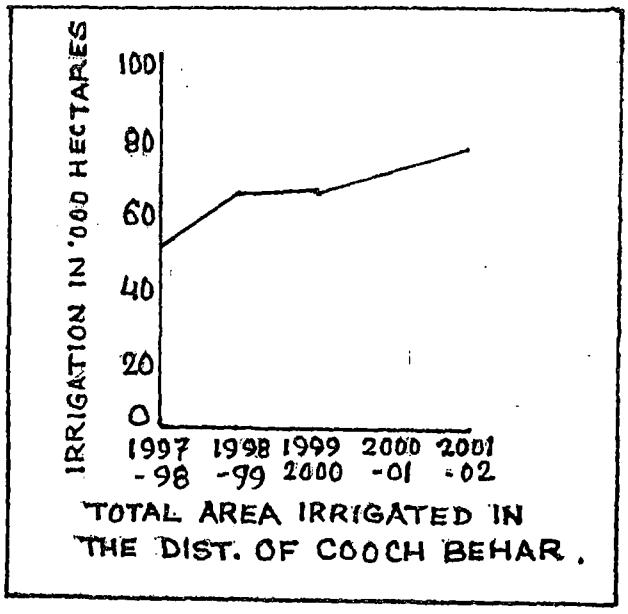


Fig. 7.14

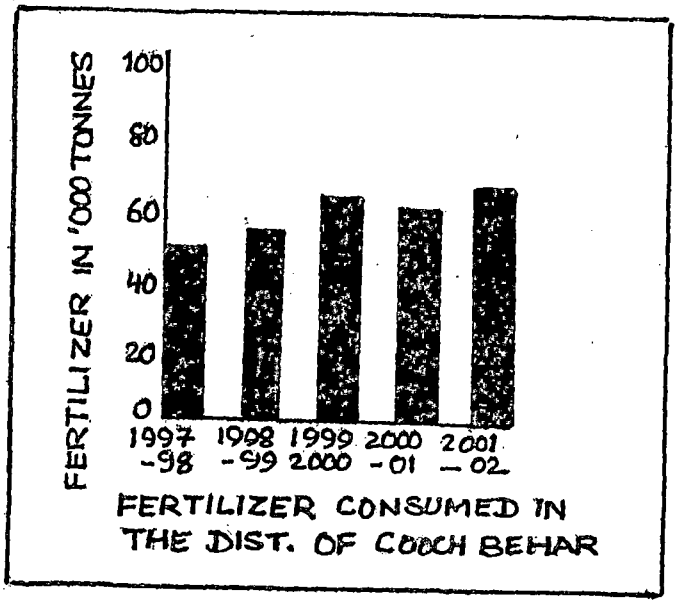


Fig. 7.15

Table 7.16

Fertiliser Consumed in the District of Cooch Behar

('000 tones)

Year	N	P	K	Total (N+P+K)
1997-98	26.5	13.9	7.3	47.7
1998-99	28.1	16.5	8.9	53.5
1999-00	31.3	19.5	10.6	61.4
2000-01	30.1	17.7	10.2	58.0
2001-02	31.8	19.8	13.0	64.6

Note: N = Nitrogen

P = Phosphate

K = Potassium

Source: Directorate of Agriculture, Govt. of West Bengal, 2002.

The average consumption of fertilizer (Table 7.16) in terms of nutrient is 64.6 thousand tones in 2001-02. The consumption of fertilizer also shows increasing trend in district (Fig. 7.15).

Table 7.17

Distribution of Operational Holding according to Size Class in Cooch Behar

Year	Size Class												
	Marginal		Small		Semi-medium		Medium		Large		Total		Average
	No. of Holding	Area of Holding	No. of Holding	Area of Holding	No. of Holding	Area of Holding	No. of Holding	Area of Holding	No. of Holding	Area of Holding	No. of Holding	Area of Holding	Size of Holding
1985-86	160974	70121	66853	92506	31595	79072	5240	25141	—	—	264362	267470	1.01
1990-91	320266	159886	81013	120827	35983	105948	43566	43566	50	1588	445212	431785	0.96
1995-96	315894	166236	89464	117031	35382	107961	40966	40966	53	2294	448900	434488	0.97

Source: Agricultural Census, West Bengal, 2002.

Note: Marginal: Below 1.0 acre.
Small: 1.0 acre and above but less than 2.0 acres.
Semi medium: 2.0 acres and above but less than 4.0 acres.
Medium: 4.0 acres and above but less than 10.0 acres.
Large: 10.0 acres and above (1 acre = 0.404686 hectare).

Majority of the farmers in the district are having less than one acre of cultivated land (Table 7.17). Only a little more than 50 holdings are large in size. They have more than 10 acres of cultivated land. Majority of the farmer practice subsistence agriculture.

Table7.18
Roads Maintained by PWD, Zilla Parishad & Panchayat in the District of Cooch Behar

(in kilometer)

Year	P.W.D.			Zilla Parishad			Gram Panchayat and Panchayat Samity		
	Surfaced	Unsurfaced	Total	Surfaced	Unsurfaced	Total	Surfaced	Unsurfaced	Total
1997-98	662	366	1028	94	106	200	18	927	945
1998-99	662	366	1028	98	110	208	24	913	937
1999-00	662	366	1028	99	110	209	26	910	936
2000-01	723	305	1028	99	110	209	26	910	936
2001-02	726(P)	35(P)	761(P)	113	212	325	32	788	820

Sources: 1. P.W.D. (Roads), 2. Zilla Parishad.
3. Panchayat Samities, 4. Gram Panchayat, Jalpaiguri, 2002.

Roads and Communication

Cooch Behar roads are maintained by the P.W.D. Zilla Parishad and Panchayat. There are 726 kilometers of surfaced roads maintained by the P.W.D. according to the data available for 2002. In 1997-98 there was only 662 kilometers of P.W.D. road in the district. Zilla Parishad and Panchayat Samity and gram panchayat maintain 325 kilometer and 820 kilometers of road respectively. About 90 percent of the total population in the district live in rural areas and there exists a primitive rural agrarian economy. Moreover, infrastructural development in the rural area is very low or in the process of development.

7.04 Uttar Dinajpur

This district is completely riverine plain. The altitude is insignificant here. Uttar Dinajpur lies between 26°35′15″ north latitude and 87°43′37″ E longitude in the north south direction. (Fig. 7.16) This region represents a monotonous landscape characterized by agrarian fields with scattered homestead leaving some barren land here and there.

The following Table 7.19 shows land utilization in Uttar Dinajpur.

Table7.19

Classification of Land use in the District of Uttar Dinajpur

(Area in '000 hect.)

Year	Total area according to D.L.R., W.B.	Forest according to state forest deptt.	Current fallow	Other fallow and other than current fallow	Net cropped area
1997-98*	534.187	1.430	11.840	0.274	443.994
1998-99	312.279	0.579	7.714	0.204	257.346
1999-00	312.279	0.579	6.080	0.017	260.538
2000-01	312.467	0.579	4.755	0.000	273.409
2001-02	312.467	0.579	5.196	0.002	272.505

* Combined Uttar Dakshin Dinajpur, 2002.

Source: Directorate of Agriculture, Govt. of West Bengal.

The total geographical area of Uttar Dinajpur is 312467 hectares and only 0.579 hectares area is covered by forest. The percentage of the net cropped area to total area of the district is a little more than 84 percent. One point six (1.6) percent of land is under current fallow. Other fallow land other than current fallow covers an area of about 0.002 hectares. (Fig. 7.17)

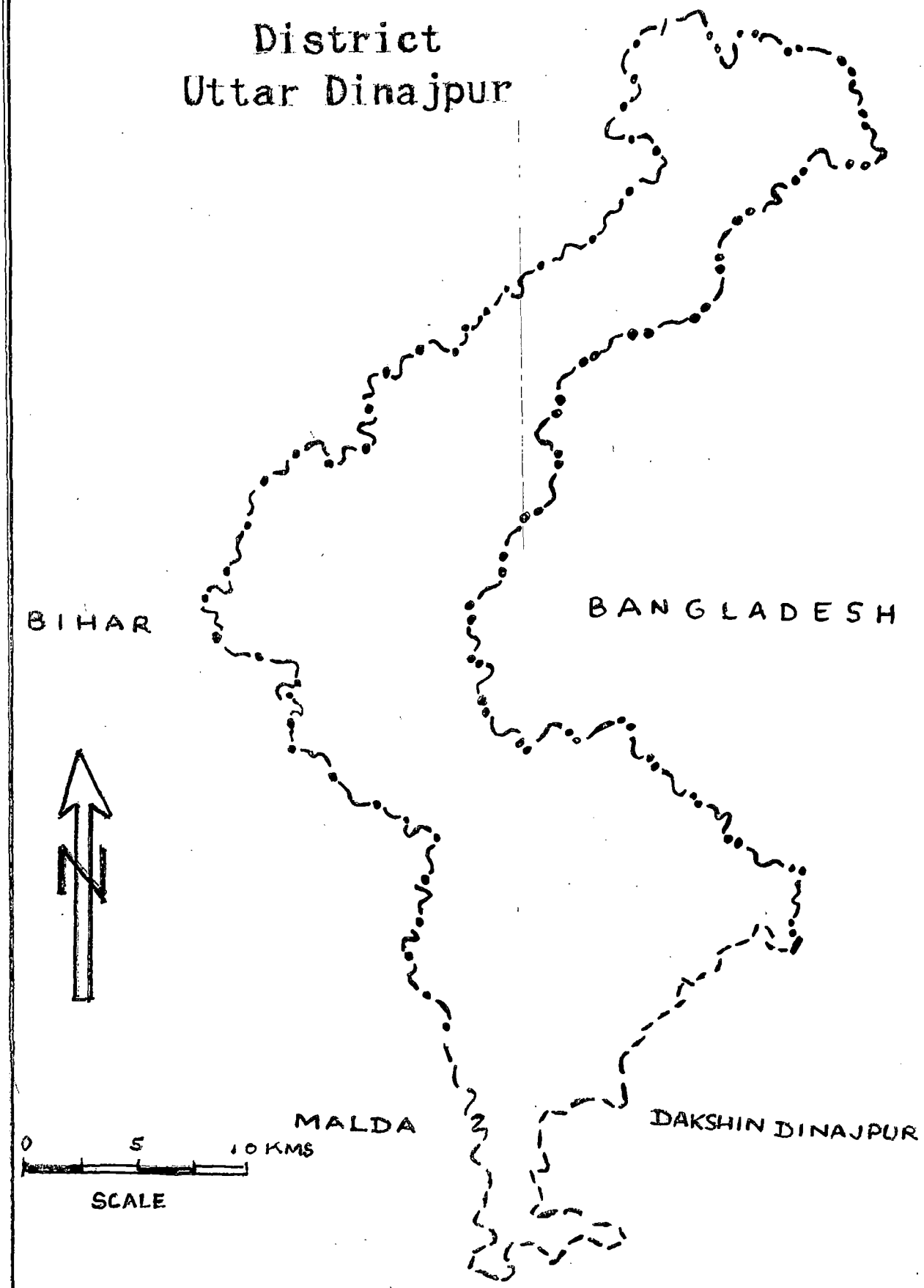

District
Uttar Dinajpur
BIHAR
BANGLADESH
MALDA
DAKSHIN DINAJPUR
0
5
10 KMS
SCALE

Fig. 7.16

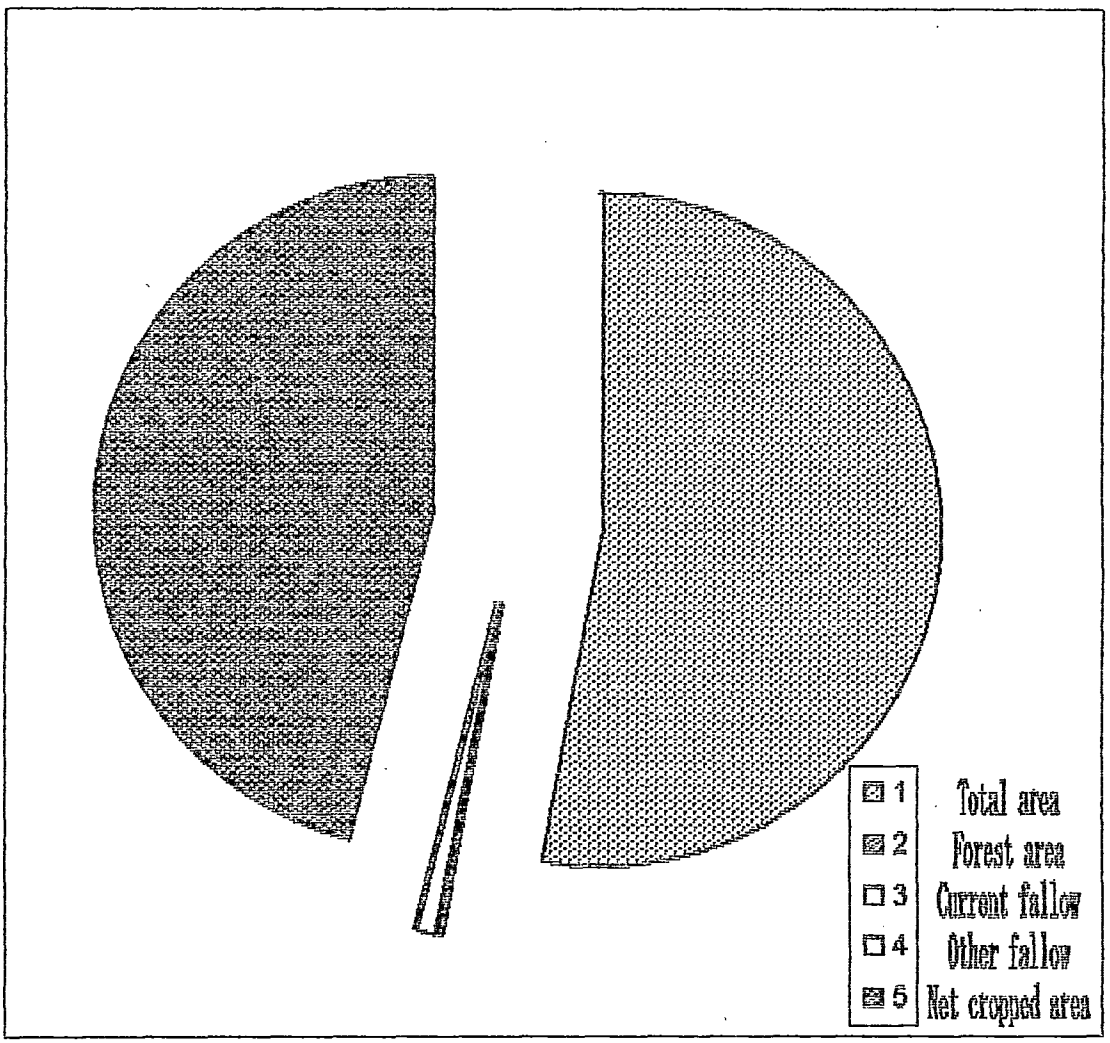


Fig 7.17 Some classification of land utilization statistics in the district of Uttar Dinajpur (2001-02)

Table 7.20 and 7.21 gives an over all picture of the area under principal crops and production of principal crops. In this district total cereals which includes rice wheat and other crops occupy the highest percentage of area. Jute is another important crop also showing increasing trend in cultivated area.

Table 7.20

Area Under Principal Crops in the District of Uttar Dinajpur

('000 hectare)

Crops	1997-98	1998-99	1999-00	2000-01	2001-02
Total Cereals	282.7	298.5	319.4	322.0	321.1
Total Pulses	14.7	10.9	7.8	9.1	7.4
Total Foodgrains	297.4	309.4	327.2	331.1	328.5
Total Oil Seeds	38.9	37.1	39.3	45.4	46.5
Total Fibre (Jute and Mesta)	61.7	63.4	60.2	61.5	66.8
Total Miscellaneous Crops	9.9	11.7	10.7	11.9	12.9

Table7.21

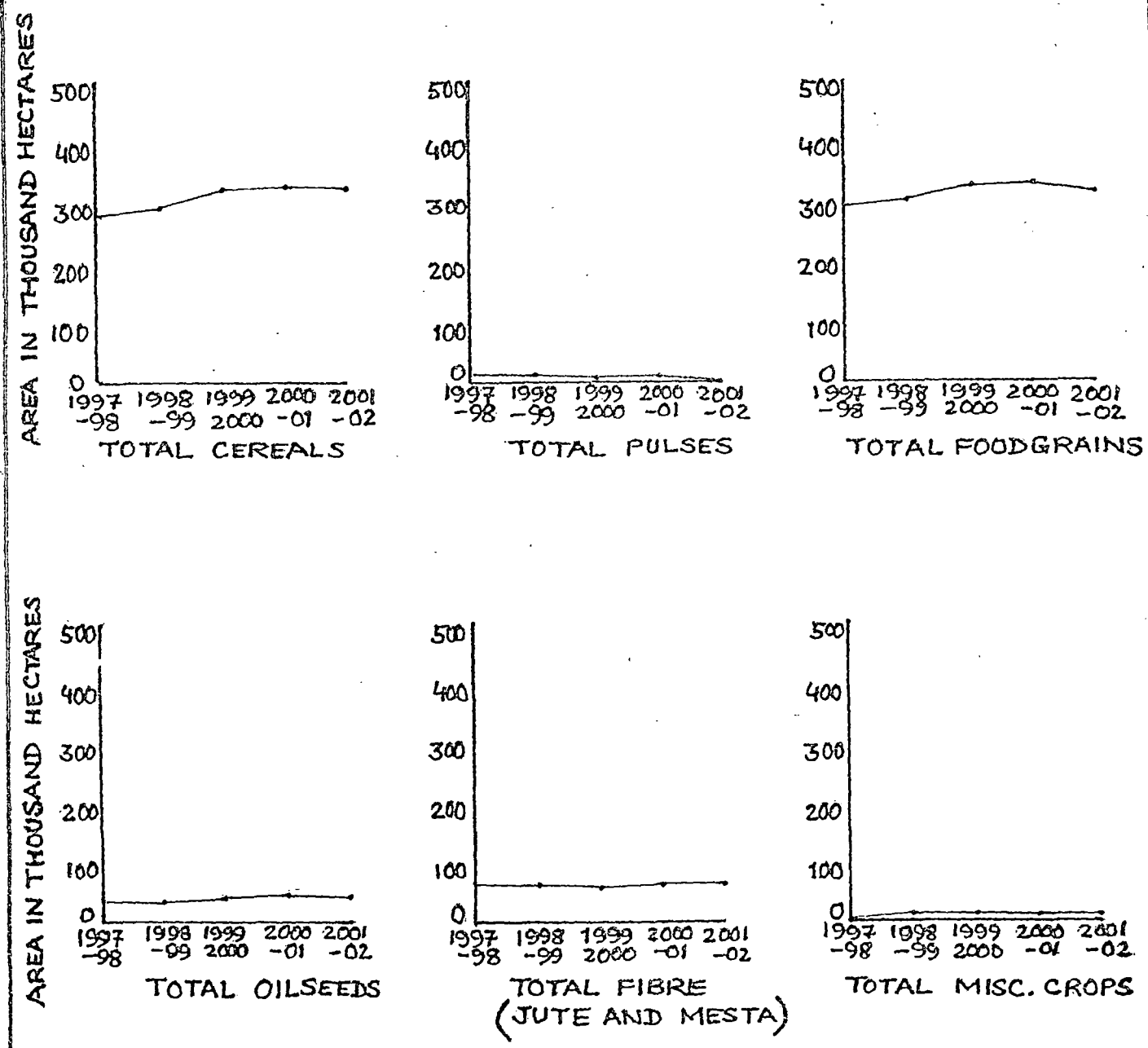
Production of Principal Crops in the District of Uttar Dinajpur
(Production in '000 hectares)

('000 hectare)

Crops	1997-98	1998-99	1999-00	2000-01	2001-02
Total Cereals	556.0	642.7	656.5	716.5	638.6
Total Pulses	6.9	4.5	3.7	4.6	10.7
Total Foodgrains	562.9	647.2	660.2	721.1	649.3
Total Oil Seeds	21.2	20.6	22.1	32.4	29.7
Total Fibre (Jute and Mesta)	496.7	477.5	530.1	473.7	642.28
Total Miscellaneous Crops	109.6	137.4	127.4	166.4	125.7

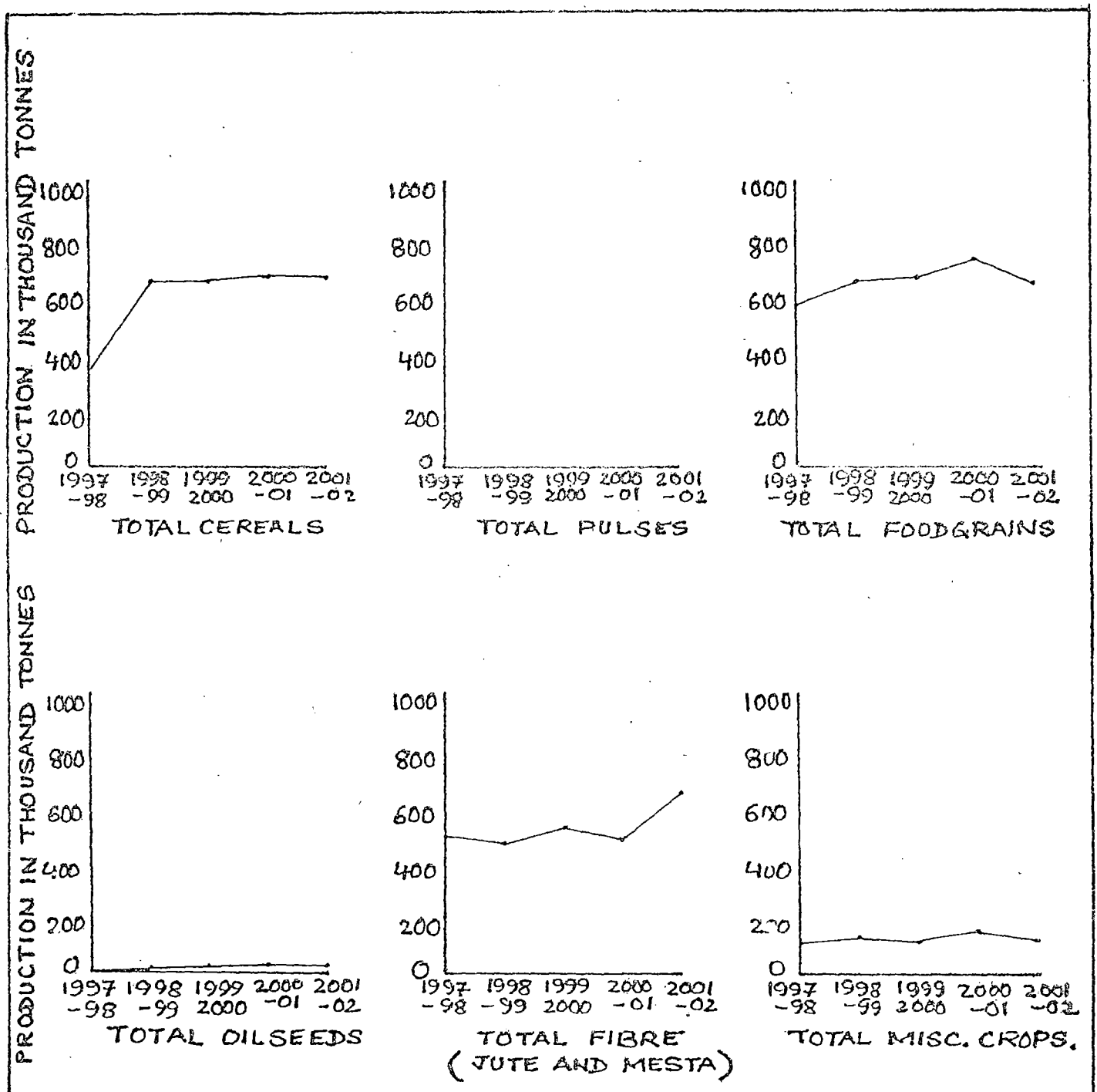
Source: 1. Directorate of Agriculture, Govt. of West Bengal.
2. Bureau of Applied Economics and Statistics, Govt. of West Bengal, 2002.

The important cereals of this district are rice and wheat. About 92 percent of the cultivated area is devoted to rice cultivation and wheat is grown in more than 26



Area under principal crops in the district of Uttar Dinajpur.

Fig. 7.18



Production of principal crops in the district of Uttar Dinajpur.

Fig. 7.19

percent of the total cultivated area. Jute including mesta covers an estimated area of 63.1 thousand hectares and the total production is 611.1 thousand tones. Therefore it can be mentioned that all the food crops and cash crop like jute is showing increased rate of production.

Total area devoted under different crops and production of important crops are graphically represented in the Fig. 7.18 and 7.19 respectively.

Yield rate of some selected crops (Table-7.22) will give more clear picture about the agricultural production in the district of Uttar Dinajpur.

Table 7.22
Yield rate of some selected Crops in Uttar Dinajpur

(Yield kg/ha)

Crops	1997-98	1998-99	1999-00	2000-01	2001-02
Rice	1938	2175	1995	2220	1983
Wheat	2241	1999	2590	2300	2031
Gram	611	467	595	459	540
Jute	1440	1368	1584	1404	1746
Rapeseed and Mustard	565	586	578	787	708
Potato	17235	16256	18526	19789	18535
Tea	-	-	-	-	1929

Source: Bureau of Applied Economics and Statistics, 2002.

Yield rate of rice shows increasing trend with occasional variations. But in 2000-2001 yield rate of rice was 2220 kg/hect. Wheat is showing increased yield rate and 1999-2000 it was 2590 kg/hect. Next year the yield rate falls sharply and continued till 2001-2002 yield rate of potato is increasing every year but case of jute and gram yield rate is showing upward trend with a exception of few years (Fig. 7.20)

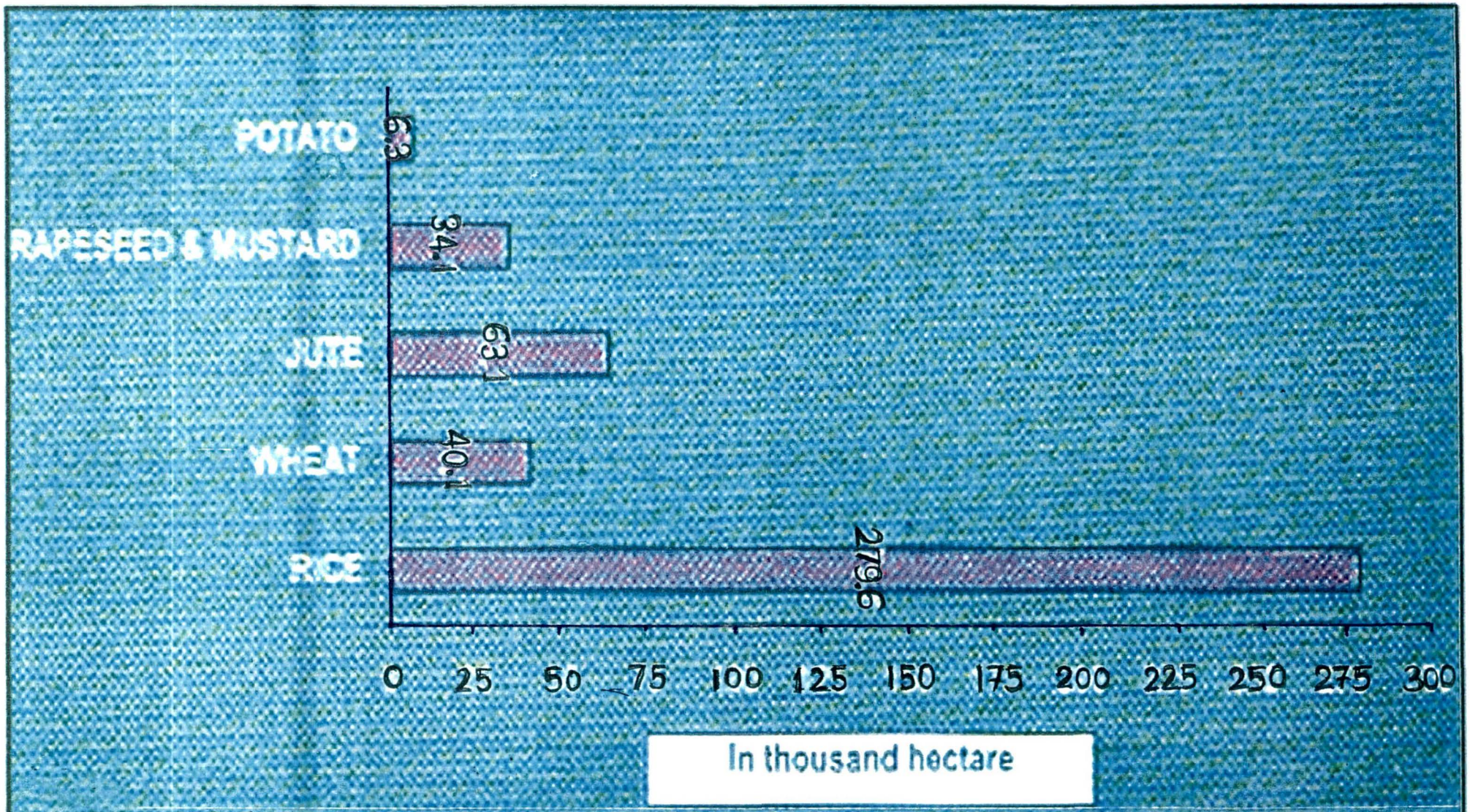


Fig- 7.20 Bardiagram showing area of Rice, Wheat,Jute, Repeseed & Mustard and Potato in Uttar Dinajpur District in the year 2001-2002

Table 7.23

Area Irrigated by Different Sources in Uttar Dinajpur

(000 hectare)

Years	Area Irrigated by							
	Govt. Canals	Tanks	HDTW	MDTW	STW	RLI	Other sources	Total
1997-98	6.00	14.83	-	-	-	-	38.75	59.58
1998-99	6.00	14.83	-	-	-	-	39.73	60.56
1999-00	6.00	14.83	-	-	-	-	40.62	61.45
2000-01	6.00	14.83	-	-	-	-	41.20	62.03
2001-02	6.00	14.83	7.44	0.14	96.36	2.34		127.11

Note: HDTW – High Capacity Deep Tubewell.
MDTW – Middle Capacity Deep Tubewell.
STW – Shallow Tubewell.
RIL – River Lift Irrigation.
ODW – Open Dug Well.
Including R.L.I., T.W., D.S.T.W.

Sources: 1) Irrigation and Waterways Directorate.
2) Principal Agricultural Office.
3) Assistant Engineers Agri. Mech., Mech Agri Irri., 2002.

In Uttar Dinajpur the total area of land irrigated in 1997 to 98 was nearly 60 thousand hecatares and it increased more than 50 percent in the year 2001-2002. The total land area irrigated by different sources in 2001-2002 is a little more than 127 hectares (Fig.-7.21). So it can be rightly mentioned that because of improvement in the irrigational facilities the production of important crops like rice, jute, potato and mustard and linseed oil also increased simultaneously.

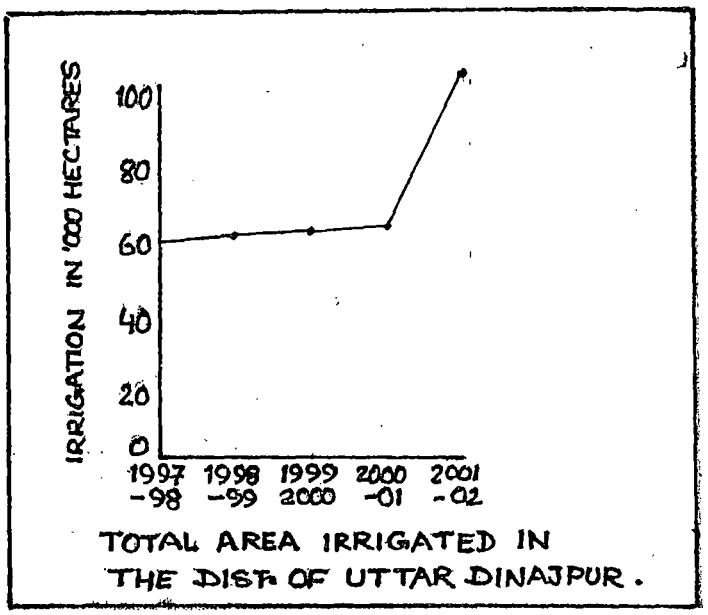


Fig. 7.21

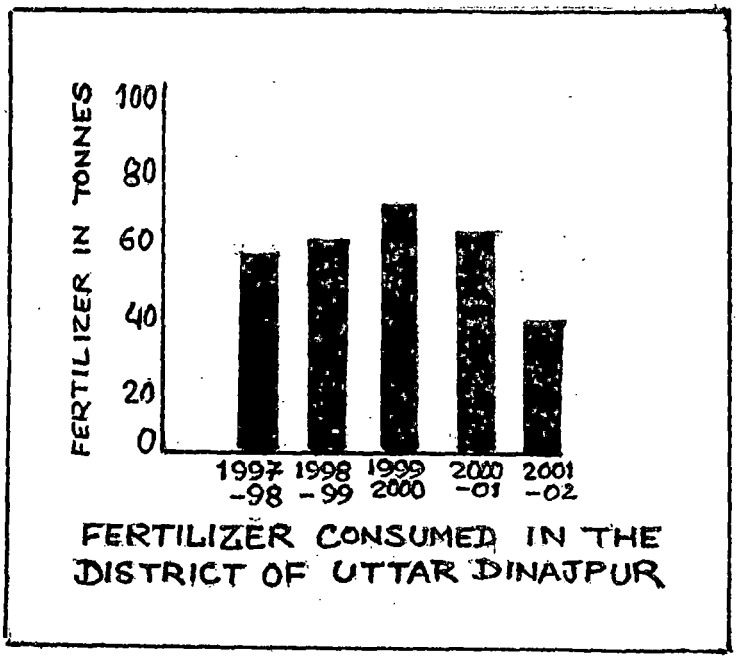


Fig. 7.22

Table7.24

Fertiliser Consumed in the District of Uttar Dinajpur

(000 tones)

Year	N	P	K	Total (N+P+K)
1997-98	31.6	14.6	8.1	54.3
1998-99	33.0	17.2	9.6	59.8
1999-00	36.5	20.4	11.8	68.7
2000-01	31.5	18.1	11.3	60.9
2001-02	18.6	10.5	8.3	37.4

Note: N = Nitrogen
P = Phosphate
K = Potassium

Source: Directorate of Agriculture, Govt. of West Bengal, 2002.

The application of chemical fertilizer and better irrigational facilities the boosted the production of cereals viz. rice and wheat has gone up. In 1997-98 fertilizer was used a little more than 54 thousand tones. This figure increased till 2001-02 and fertilizer consumption in the district of Uttar Dinajpur was nearly seventy thousand tones. (Fig. 7.22)

Table7.25

Distribution of Operational Holding according to Size Class in Uttar Dinajpur

Year	Size Class												
	Marginal		Small		Semi-medium		Medium		Large		Total		Average
	No. of Holding	Area of Holding	No. of Holding	Area of Holding	No. of Holding	Area of Holding	No. of Holding	Area of Holding	No. of Holding	Area of Holding	No. of Holding	Area of Holding	Size of Holding
1985-86	259360	105675	88633	132946	55701	152643	12109	64468	38	395	415841	456127	1.10
1990-91	419013	219490	113594	180431	49468	145806	11861	66916	115	2043	594051	614686	1.03
1995-96	479238	258353	134023	195673	50416	142241	8063	43118	97	1646	671837	641031	0.95

Source: Agricultural Census, West Bengal, 2002.

Note: Marginal: Below 1.0 acre.
Small: 1.0 acre and above but less than 2.0 acres.
Semi medium: 2.0 acres and above but less than 4.0 acres.
Medium: 4.0 acres and above but less than 10.0 acres.
Large: 10.0 acres and above (1 acre = 0.404686 hectare).

The size of holdings has great influence upon the productivity of farming. In Uttar Dinajpur the agricultural holdings are very small and fragmented. In 1985-86 the size of average holding was 1.10 hectares per farmer and it came down to 0.95 hectare per farmers.

Table7.26

Road maintained by Municipalities in the District of Uttar Dinajpur

Year	Surfaced	Unsurfaced	Total
1997-98	213.65	84.24	297.89
1998-99	221.30	105.60	326.90
1999-00	227.47	120.82	348.29
2000-01	227.47	124.98	352.45
2001-02	268.05	155.50	423.55

Source: District Statistical Handbook, Govt. of West Bengal, 2002.

Transport and communication

There are 663.90 kilometers of roads maintained by the P.W.D., according to the 2001 and 2002 data published by the Government of West Bengal.

Thus, it may be concluded the plain topography soil, climate, size of holding, fertilizer, irrigation and communication have collectively influenced the spatial pattern of agricultural landscape in Uttar Dinajpur. But farmers are still in the level of subsistence agriculture.

7.05 Dakshin Dinajpur

Dakshin Dinajpur is a low lying plain area. The district is located between 25°10′55″ N latitude to 89°0′30″ E longitude. (Fig. 7.23) According to Directorate of Agriculture 2002 the total area of the district is 221908 hectares. There is about 0.41 percent of forest area and current fallow land is 0.72 percent. The table 7.27 shows that the

District
Dakshin Dinajpur

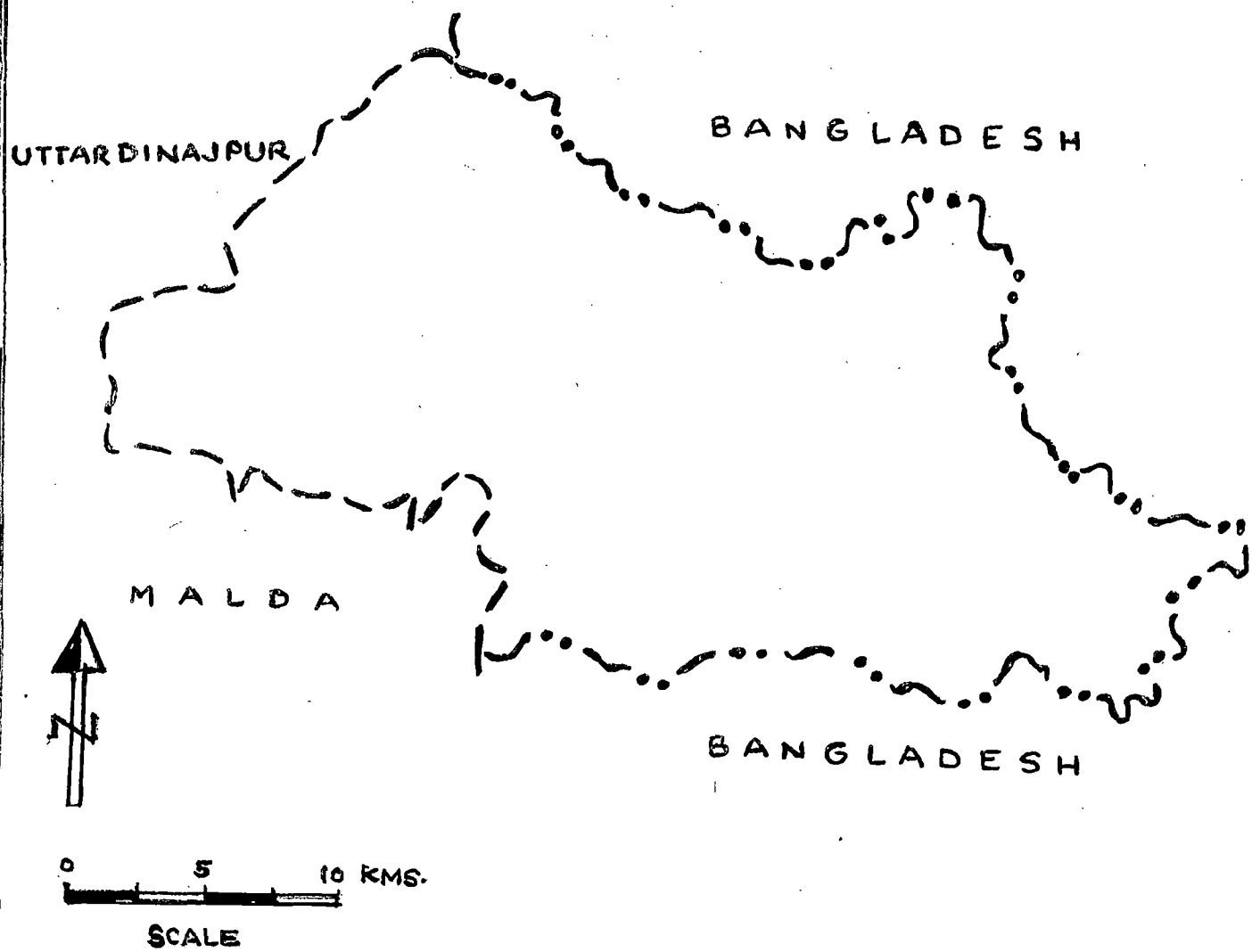


Fig. 7.23

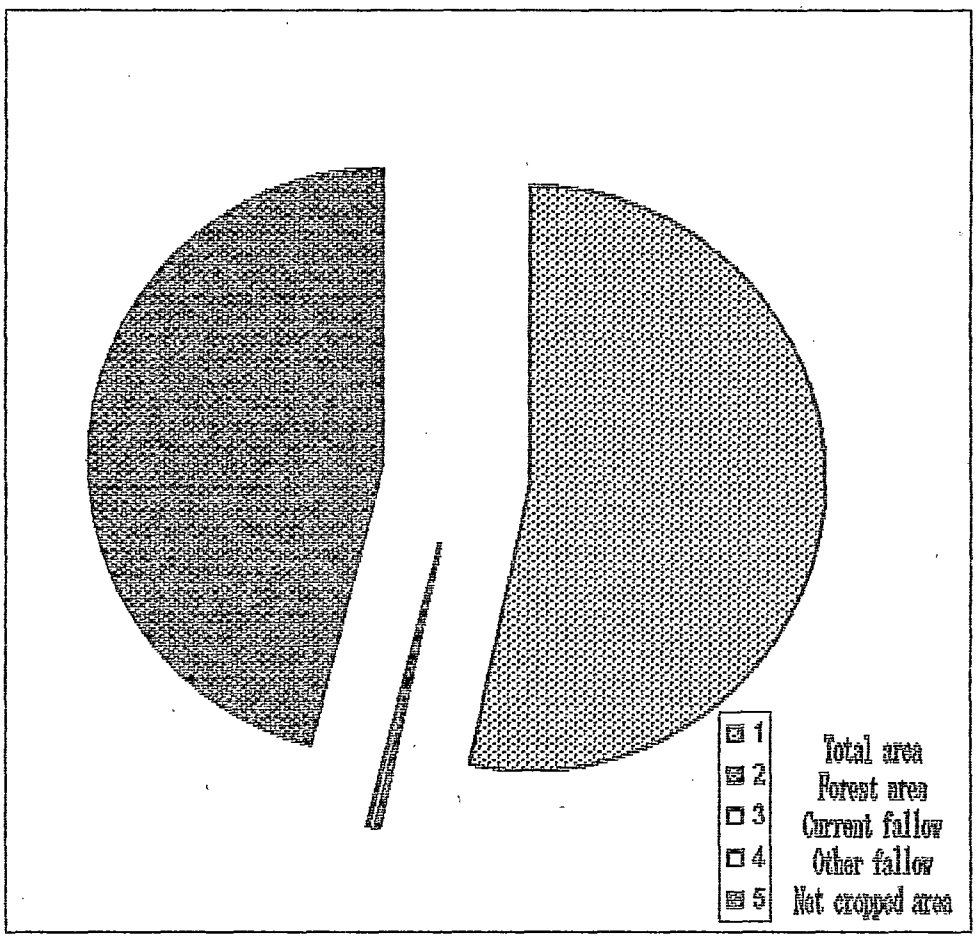


Fig 7.24 Some classification of land utilisation statistics in the district of Dakshin Dinajpur (2001-02)

economy of the district is primarily dependent on agriculture. More than 86 percent of the land area is under cultivation. The percentage of the net cropped area is increasing every year since 1999 (Fig. 7.24).

Table7.27

Some Classification of Land Utilization Statistics in the District of Dakshin Dinajpur

(Area in 000 hect.)

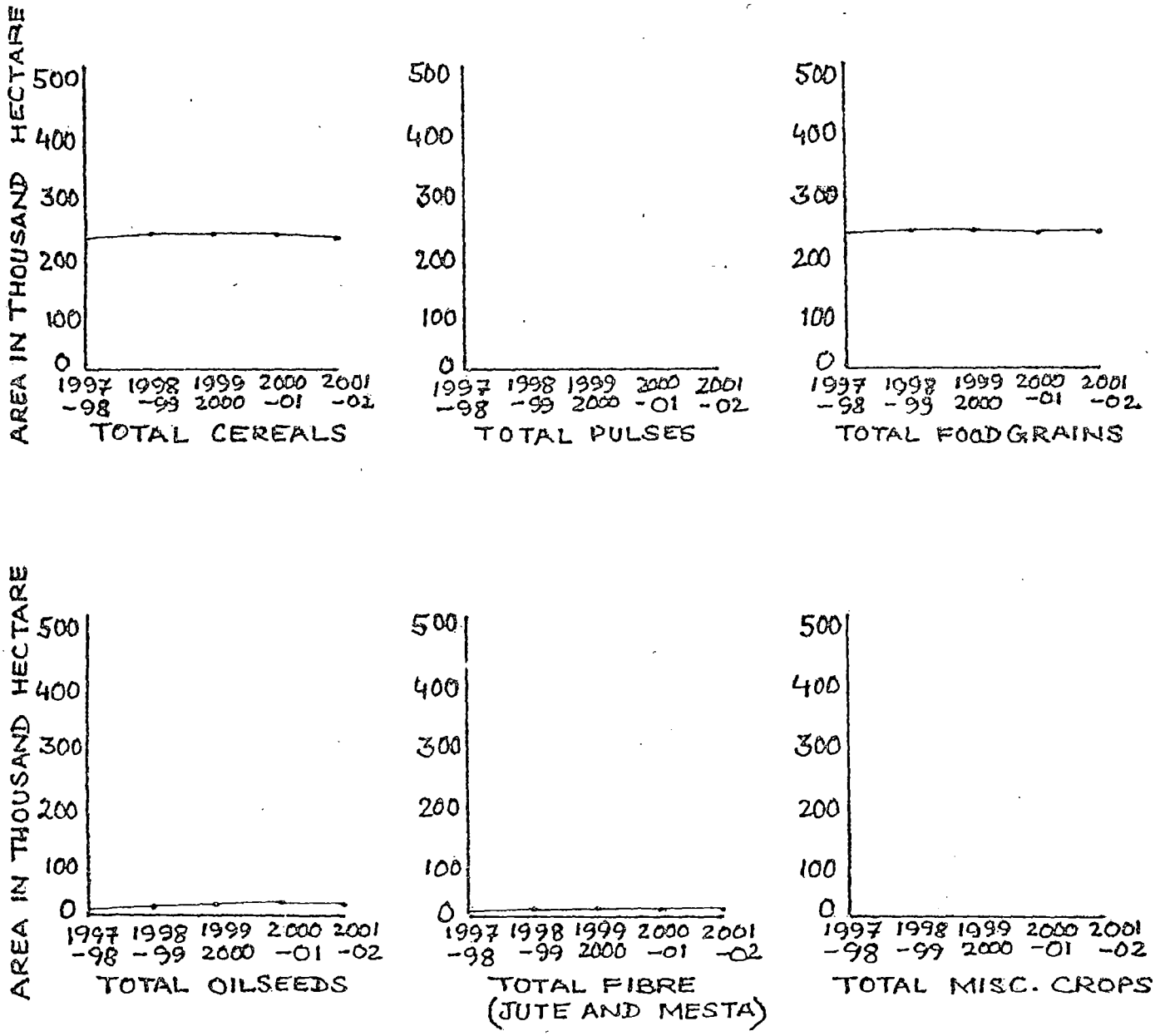
Year	Total area according to D.L.R., W.B.	Forest according to state forest deptt.	Current fallow	Other fallow and other than current fallow	Net cropped area
1997-98*	534.187	1.430	11.840	0.274	443.994
1998-99	221.909	0.851	2.632	0.259	189.809
1999-00	221.906	0.851	2.734	0.115	192.390
2000-01	221.908	0.932	1.487	0.034	190.462
2001-02	221.908	0.932	1.603	0.048	191.751

* Combined with Uttar & Dakshin Dinajpur, 2002.

Source: Directorate of Agriculture, Govt. of West Bengal, 2002.

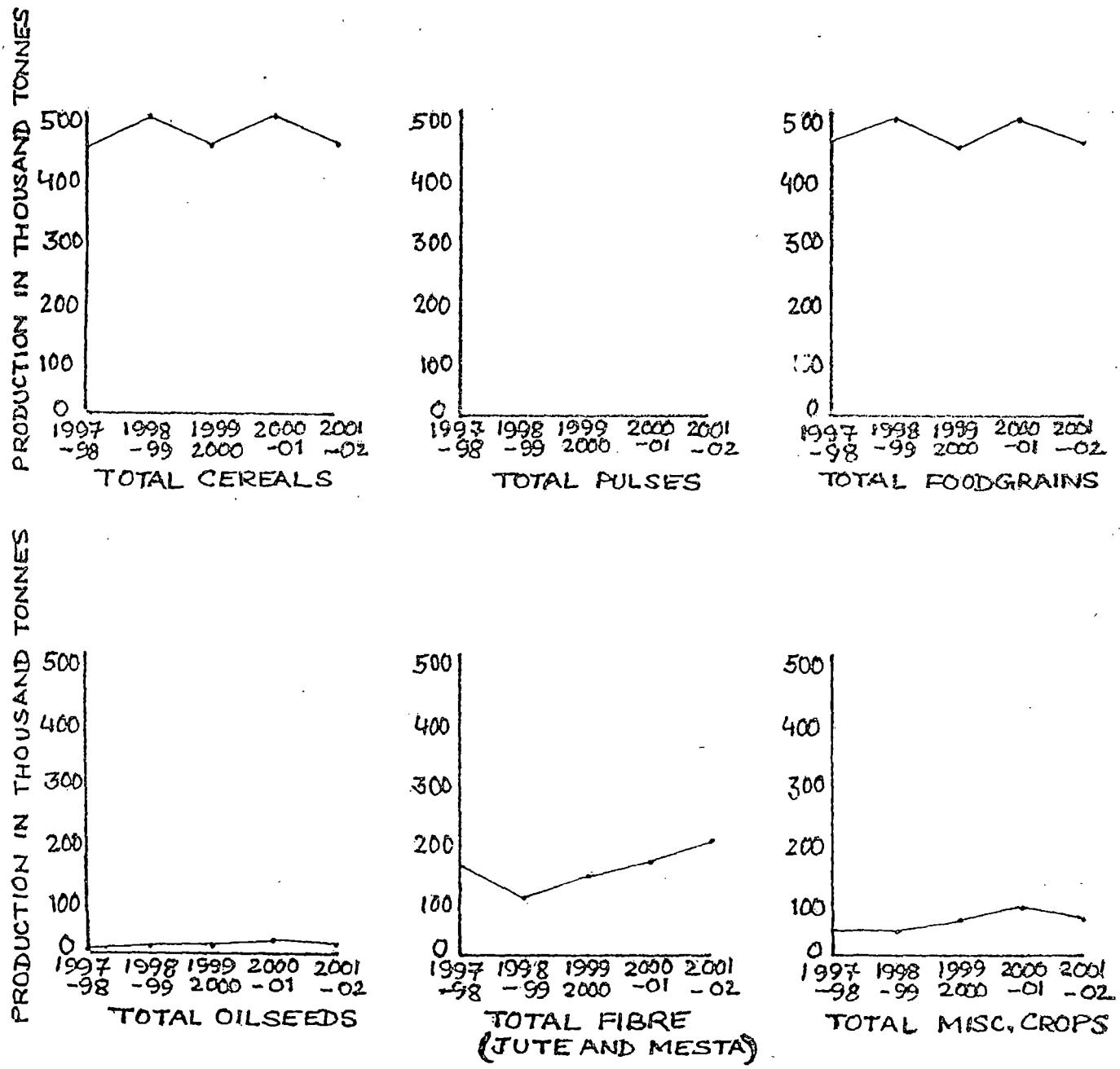
Since 1997-98 the area under total food grains is increasing but the area under pulses is decreasing sharply. Cultivated area for other crops such as oilseeds jute and mesta and miscellaneous crops also shows upward trend. Increased production of total creals and total food grains is also noticed. Production of jute and mesta miscellaneous crops, oilseeds also increased substantially fro 1997-98 to 2001-02. (Fig. 7.25 and 7.26)

To understand more about the agricultural situation of Dakshin Dinajpur an attempt has been made to analyse the area and production under different crops for a period for five years since 1997 to 2002 (Table 7.28 and 7.29).



Area under principal crops in the district of Dakshin Dinajpur.

Fig. 7.25



Production of principal crops in the district of Dakshin Dinajpur.

Fig. 7.26

Table 7.28

Area Under Principal Crops in the District of Dakshin Dinajpur

(area in hectare)

Crops	1997-98	1998-99	1999-00	2000-01	2001-02
Total Cereals	213.0	222.1	226.6	221.0	220.8
Total Pulses	6.3	6.1	4.0	4.1	3.4
Total Foodgrains	219.3	228.2	230.6	225.1	224.2
Total Oil Seeds	11.0	17.6	20.6	22.6	22.5
Total Fibre (Jute and Mesta)	14.7	12.0	14.4	16.6	18.5
Total Miscellaneous Crops	5.7	5.4	5.9	7.2	7.1

Table 7.29

Production of Principal Crops in the District of Dakshin Dinajpur

(Production in 000 hectares)

(Production in tonnes)

Crops	1997-98	1998-99	1999-00	2000-01	2001-02
Total Cereals	445.9	479.0	445.6	492.5	449.6
Total Pulses	4.7	3.7	2.6	2.5	2.2
Total Foodgrains	450.6	482.7	448.1	495.0	451.8
Total Oil Seeds	7.2	11.6	16.4	21.0	17.1
Total Fibre (Jute and Mesta)	146.6	95.0	133.5	161.1	196.5
Total Miscellaneous Crops	43.5	44.5	60.5	89.5	68.3

Source: 1. Directorate of Agriculture, Govt. of West Bengal.

2. Bureau of Applied Economics and Statistics, Govt. of West Bengal, 2002.

Table7.30

Yield Rate of Some Selected Crops in the District of Dakshin Dinajpur

(Kilogram per hectare)

Crops	1997-98	1998-99	1999-00	2000-01	2001-02	
	District	District	District	District	District	West Bengal
Rice	2082	2161	1947	2218	2013	2514
Wheat	2472	2048	2423	2461	2541	2215
Gram	847	769	550	113	382	851
Jute	1782	1422	1656	1746	1908	2441
Rapeseed and Mustard	653	669	797	932	764	766
Potato	14072	13504	13863	18303	14188	
Tea	-	-	-	-	-	1732

Source: 1)Bureau of Applied Economics and Statistics, 2002.

2) Directorate of Agriculture, Govt. of West Bengal.

3) Tea Board, 2002.

The table 7.30 shows the yield rate of rice is more or less stable with occasional variations. From 1997-98 till 2002 the yield rate or rice has an increasing trend and rice is grown well in the district. Wheat is also showing increased yield rate since 1997. So far gram is concerned it is showing decreasing yield rate. Jute is giving good return to the farmer and yield rate is also increasing with occasional variations. Oils seeds such as mustard and rapeseeds are also showing increasing yield rate since 1997, but in 2002 shows a decreasing trend. Potato was produced more in quantity in 2000-2001 but there is a sharp fall in 2002. (Fig. 7.27)

Fig-7.27 Bar diagram showing area of Rice, Wheat,Jute, Rapeseed & Mustard and Potato in Dakshin Dinajpur District in the year 2001-2002

Table 7.31

Area Irrigated by Different Sources in Uttar Dinajpur

(000 hectare)

Years	Area Irrigated by							
	Govt. Canals	Tanks	HDTW	MDTW	STW	RLI	Other sources	Total
1997-98	20.67*	-	-	-	-	-	28.55	49.22
1998-99	20.67*	-	-	-	-	-	28.55	49.22
1999-00	20.67*	-	-	-	-	-	29.28	49.95
2000-01	20.67*	-	-	-	-	-	27.57	48.22
2001-02	10.35*	3.48	0.19	0.14	38.31	9.89	-	62.36

** including "ODW" & others.
* including other irrigation.
Note: HDTW – High Capacity Deep Tubewell.
MDTW – Middle Capacity Deep Tubewell.
STW – Shallow Tubewell.
RIL – River Lift Irrigation.
ODW – Open Dug Well.
Including R.L.I., T.W., D.S.T.W.
Sources: 1) Principal Agricultural Office.
2) Assistant Engineers Agri. Mech. Agri Irri., 2002.

In Dakshin Dinajpur tanks are used as reservoir for irrigating the field. It is only recently that some other sources of irrigation is practised in Dakshin Dinajpur. In 2002 a little more than 62 thousand hectares of agricultural land is irrigated by different sources of irrigation (Fig. 7.28).

Table7.32

Fertiliser Consumed in the District of Dakshin Dinajpur*

(000 tones)

Year	N	P	K	Total (N+P+K)
1997-98	31.6	14.6	8.1	54.3
1998-99	33.0	17.2	9.6	59.8
1999-00	36.5	20.4	11.8	68.7
2000-01	31.5	18.1	11.3	60.9
2001-02(P)	14.9	10.1	5.5	30.5

Note: N = Nitrogen
P = Phosphate
K = Potassium
Source: Directorate of Agriculture, Govt. of West Bengal, 2002.
Combined with Uttar & Dakshin Dinajpur.

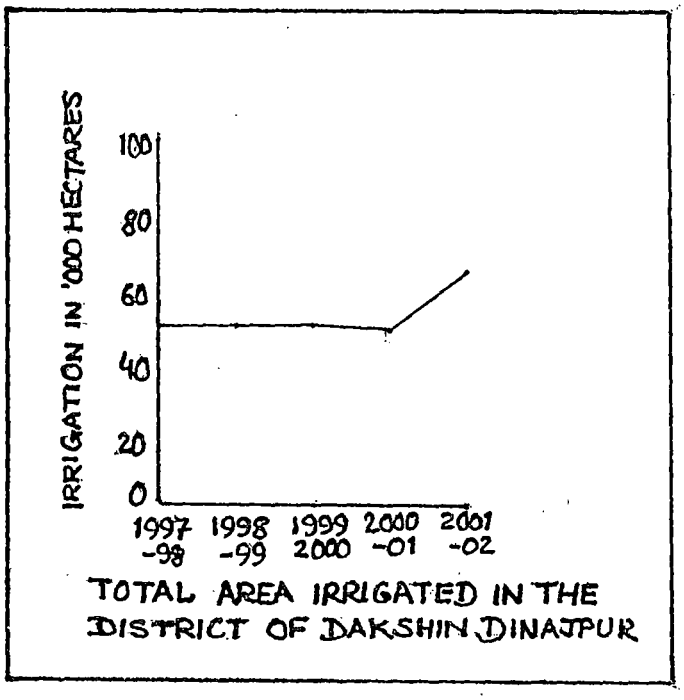


Fig. 7.28

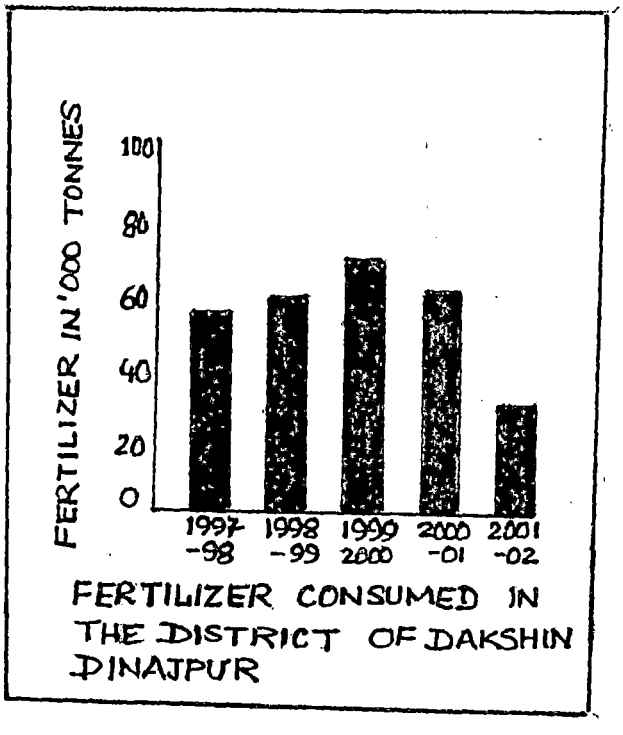
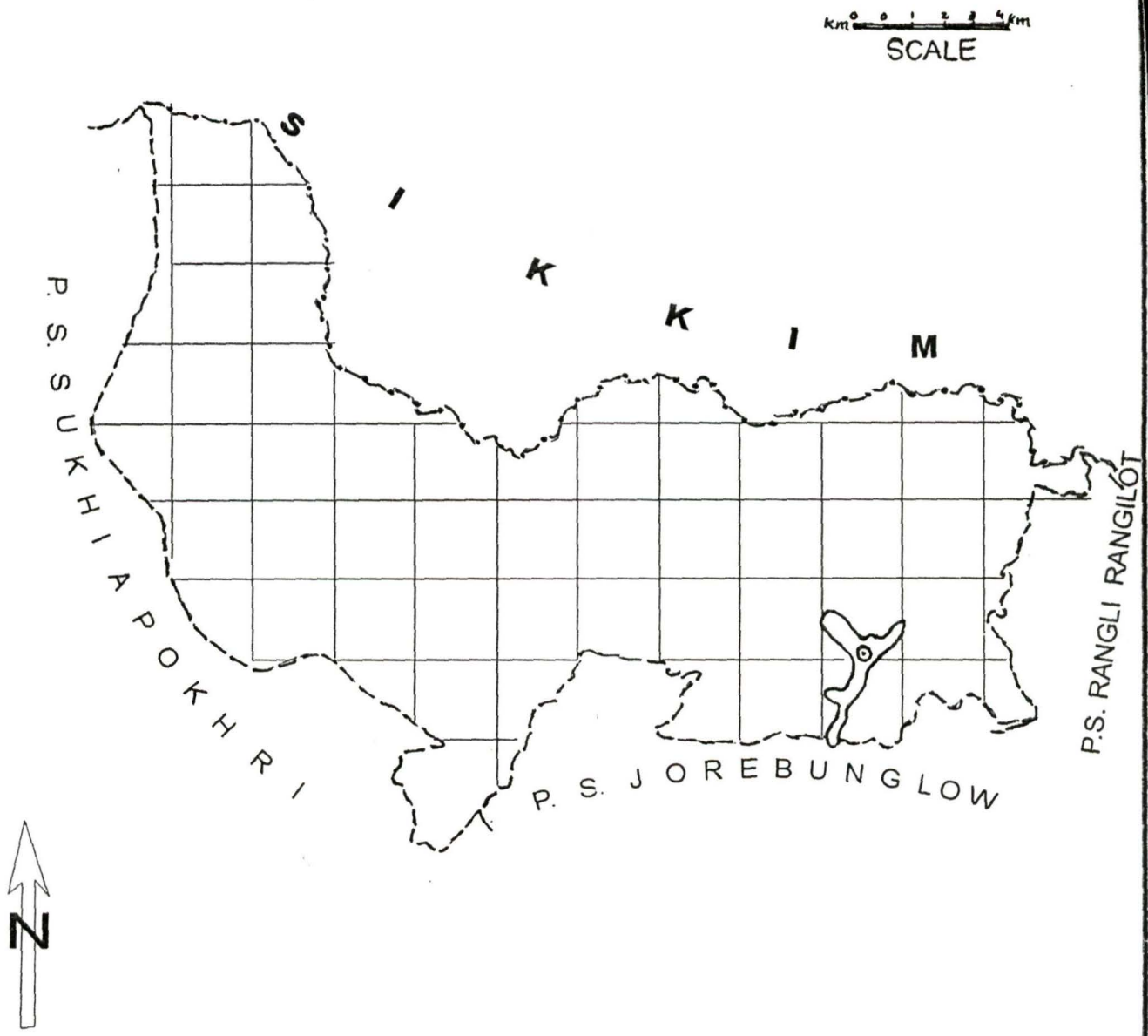


Fig. 7.29

Plate-3 Maize cultivation in Goru Bathan

Plate 4 Mirik forest in Darjeeling District

C.D. BLOCK DARJEELING PULBAZAR
CROPPING PATTERN



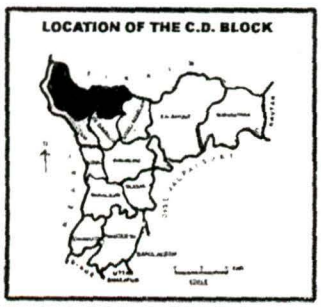


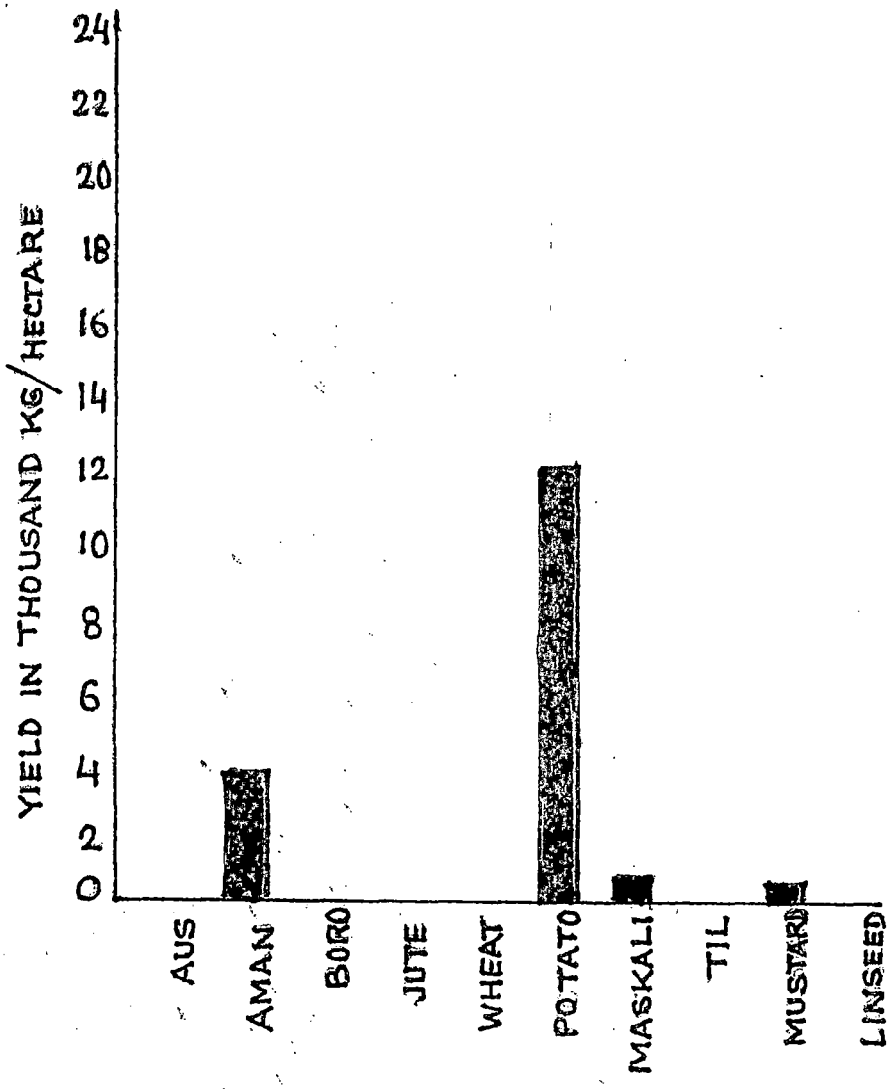
Fig- 11.3

INDEX

International Boundary
State Boundary
District Boundary
P.S. Boundary

URBAN AREA

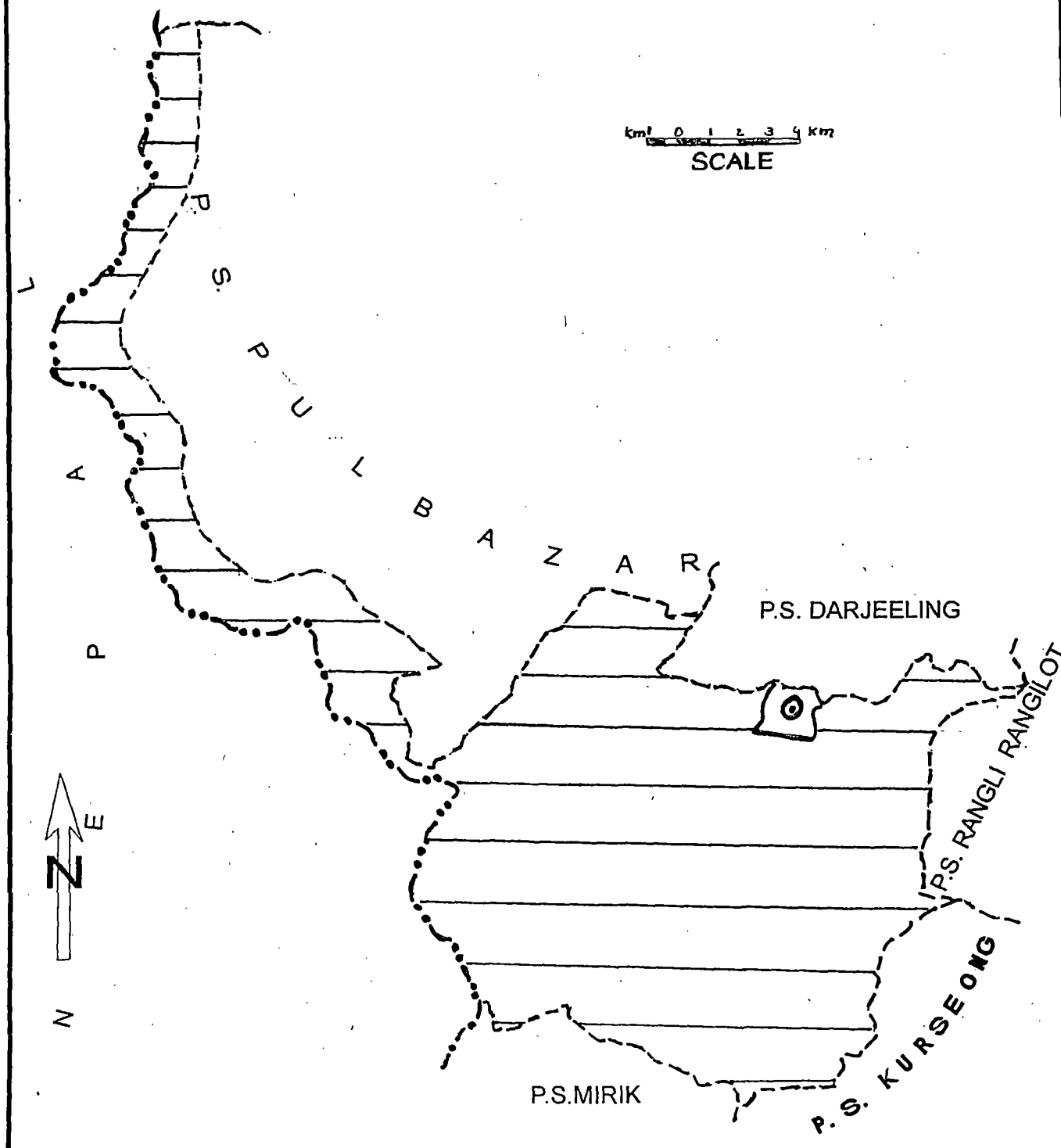
CROP COMBINATION
AMAN(RICE)POTATO,MAIZE)

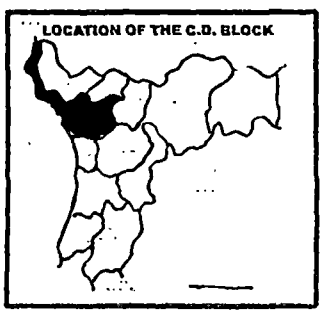


DARJEELING - PULBAZAR
2001 - 2002

Fig. 11.3

C.D. BLOCK JOREBUNGLOW-SUKHIAPOKHRI
CROPPING PATTERN





INDEX

International Boundary	
State Boundary	
District Boundary	
P.S. Boundary	
URBAN AREA	
CROP COMBINATION POTATO. MAIZE	

Fig- 11.4

From table 7.32 it is clear that chemical fertilizers are used in different agricultural farms. Nitrogen is used in higher quantity followed by phosphate and potash. In the year 1997-99, 54 thousand tones of fertilizer was used and consumption increased till 1999-00. But after that year use of fertilizer decreased and in 2001-02 it was only 30 thousand tones (Fig.- 7.29).

The operational holding of the farmers are plotted in Table 7.33. Since operational holding figures for the cultivator is not available separately for Dakshin Dinajpur, the combined figure for Uttar and Dakshin Dinajpur has already been discussed.

Communication system in the district of Dakshin Dinajpur is shown in Table 7.34.

Table7.33

Length of Roads Maintained by P.W.D. in the District of Dakshin Dinajpur

(in Kilometer)

Year	State Highways	District Highways	Village Roads	Total	Total
1997-98	56.00	11.00	219.00	219.00	286.00
1998-99	56.00	11.00	219.00	219.00	286.00
1999-00	56.00	11.00	219.00	219.00	286.00
2000-01	56.00	11.00	219.00	219.00	286.00
2001-02	136.00	101.00	185.00	185.00	422.00

Source: P.W.D. (Roads), West Bengal, 2002.

The network of communication has improved in the district. Total 101 kms. of new surfaced roads are being constructed. In 1997-98 there were only 286 km. of road. The district at present has a total of 422 kms. of road. The communication system is also fast developing like consumption of fertilizers and increased yield rates.

The district of Dakshin Dinajpur is gradually becoming important in the cultivation of rice and jute but due to some socio-economic factor the peasants are still very poor excepting a few cultivators.

7.06 Malda

The district of Malda is a low lying plain without any hill. The land is sloping towards south. So no high land can be seen in the district. The district is located between $25^0$32'08" N to $24^0$40'20" n latitude and $88^0$28'10" E to $87^0$45'50"E longitude. (Fig. 7.30)

Malda is divided into three distinct areas such as –

a) Barind area at the northern part of the district.

b) Tal area at the northern part of the district.

c) Diar area at the southern part of the district.

According to the census operation of 2001 the land utilization pattern in the district of Malda (Table 7.34) is classified in the following manner:

Table7.34

Some Classification of Land Utilization Statistics in the District of Malda

(in '000 hectares)

Year	Total area according to D.L.R., W.B.	Forest according to state forest deptt.	Current fallow	Other fallow and other than current fallow	Net cropped area
1997-98	371.04	1.68	14.41	0.26	286.57
1998-99	371.04	1.68	14.33	0.26	286.57
1999-00	371.04	1.68	19.58	0.26	281.28
2000-01	371.04	1.68	58.20	0.26	222.91
2001-02	371.04	1.68	58.11	0.31	223.11

Source: Directorate of Agriculture, Govt. of West Bengal, 2002.

DISTRICT MALDA

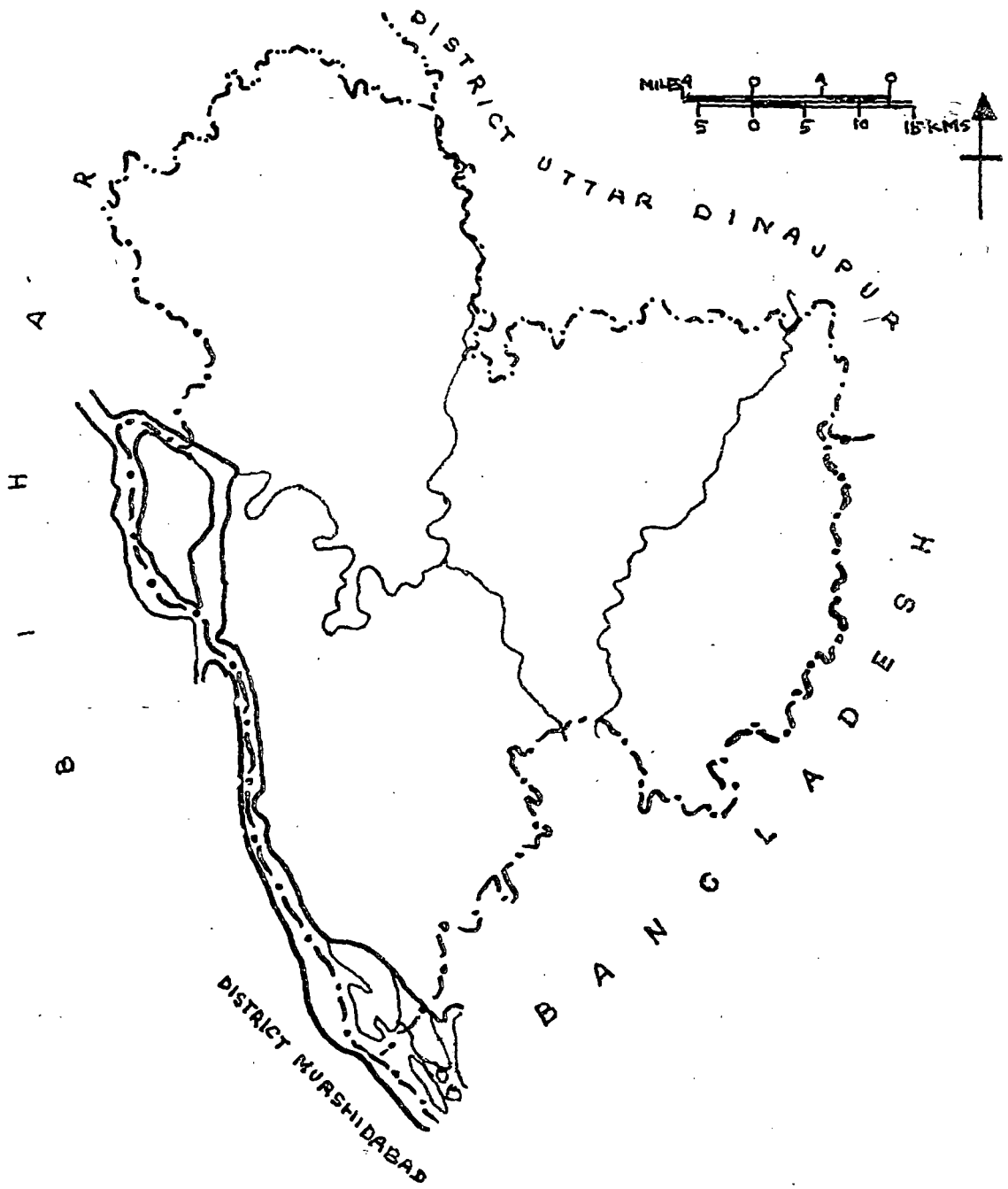


Fig. 7.30

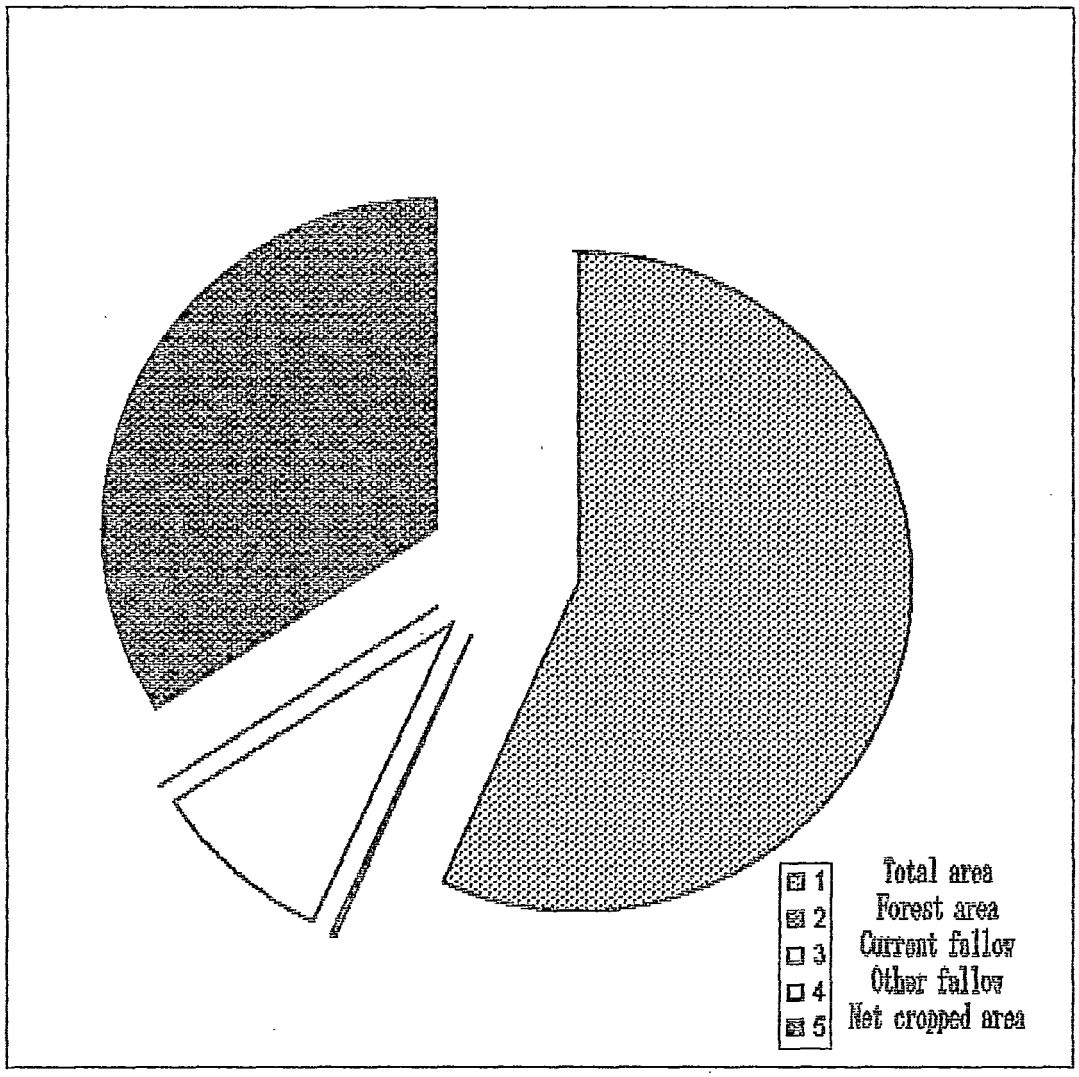


Fig 7.31 Some classification of land utilisation statistics in the district of Malda(2001-02)

Table 7.34 shows that total area of the district is 37105 thousand hectares. Only 0.45 percent area of the district is covered with forest. A little more than 15 percent land is current fallow land. The district has 1.68 thousand hectares of land under forest cover. In 1997-98 286.57 thousand hectares was net cropped area and in 2001-02 the net cropped area decreased to 223.11 thousand hectares (Fig. 7.31) sixty percent net cropped area of the district is 60 p.c.

Table 7.35 and 7.36 indicates the area and production under different corps in Malda for the period 1997 to 2002.

Table7.35

Area Under Principal Crops in the District of Malda

('000 hectare)

Crops	1997-98	1998-99	1999-00	2000-01	2001-02
Total Cereals	292.4	286.0	285.5	277.6	268.9
Total Pulses	28.8	22.3	25.0	36.1	30.5
Total Foodgrains	321.2	308.3	310.5	313.7	299.4
Total Oil Seeds	22.0	22.8	22.2	35.7	35.5
Total Fibre (Jute and Mesta)	26.7	26.4	24.5	24.5	28.8
Total Miscellaneous Crops	11.7	12.9	12.2	12.3	9.5

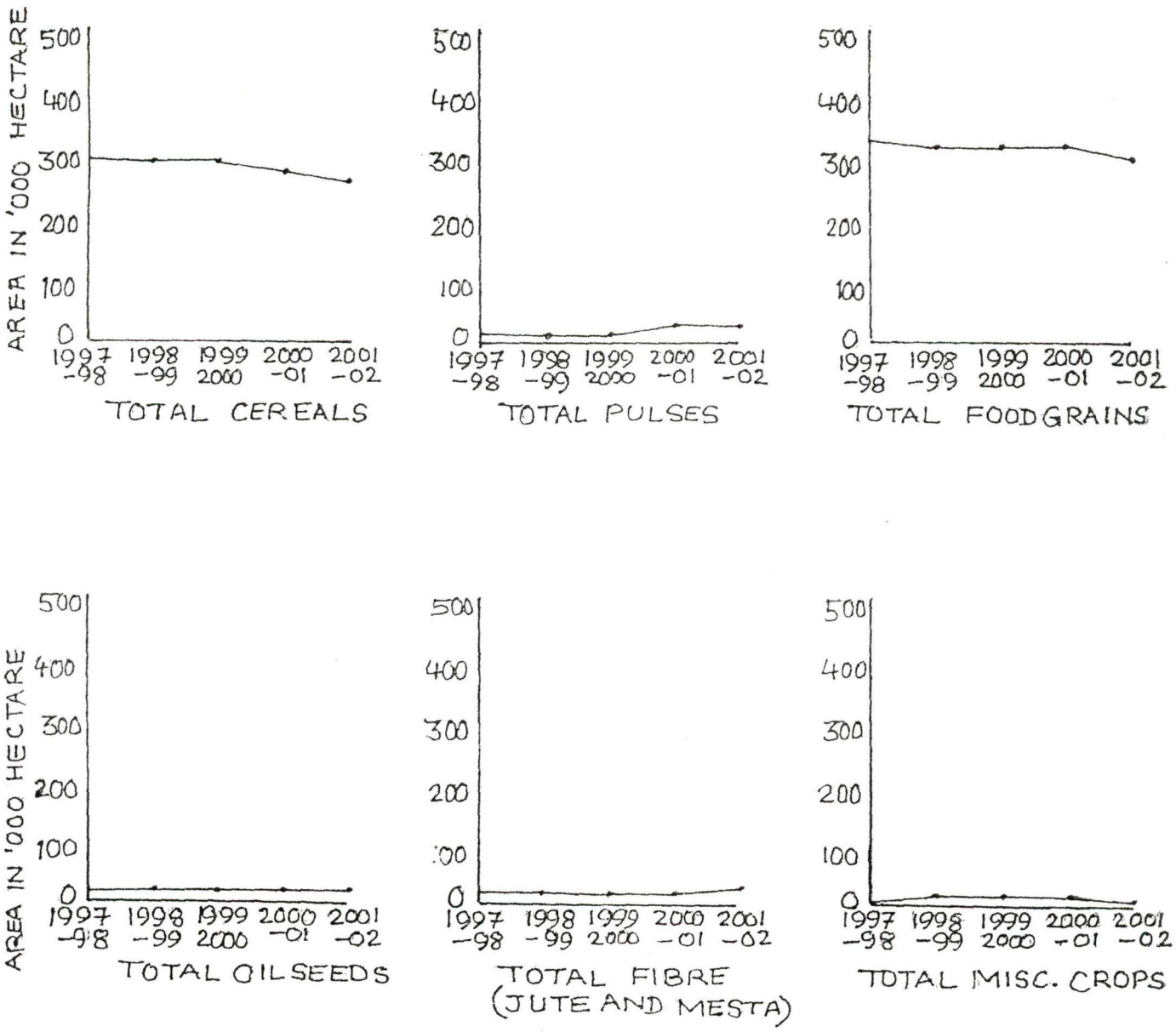
Table7.36

Production of Principal Crops in the District of Malda
(Production in 000 hectares)

(Production in tonnes)

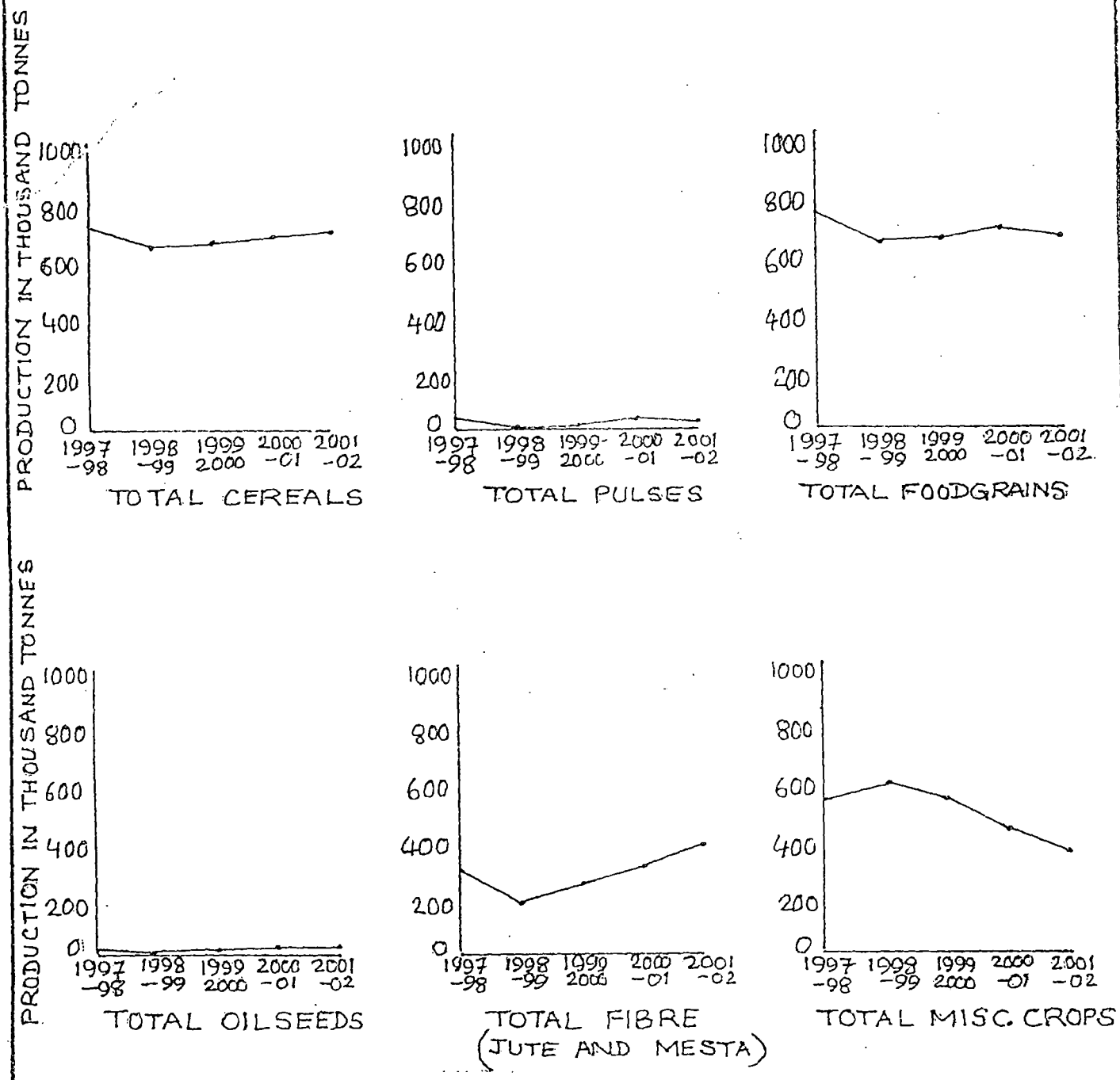
Crops	1997-98	1998-99	1999-00	2000-01	2001-02
Total Cereals	715.0	628.8	645.9	659.1	678.6
Total Pulses	20.8	9.2	11.3	29.6	25.6
Total Food grains	735.8	638.0	657.2	688.7	704.2
Total Oil Seeds	17.7	14.4	20.0	36.1	37.0
Total Fibre (Jute and Mesta)	281.9	196.6	245.0	252.5	380.9
Total Miscellaneous Crops	510.3	585.5	522.0	413.4	347.2

Source: 1. Directorate of Agriculture, Govt. of West Bengal.
2. Bureau of Applied Economics and Statistics, Govt. of West Bengal, 2002.



Area under principal crops in the district of Malda.

Fig. 7.32



Production of principal crops in the district of Malda.

Fig. 7.33

The district of Malda is very fertile. Because of favourable climatic and other physical conditions foodgrains are grown abundantly. Rice occupies 213.3 thousand hectares of land followed by wheat, pulses and jute. Area under important crops such as potato, rape and mustard seeds are cultivated in more areas in 2002 as compared to 1997-98. Area under pulses is also increasing since mid nineties. (Fig. 7.32)

Rice is the principal crop grown in Malda. Production of rice shows improvement since 1997 with a little exception for a few years. In 2002 more than 536 thousand tones of rice was produced. Next important crops are wheat, jute, sugarcane, barley, gram potato cereals rapeseed etc. Other crops which are grown in the district are maize, tobacco, chilies and ginger. (Fig. 7.33)

To understand more accurately about the total production of the district of Malda, yield rate (Table 7.37) of some selected crops are discussed below.

Table 7.37

Yield Rate of Some Selected Crops in the District of Malda

(Kilogram per hectare)

Crops	1997-98	1998-99	1999-00	2000-01	2001-02
	District	District	District	District	District
Rice	2414	2147	2252	2360	2513
Wheat	2585	2373	2437	2511	2616
Gram	686	677	595	1275	733
Jute	1908	1332	1800	1854	2412
Rapeseed and Mustard	823	641	922	1083	1051
Potato	18530	16866	18040	17642	17838

Jute – kg. Per hectare.

Source: 1) Bureau of Applied Economics and Statistics, 2002.
2) Directorate of Agriculture, Govt. of West Bengal.

Rice is grown in all parts of Malda and yield rate of rice is also very high and as high as West Bengal's total yield rate.Potato and Wheat also gives high yield rate. Other

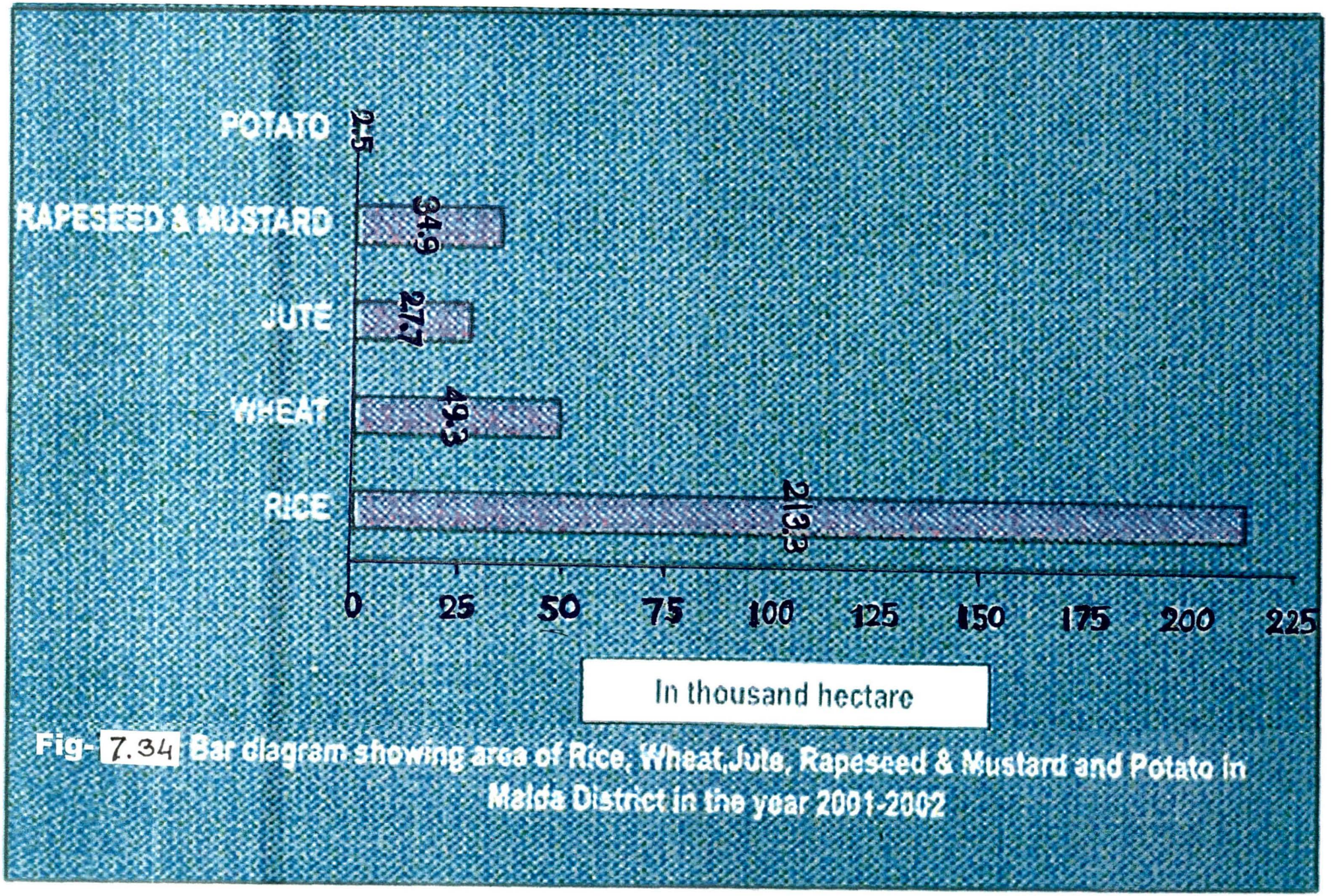


Fig- 7.34 Bar diagram showing area of Rice, Wheat, Jute, Rapeseed & Mustard and Potato in Malda District in the year 2001-2002

corps such as gram, jute and mustard and rapeseeds are showing increasing yield rate. Yield rate of some selected crops are depicted in Fig. 7.34.

Table7.38

Area Irrigated by Different Sources

(000 hectare)

Years	Area Irrigated by									
	Govt. Canals	Tanks	HDTW	MDTW	LDTW	STW	RLI	ODW	Other sources	Total
1997-98	-	1.392	-	-	-	-	-	-	107.768*	109.160
1998-99	-	1.300	-	-		-	-		106.129*	107.429
1999-00	-	1.300	-	-		-	-		110.150*	111.450
2000-01	-	1.301	5821	0.195	0.452	71.835	8.213	-	24.879	112.796
2001-02	-	1.308	6.438	0.253	0.677	81.582	9.005	-	24.857	124.120

Note: HDTW – High Capacity Deep Tubewell.
MDTW – Middle Capacity Deep Tubewell.
LDTW – Low Capacity Deep Tubewell.
STW – Shallow Tubewell.
RIL – River Lift Irrigation.
ODW – Open Dug Well.
Including R.L.I., T.W., D.S.T.W.

Sources: 1) Irrigation and Waterways Directorate.
2) Principal Agricultural Office.
2) Assistant Engineers Agri. Mech., Agri Irri., 2002.

* Including DTW, RLI, STW & Others.

The farmers of Malda are using different sources of irrigation like tank, high capacity deep tube well, low capacity deep tube well, middle capacity deep tube well, shallow tube well, river life irrigations and many more. The data in the table 7.38 indicates that more and more land is being covered by the well-developed system of irrigation. Irrigation, is therefore one of the many reasons for the agricultural development of Malda (Fig. 7.35).

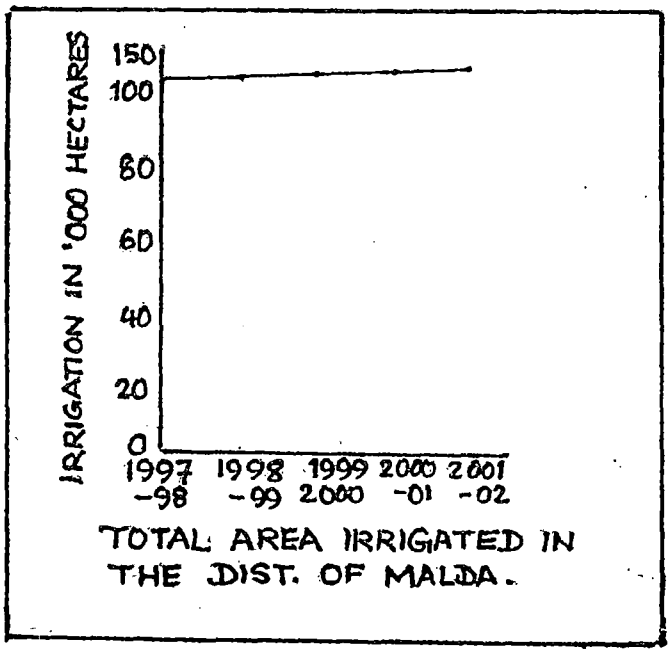


Fig. 7.35

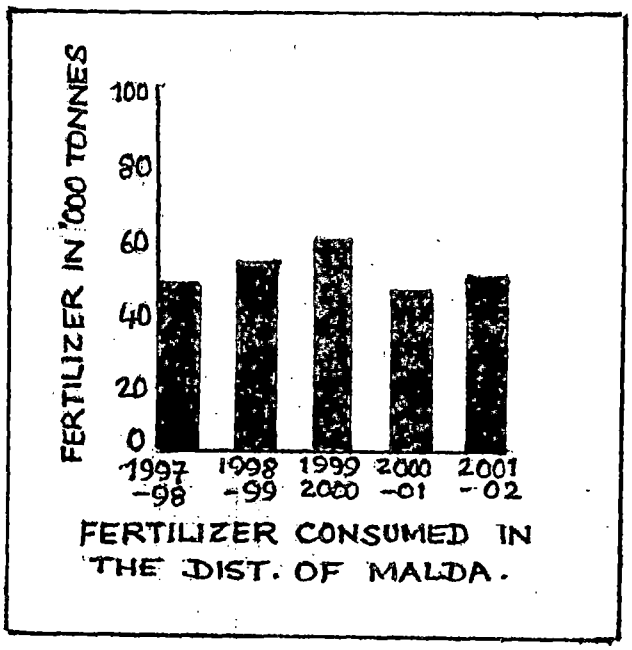


Fig. 7.36

Table 7.39

Fertiliser Consumed in the District of Malda*

('000 tones)

Year	N	P	K	Total (N+P+K)
1997-98	25.3	13.2	8.5	47.0
1998-99	27.0	15.5	10.1	52.6
1999-00	29.4	18.0	12.1	59.5
2000-01	20.5	11.6	11.2	43.3
2001-02	22.1	13.7	13.3	49.1

Note: N = Nitrogen
P = Phosphate
K = Potassium

Source: Directorate of Agriculture, Govt. of West Bengal, 2002.

Use of fertilizer is gaining popularity among the farmer of Malda. The data in the table (7.39) also suggests increased used of fertilizer and therefore, bumper corps are grown. Total tonnes of fertilizer used in the district was 49.1 thousand hectares, in 2001-2002. Important fertilizer used are nitrogen, phosphate and potash (Fig. 7.36).

Table7.40

Distribution of Operational Holding according to Size Class in U~~ttar Dinaj~~pur MALDA

Year	Size Class												
	Marginal		Small		Semi-medium		Medium		Large		Total		Average
	No. of Holding	Area of Holding	No. of Holding	Area of Holding	No. of Holding	Area of Holding	No. of Holding	Area of Holding	No. of Holding	Area of Holding	No. of Holding	Area of Holding	Size of Holding
1990-91	335405	154609	73349	111171	29810	83262	7777	44411	128	1928	446469	395381	0.89
1995-96	343677	157309	74863	112926	30198	82188	7528	41342	120	1232	456386	394997	0.87

Source: Agricultural Census, West Bengal, 2002.

Note: Marginal: Below 1.0 acre.
Small: 1.0 acre and above but less than 2.0 acres.
Semi medium: 2.0 acres and above but less than 4.0 acres.
Medium: 4.0 acres and above but less than 10.0 acres.
Large: 10.0 acres and above (1 acre = 0.404686 hectare).

Like other districts of North Bengal average size of holding is below one hectare for a farming family. In 1995-96 there were only 120 big or large farms, Marginal farmers are having largest number of holdings followed by small and semi-medium holdings. Again area of big farms are ranging between 1900 to 1200 hectares.

Length of different classes of road maintained by P.W.D. in Malda is shown in Table 7.42.

Table 7.41

Length of Roads Maintained by P.W.D. in the District of Malda

(in Kilometer)

Year	National Highways	State Highways	District Highways	Village Roads	Total
1997-98	70	50	196	294	610
1998-99	70	50	196	294	610
1999-00	70	50	196	294	610
2000-01	70	50	196	294	610
2001-02	70	50	261	247	628

Source: P.W.D. (Roads) Malda, West Bengal, 2002.

Roads and Communication

The development in transport (Table 7.41) is another factor accelerating the process of transformation of agriculture. Malda is not showing much improvement in total network of road communication. A few kilometers of new roads were constructed during 1997-98 to 2001-2002.

PART – TWO

PROBLEMS AND PROSPECTS OF PHYSICAL ENVIRONMENT OF AGRICULTURAL RELEVANCE

CHAPTER – EIGHT

Geology Including Rocks Composition, Soil and Agriculture (Existing)

8.0 Geology

8.01 Geology, Soil and Agriculture

Since my particular study area of this thesis is Darjeeling district so from this chapter onwards I will only focus my study in Darjeeling district. Any agricultural operation is intimately related to soil, which has its historical and natural background in its formation. It is formed as a result of a complex combination of the interaction of rocks, macro and micro organisms of zoological and phytological worlds, climate, relief and production activities of man. Soils are formed by the weathered igneous sedimentary and metamorphic rocks. When this weathered fine materials begin to support plant life, the chemical and physical changes in it are accelerated and brings revolution in the agricultural world. It is quite relevant to mention that the agricultural activity particularly its production is fully dependant on geology from which specific productive soils are derived.

Keeping in mind the above-mentioned point, we will discuss about the rock characteristics and related soils of Darjeeling district, which ultimately play a vital role in flourishing its agricultural activities. Most silt loam soil and mature soil are more productive than sandy soil and mature soil are more productive than soil that is either geologically young or very old. It should be remembered that productivity of the particular soil is partly determined by the way it has been managed in cultivation. So productivity of Darjeeling district has been analysed in terms of its relation to management and treatment as an investment, as good management and some soil treatment system increases the efficiency of the soil in fulfilling crop requirements and protect the soil from drainage and erosion. This is depicted on the map prepared

DISTRICT-DARJEELING
Geology

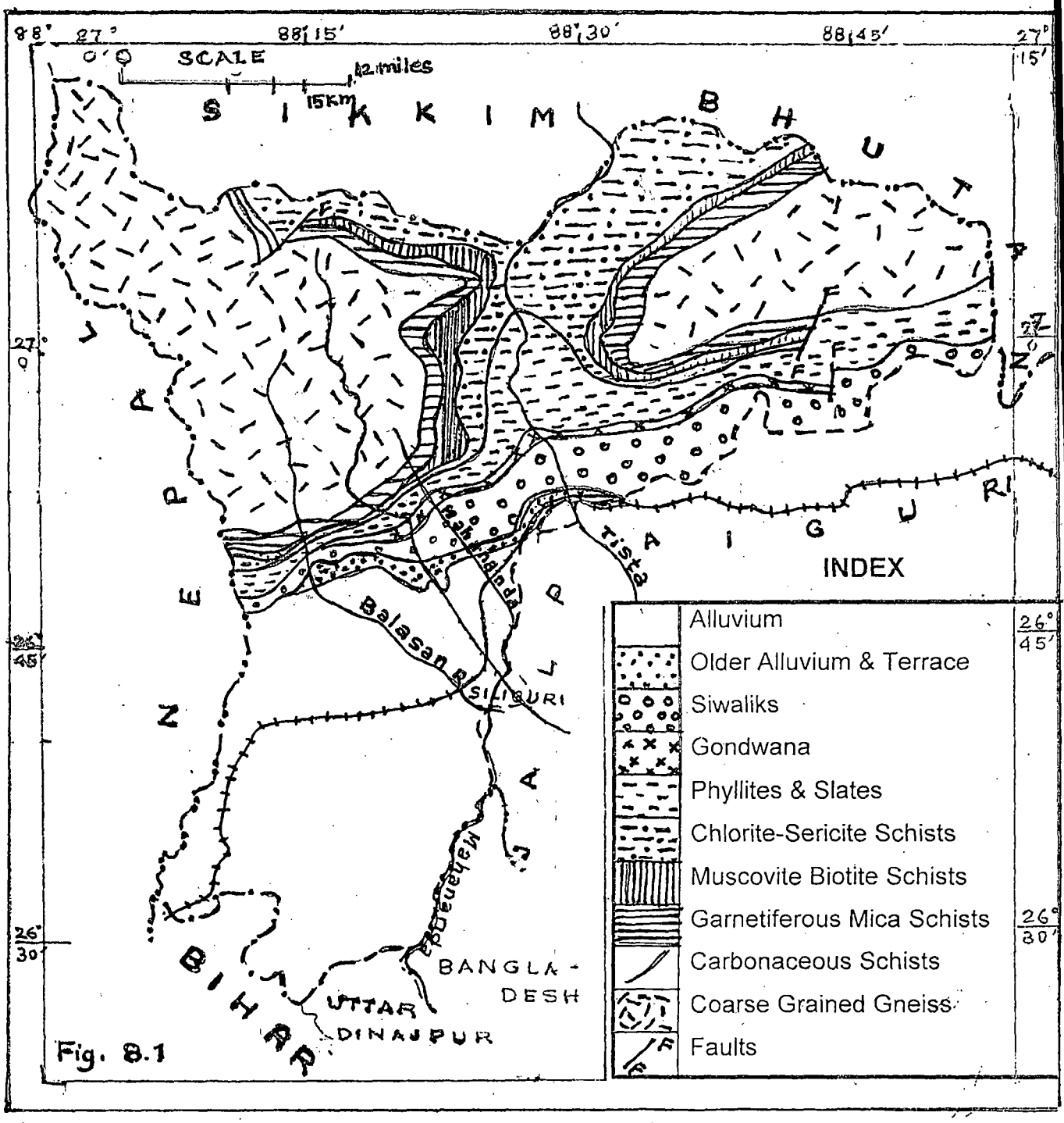


Fig. 8.1

on the basis of superimposition of these parameters, e.g. rock, climate and soil and analysed its relationship with the crop productivity potentiality. Figure 8.1 depicts geology of Darjeeling district.

Geographically Darjeeling belongs to the plains of India but geologically Darjeeling hills can be divided into three zones viz. – an outer belt of Siwalik frontal range, a medium narrow belt of Gondwanas and an inner range of metamorphites.

The low hills of the Siwaliks formations lying below 937 m. are composed of pebble stone in the upper levels and sand stone in the lower levels. Clay stones, shale and stills tone alterations are minor but these gain abundance in the lower part of the area. Soils derived from these groups of rocks are sandy loam with little humus.

The narrow belt of Gondwana formation gives rise to a low range rarely exceeding 750 m. lying in between higher hills of the Siwaliks and there of the metamorphites. This formation is composed of coal, seams clay sandstones and shales.

The hill ranges of the inner belt are 1000 to 2500 meters. The outer zone of the inner belt is occupied by the Dalings, which gradually give place to the Darjeeling genisses in the upper levels. This series of consists of slates schists, phyllites and quartizes, similar groups of rock occur from the Niora river to Jaldakha river in the Kalimpong division known as Buxa series. This group consists of dolomites, slate, phyllite, schists and orthoquartizes (Lahiri, 1957)[1].

The physical configuration of Darjeeling varies from a wide range of alluvial plain, terai Duars to the mountainous areas of the Darjeeling Himalaya or the lower Himalayan range. In terms of geological era, this region is the product of very recent times.

[1] Lahiri, S., 1957: Influence of Physiograph on the location and landuse of the tea gardens of Darjeeling.

The greatest difference in relief has brought about difference in climate, natural vegetation, drainage and soil character. All these factors together influence the agricultural practices in the Darjeeling district.

Soil conditions of Darjeeling hill is acidic. The brown forest soil of the area contains medium to high level of organic matter – nitrogen (N), phosphorous (P) and potassium (K).

In Siliguri sub-division of Darjeeling district, soil is leached, light acidic with low organic carbon. Good drainage offers scope for cultivation.

The agricultural pattern in Darjeeling hill area is somewhat different from that of the plain areas of the district. This is mainly because of the physical constraints in the hill area.

The hilly areas of the Darjeeling consists of a landscape with rugged terrain full of ridges. The mountainous are made of folded rocks piled one over another by a series of north-south horizontal compressions. The pre-Cambrians or the crystalline basement of the Himalayas belong entirely to what was originally the northern borders of India built up the metamorphosed rocks of Aravallies. In Darjeeling they are called the Darjeeling gneiss and Debeng series.

The Darjeeling district may be divided into from tracts viz. the hard rocks area, the Bhabar belt, the Terai belt and the alluvial plains. The southern portion of the hard rocks are is covered with sedimentary rocks and the northern part is composed of metamorphic rock. The Bhabar belt comprises big-boulders, rock fragments and fine grained clastics derived from hard rock area and is characterized by boulder surfaces, forest of tall trees and steep slopes. The terai belt is composed mostly of coarse granular materials alternating with fine clastics. This belt is the zone of rejected recharge and as such has developed swampy condition. The alluvium consists of succession of layers of sand silt clay with occasional gravel beds and lenses of peaty organic matter.

The soil of Darjeeling is characterized by brown podzolic variety. It may be mentioned here that mountains cover about sixty six (66%) percent of Darjeeling district. The nature of the soil changes with altitude. For example, it is black and alluvial in the Siliguri but higher up it is rather reddish or white in colours. (Fig.8.2)

Geology and composition of soils have influenced the agricultural practices of Darjeeling. The soil in the plain is dark and more fertile. For a better understanding about the types of soil of cultivable areas in different blocks of Darjeeling district, (Table 8.01) is given below.

Table 8.01

Classification of Types of Soil in Each Block of Darjeeling)

(Types of soil in percentage temp.)

Name of the Block	Cultivable Area in Hec.	Sandy Loam	Sandy Loam	Clayee Loam	Clayee Loam	Boulder etc.
Darjeeling Pulbazar	9783.00		95			
Jorebunglow Sukhiapokhri	2037.00		95			
Rangli-Rangliot	2958.00		95			
Kurseong	2023.00		60			40
Mirik	1130.00		60			40
Kalimpong-I	7206.00	28	60			12
Kalimpong-II	7120.00	28	60			12
Gorubathan	4844.00	28	60			12
Siliguri Naxalbari	11316.00	28	60			
Khoribari Phansidewa	18454.00		60	30	10	

Source: Annual Action Plan, 1989.

From Table 8.01, it is revealed that sandy loam is the predominant type of soil in all the blocks of Darjeeling district. Soils in the district are mostly acidic.

Due to physiogrpahical and soil conditions rice and wheat are not grown over most of the areas. Important crops that are grown in the hill areas of Darjeeling are maize,

DISTRICT DARJILING
SOIL

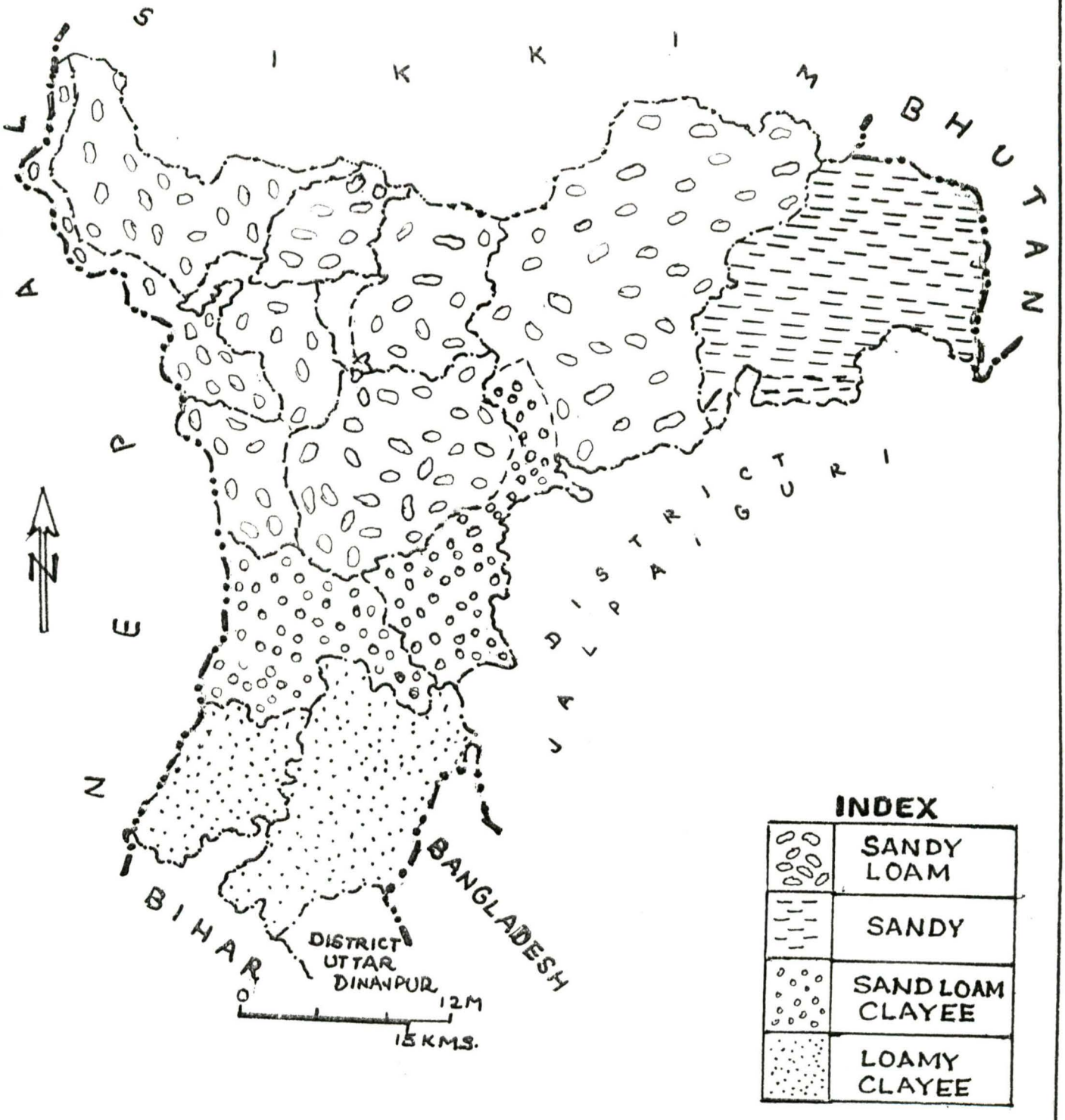


Fig. 8.2

millets, potatoes and vegetables. While undertaking the field work it was observed that dry land under cultivation are usually unirrigated and are used for growing maize and millets. In Kalimpong sub-division highest percentage of land is under cultivation. In Darjeeling sadar sub-division and Kurseong a few patches of no-contiguous cultivated land are found in the northern part of rivers Great and Little Rangeet. Few agricultural lands are also present to the south of water parting.

On the eastern side of the Great and Little Rangeet Cinchona plantations are located in Mungpoo and Latpanchor.

In Kalimpong subdivision comparatively large areas are under cultivation in the upper basins of the western and southern river valleys. Some areas are also cultivate in the north of the main range in the upper basin of the river Rishi Khola.

On the whole agricultural practices and cropping pattern shows considerable variations due to influence of geology and soil formation. The present cropping pattern in the hill areas ows its origin to the old system of agriculture with a heavy bias on cultivation of food crops. (Fig. 8.3)

There is no flattened land or valley at the relatively high altitude. This is one of the many reasons of limitations in the area available for cultivation. The crops grown in different elevations are grouped as follows (Table 8.02).

Table 8.02

Rotation of Crops at Different Altitudes

Levels of Altitudes	
1718 m - 2185 m	Maize, potato, radish, carrot. Peas, beans, turnip, cabbage.
1250 m - 1718 m	Aman paddy, maize, potato, squash, cauliflower. Cabbage, peas, beans, radish, wheat, ginger cardamom pineapple and orange.
625m – 1250m	Maize, paddy, wheat, potato, beans, ladies finger, tomato, beans tomato, cauliflower, cabbage, orange, plum, peach.
80m – 625m	Paddy, wheat, jute, potato, maize, vegetables.

Source: District Agriculture Office, Darjeeling, West Bengal, 2002.

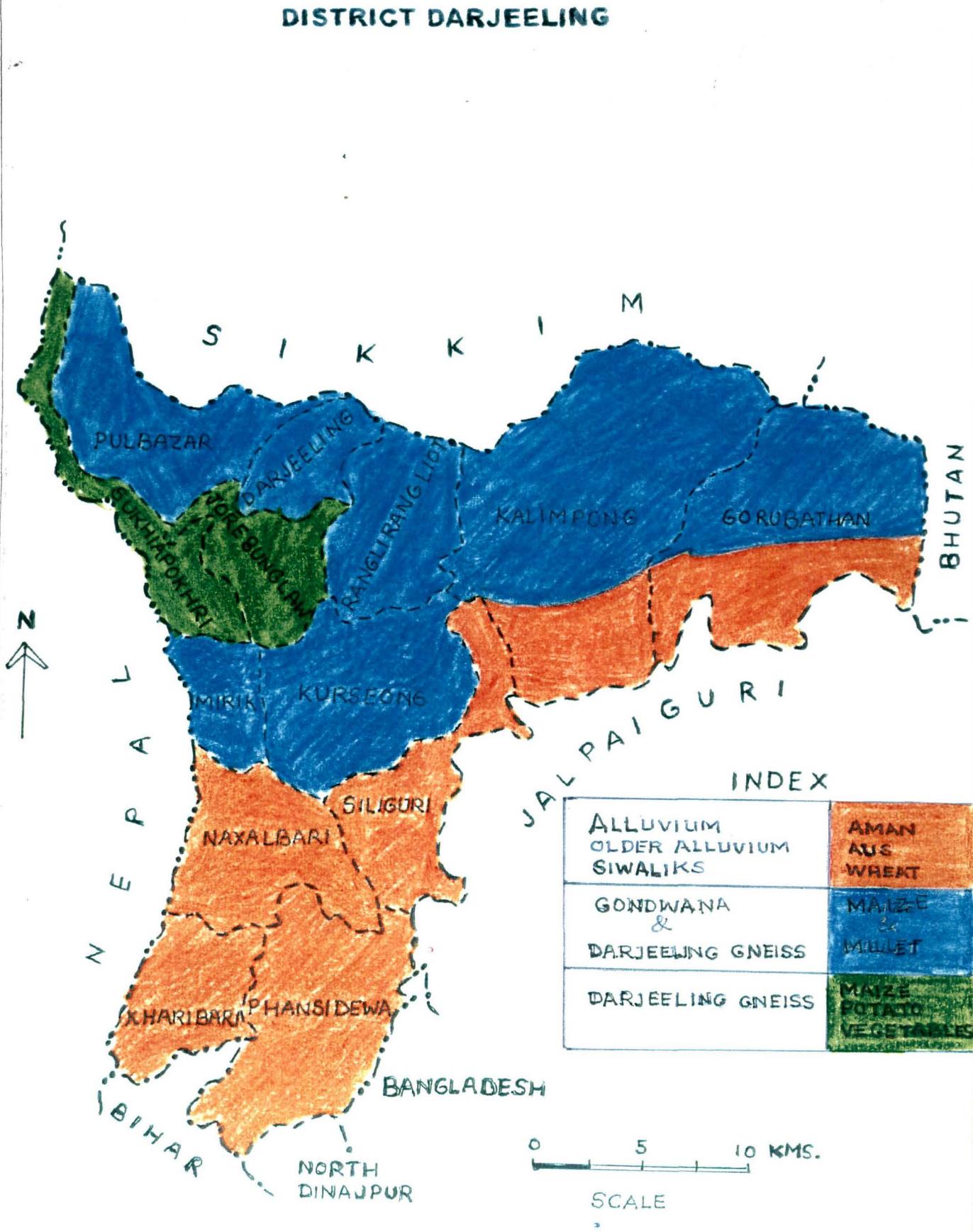


Fig. 8.3 Showing relationship between geology & crops.

In high altitudes the productivity per unit area is very low, since crops are subject to various physical and other constraints. Besides some food crop like maize, potato and different kinds of vegetables, Darjeeling hill areas have necessary environment for growing sub-tropical and temperate fruits. Rich black soil of Darjeeling is suitable for orange cultivation and it grows well between 600 to 1250 m.

The soil in the plain areas of Siliguri sub-division is dark in colour and fertile. Paddy is grown in different blocks of Siliguri sub-division because of favourable climatic and soil conditions of the region. Jute is another important cash crop is widely grown in this region. Wheat, vegetables, pineapple, potato, maize, millets are also grown in plain areas of Siliguri sub-division.

Tea is an important cash crop of Darjeeling district. Tea gardens are located between an average elevations varying from 625 meter to 1250 meters with comparatively less steep gradients. Areas with altitudes varying between 312 meters to 625 meters lie mainly near the valleys of the main river. But slopes near the main valleys are usually very steep and tea and cinchona plantations are found here.

CHAPTER – NINE

9.0 Climate and Agriculture (Merits and Demerits) Including Agro Climatic Regions

9.01 Climate and Agriculture:

Climate is one of the most important physical factors affecting the cultivation practices of an area. Physical factors consist of temperature rainfall, frost, fog, winds, snow and the length of the growing season. Annual and daily variations in any or all the climatic factors are important in determining the efficiency of crop grown and output per kilogram per hectare. The micro-climatic conditions in and around the crops are of great significance because they affect the output of crops favourably or adversely (Husain, 1979)[1].

Crops like rice, sugarcane, wheat, tea flourish in warm and moist climate whereas crops like potatoes, mustard, linseed require relatively warm temperature during the growing periods and low temperature during the development stages. The crops also have a minimum temperature limit, low temperature retards growth of certain plants.

Moisture in the form of rainfall, ground water or surface water is more important than any other environmental factors within wide temperature limit in the production of crops. There are also optimum and minimum requirement of moisture condition for plant growth. Rainfall which is uncertain and unevenly distributed is the cheapest sources of water for cultivation in the district of Darjeeling.

8.02 The northern hilly region of Darjeeling comprises of three hill sub-divisions. Viz.- Sadar, Kalimpong and Kurseong. The climate of the hill region is cold and humid. Average maximum temperature is 20° Celsius in May and minimum

[1] Hussain, M., 1979 – Agricultural Geography, pp. 23-26.

temperature is 3° Celsius in January. The sky is fog and cloudy. Snowfall also occurs in certain year.

Table 9.01 and 9.02 shows climatic features of the district of Darjeeling.

Table 9.01

Maximum and Minimum Temperature by Month in the District of Darjeeling

(In degree Celsius)

Month	1997		1998		1999		2000		2001	
	Maxi.	Mini.	Maxi.	Mini.	Maxi.	Mini.	Maxi.	Mini.	Maxi.	Mini.
January	-	1	13	9	15	11	27	4	23	1
February	-	1	14	9	13	-	12	9	19	2
March	-	4	17	7	36	-	33	9	19	3
April	-	4	38	13	25	-	-	15	21	6
May	27	8	28	13	23	-	22	15	20	7
June	25	10	25	17	27	26	-	13	21	8
July	26	12	-	15	-	-	26	17	23	5
August	25	11	24	14	33	15	-	15	23	9
September	25	9	27	13	21	16	24	16	20	9
October	23	5	21	13	21	15	-	14	21	7
November	-	4	18	12	-	10	19	13	-	6
December	24	1	14	11	16	11	15	11	-	3
For the Year	27	1	38	7	36	10	-	4	23	1

Source: Meteorological Department, Govt. of India, 2002.

Table 9.02

Monthly rainfall in the district of Darjeeling.

(in millimeter)

Month	Normal	Actual				
		1997	1998	1999	2000	2001
January	18	27	1	3	2	2
February	18	19	6	0	25	13
March	29	31	138	1	0	5
April	106	116	237	42	143	72
May	212	164	166	274	265	281
June	549	452	506	695	783	503
July	737	756	997	683	622	517
August	684	749	928	1013	670	611
September	416	546	352	364	463	375
October	165	28	131	224	26	325
November	34	7	12	17	24	23
December	13	71	0	7	0	0
Total	2981	2966	3474	3323	3123	2727

Source: Meteorological Department, Govt. of India, 2002.

The mountainous portion of the district of Darjeeling bordering Himalayas experience lower temperature mainly due to the effect of elevation. In the remaining part of Darjeeling district average annual temperature is almost uniform. Within the hill areas of the district temperature vary considerably. Kalimpong is a much warmer hill station compared to Kurseong and Darjeeling Sadar. But as mentioned erlier, Siliguri being a terai sub-division is appreciably hot. In Darjeeling sadar mean maximum temperature is experienced 20^0c in the month of August. However, the temperature in Darjeeling Sadar town at times falls below the freezing point. The places above 400 feet above the sea level generally remain cold for a long time. In Kalimpong the highest recorded temperature is 24^0C in April-June and lowest is 11^0 Celsius during

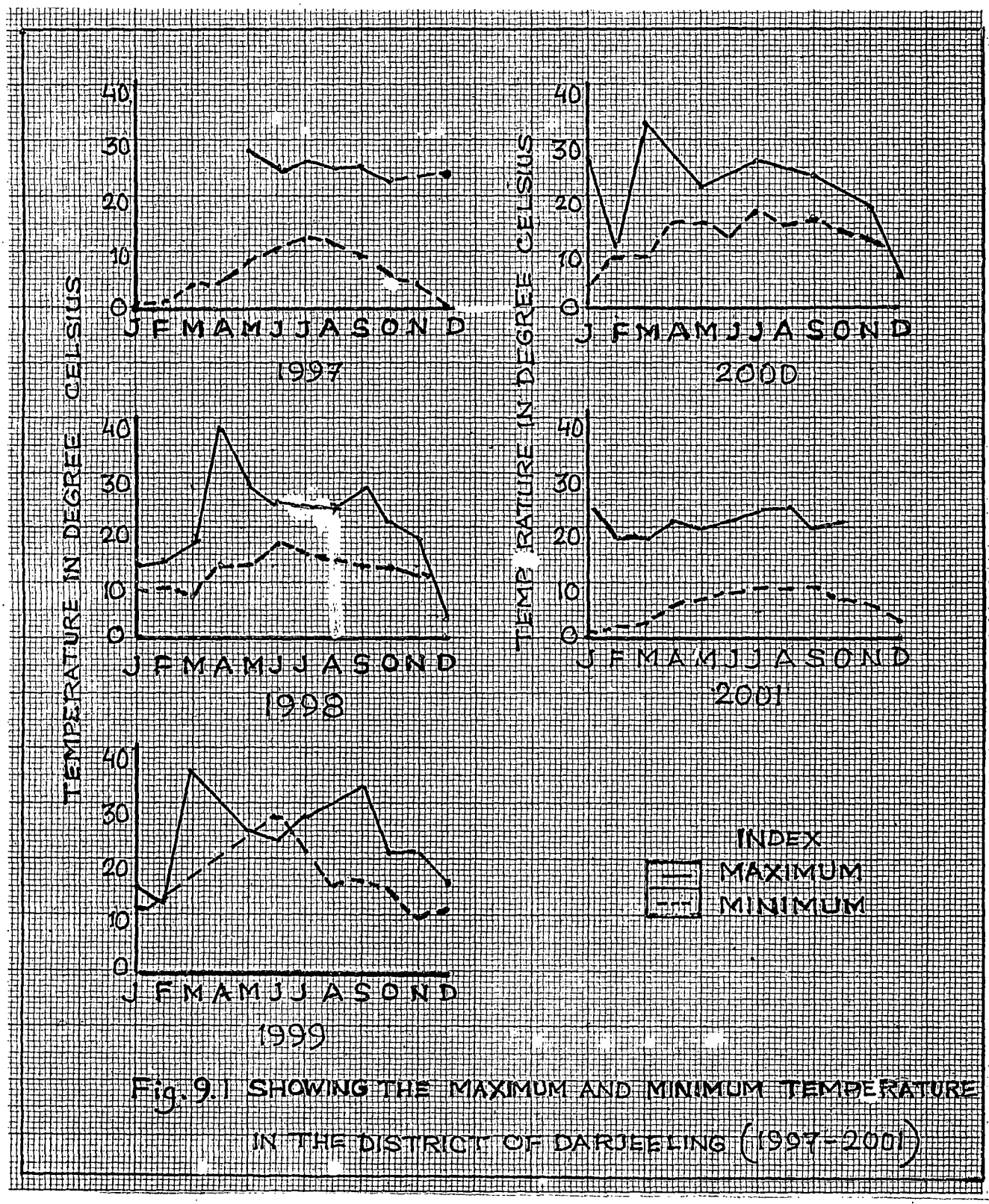


Fig. 9.1 SHOWING THE MAXIMUM AND MINIMUM TEMPERATURE IN THE DISTRICT OF DARJEELING (1997-2001)

December-January. The minimum temperature in Siliguri sub-division is around 8° Celsius during January and maximum is about 38° Celsius during July-September. The area remains warms for six to nine months a year at lower altitudes.

Since climatic conditions are important for the entire life cycle of a crop spanning from planting to ripening and harvesting. We have considered two most important agro-climatic elements, viz. temperature and rainfall for the entire growing season, at the same time studying the climatic effect on these crops.

Agriculture is characterized by an ever present uncertainty which is reflected in large differences in annual crop yield. Low temperature the growing season may sometimes prevent grain crops from ripending in time is another determinant factor for agriculture.

Darjeeling receives fairly high rainfall (Table 9.02). On account of hilly nature of terrain there are sharp contrast in the amount of rainfall even between near by stations. Rainfall in general, heavier in the southern terai region and slopes near the plain. Darjeeling district experiences nearly eighty percent of the rainfall during monsoon. Heaviest rainfall is occurs during the month of July. There are about 120 rainy days in a year. The rainy season extends from June to September.

Figure 9.1 shows temperature variations over a period of five years from 1997 to 2002. Distribution of rainfall is also plotted in fig. 9.2.Variation in temperatures and in the amount of rainfall in four sub-divisions of Darjeeling district is plotted in table 9.03.

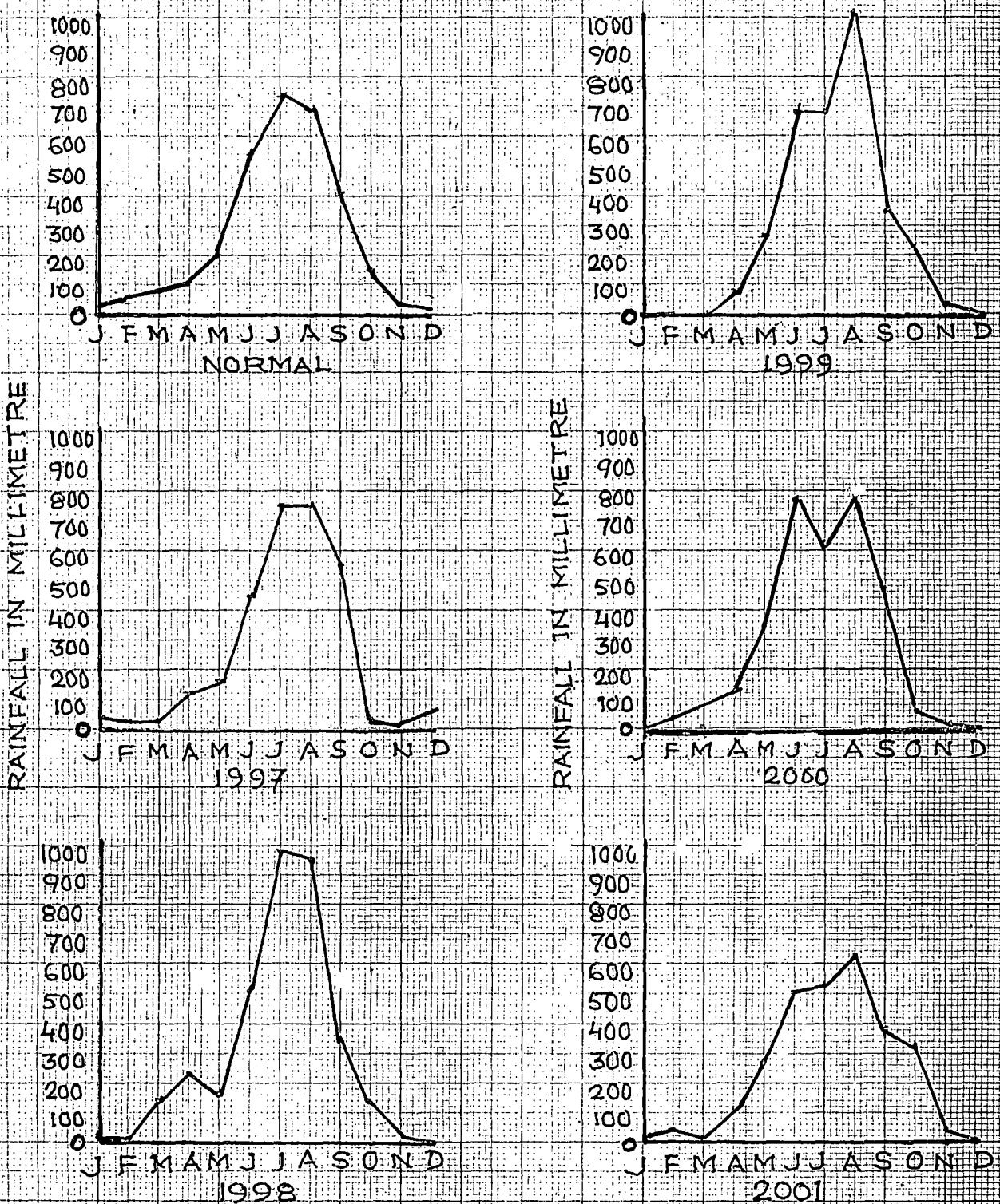


Fig. 9.2 SHOWING THE AMOUNT OF RAINFALL IN THE DISTRICT OF DARJEELING (1997 - 2001)

Table 9.03

Variation in Temperature and in the Amount of Rainfall

(In degree Celsius)

Sub-division	Station	Mean temp. coldest month	Mean temp. warmest month	Average of 15 years rainfall (in mm.)
Darjeeling	Darjeeling Pulbazar	2.0	10.0	2286.00
	Jorebunglow Sukia Pokhori			3352.80
	Rangi Rangliot			3606.80
Kurseong	Kurseong,	7.9	14.6	2794.00
	Mirik			2794.60
Kalimpong	Kalimpong I	7.8	24.4	2387.60
	Kalimpong II			2514.60
	Gorubathan			2641.60
Siliguri	Siliguri Naxalbari	12	30	2667.00
	Khoribari Phansidewa			2641.60

Sources: 1. District Census Handbook, 2001.
2. Annual Action Plan, District Rural Development Agency, 1988-89.

The cultivated area in hill ranges between 500 and 2500 m. altitude. Average annual rainfall 2780 mm. in Darjeeling, 2960 mm. in Kalimpong and 2780 mm in Kurseong and Siliguri. The mean maximum and minimum temperature in the subdivisions are 10.0, 24.4, 14.6^{0}C and 2.0, 7.8 and 7.9 for Darjeeling, Kalimpong and Kurseong respectively. In Siliguri subdivision mean maximum and minimum temperatures are 12^{0}C and 30^{0}C respectively.

Rice maize millets and barley are most important cereals in Darjeeling district while other crops such as potato, tapioca, sweet potato, spices such as ginger turmeric, oil seeds – primarily muster, pulse crops viz. pea, soybean, kalia buck wheat and sugarcane etc. are cultivated in summer. In winter different types of vegetables are grown. Potato is cultivated as summer crop in high elevation of three hill sub division

and as winter crop in Siliguri sub-division and lower elevation of three hill subdivision of the district. The summer potato is mainly utilized for seed purpose. A small quantity of rain is also received in winter season and it helps the farmer to grow vegetables. In March and April pre-monsoon rains bring fresh flush of leaves to the tea gardn after the winter season. High quality tea leaves in this area is often made from these spring flushes. Again too heavy rain in the later period often deteriorates the quality of tea. Humidity is very high and duration of sunlight is for less hours are other defects associated with the cultivation of crops in the hill areas. But occurrence of thick mist throughout the greater part of the year is one of the important factors influencing the production of high quality tea which famous for its aroma in Darjeeling[2] (Lahiri, 1981).

The principal cold weather crops in hills are wheat barley mustard and buck wheat. It is sown in August-September and harvested in December-January. Season wise area and production of some crops in the district of Darjeeling shows (Table 9.04) Aus paddy, jute is predominant crops in the plain areas of Siliguri sub-division.

It can be seen in table 9.04 that H.Y.V. of rice both in autumn and kharif rice showing an increasing yield per year with occasional variation. But local rice of both the seasons mentioned earlier is not showing any significant improvement. The yield rate of wheat is almost same for H.Y.V. as well as local varieties. Maize, millets and oilseeds have not shown any significant improvement. It can be mentioned here that maize and millet, which are hardy crop can withstand much inferior climatic condition.

[2] Lahiri, S. (1981) – Land use in Eastern Himalayan Region, p.-314.

District Darjeeling

AGRO-CLIMATIC REGION

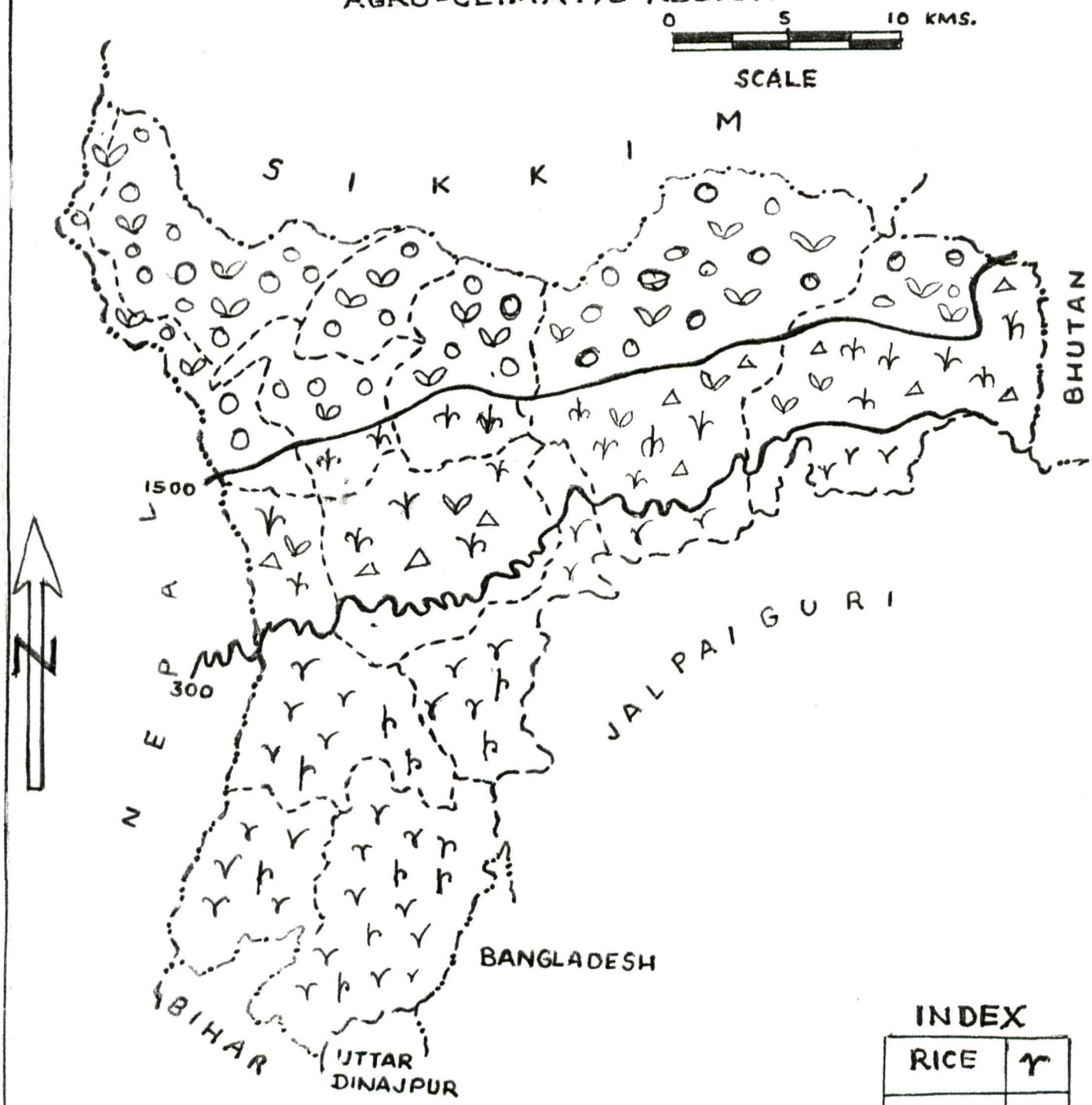


Fig. 9.3

Table 9.04

Area and Production under Different Crops (Seasonwise) in Darjeeling District

(area in hectares)
(Yield in qu/hectares))

Name of Crops	1995-96		1996-97		1997-98	
	Area	Yield	Area	Yield	Area	Yield
Autumn rice						
H.Y.V.	3155	18.15	4190.00	18.13	3930.00	17.39
Local	2085.00	12.79	2635.00	17.33	3025.00	12.06
Jute	1330.00	8.7 bales	2030.00	8.8	2180.00	8.9 bales
Maize	27805.00	24.84	27755.00	24.86	27755.00	24.86
Millet	11280.00	11.45	11280.00	11.98	12280.00	24.86
Kharif rice (Aman)						
H.Y.V.	17375.00	17.06	17170.00	16.67	16612.00	19.09
Local	15660.00	12.44	15925.00	13.38	16491.00	14.90
Sprin oilseed linseed	100.00	6.05	85.00	6.00	85.00	6.10
Rape/Mustard	106.00	8.53	911.00	7.06	743.00	8.28
Wheat						
H.Y.V.	3965.00	9.85	4035.00	20.62	4020.00	20.80
Local	30.00	10.50	29.00	0.50	30.00	10.50
Rabi Pulses						
Motar	22.00	7.30	217.00	7.30	225.00	7.00
Musur	25.00	6.00	25.00	6.00	-	-
Sumer rice Boro	450.00	30.59	480.00	30.75	475.00	31.00

Source: District Agriculture Office, Darjeeling, West Bengal, 1998.

Form the study of the climate of Darjeeling district, it has been found that, there are wide diversities in the distribution of rainfall and temperature, climatic regions of the district is closely associated with the cropping patterns of the hill and plain areas of the region, which may therefore be considered as agro-climatic regions. (Fig. 9.3)

CHAPTER – TEN

10.0 Relief Including Slopes, Altitudes, River System, Flood, Drought, Landslides and Soil Erosion

The landuse of Darjeeling district is closely related to its physical environment including relative relief, altitude, degree of slopes, river system, availability of water, land slides, flood and draughts.

10.01 Relief

The Darjeeling hill division traversed by a long ridge entering the region from north is a part of Singalila range. This is a continuation of lesser Himalayas that contains Senchal, Mahaldhiram range. The average elevation of the range varies from 1875 m. to above 2000 meters. Elevation decreases gradually on all ridges from this range a narrow belt of high lands encircling this range with an average attitude between 1250 meters to 1875 meters. A broad belt with an average elevation between 625 meters – 1250 meters lies below this level. The relative relief of this high elevation is above 625 meters. Areas between 312 meters to 625 meters altitude lie near the valleys of the main river. But slope near the valleys are very steep. To the east of the river Tista, shows a broad mass of highland in North central part of Kalimpong. This is the continuation of Bhutan range and highest point is Rishila (352 m.). Spurs radiate on all direction from this highest point separating deep mountain valleys. The central range has an altitude varying between 1875 meters and 2500 meters. In some small section in the north central part the elevation exceeds 2500 meters. There is also another high land belt with an elevation varying between 1250 meters to 1875 meters. Next to this belt, there is a broad belt with an average altitude varying between 625 meters to 1250 meters. Finally, areas lying between 312 meters to 625 meters on the outer margin of this division, bordering narrow valleys is a comparatively wide belt.

Over rest of he area of Kalimpong division relative relief varies from 312 meters to 625 meters. Some small patches of low lands are occurring on the borders of Duars plain with an elevation ranging between 156 meters to 312 meters. Most of the cultivation is practiced between 312 meters to 625 meters.

The terai in lower portion of Darjeeling is a large plain land mainly composed of old and recent alluvium, sand loams. The loafly mountains raise abruptly form the back of the terai to a height from 100 meters to 233 meters within the stretch of a few miles.

The agricultural practices in hill areas of Darjeeling is different from the plain areas of the district because of relief and other physical constraints.

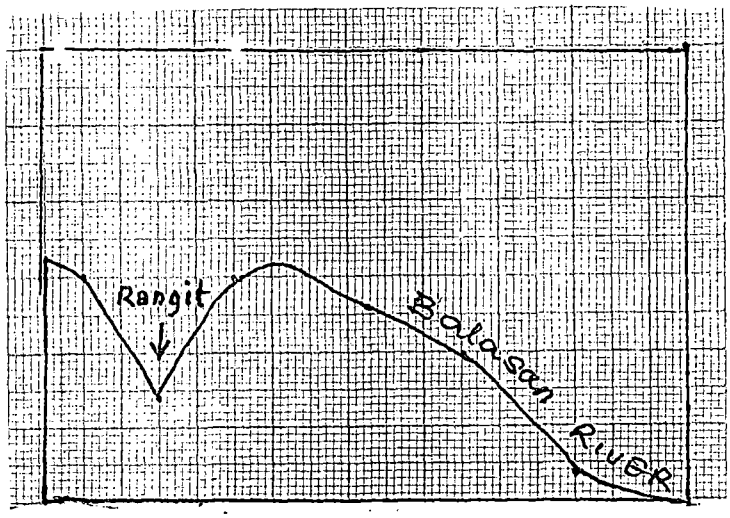
It has already been mentioned earlier that leaving aside the Siliguri subdivision the hill areas consists of a landscape with rugged terrain full of ridges and spurs of rather sharp incline and deep riverine valleys. The northernmost point of the district is characterized by very hard type rocks and it is not cultivable. Next to the hard rock region have steeper slopes and some crops are cultivated. Southern stretch of the area lying along the base of the outlying hills. This belt is fertile and cultivation is practised here. In the plain areas of Siliguri subdivision agriculture is practiced throughout the year because of flat nature of land and other physico-climatic factors.

10.02 Slope

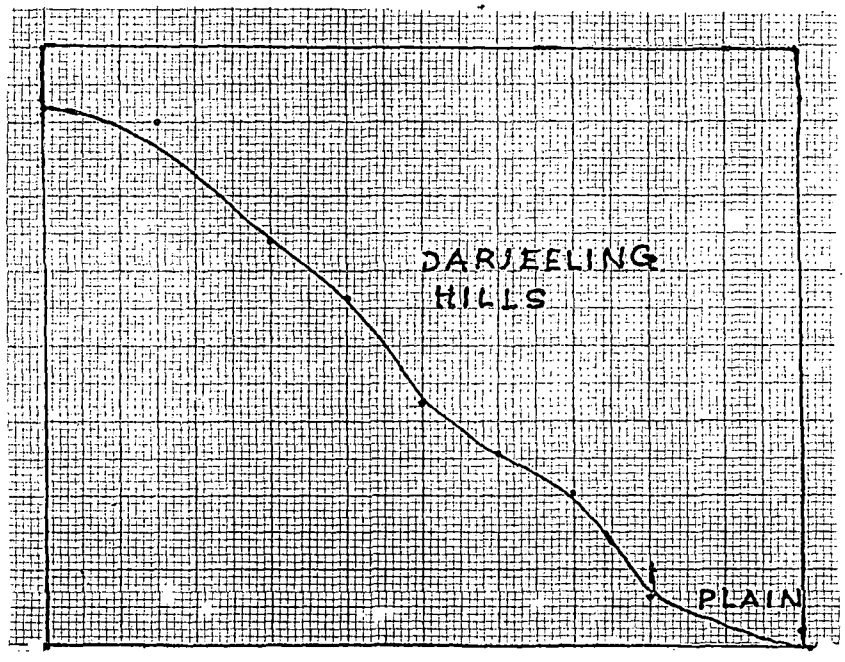
Slope as a part of relief plays very restrictive role in cultivating the area concerned. Slope determines terracing and its characteristics. Steep slopes are more prone to soil erosion and land slips. Besides the cost of production is higher on the slopes than in the plains as terraces are to be made and carefully maintained on the hills. Besides, the sunny face of slope is only used for cultivation, which further restricts the available area for cultivation. (Fig. 10.1)

The varied topographical expressions along with their degree and direction of slope, smoothness and ruggedness form the significant base of agriculture. In Darjeeling

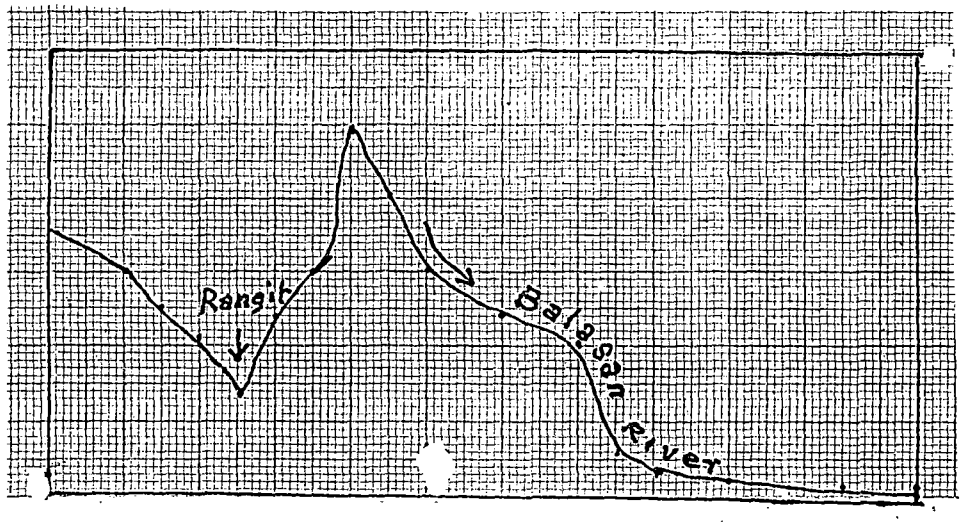
DISTRICT DARJEELING (Slopes)



Section across Mts. (NE-SW)



Section across Mts. (NW-SE)



Section along 88°15′ (N-S)

Fig. 10.1.

district moderate relief and slopes have been fully used for tea gardens. In hilly terrain the pattern of agriculture is mostly controlled by slopes. In and around Neora valley of Kalimpong subdivision, extensive deforestation has exposed the slopes to severe erosion. Landslips have the scarred the entire landscape filling up the largely dry streams below with rubble and boulders. This has over the years led to the drying up of streams.

Slope influence agriculture directly or indirectly. In Darjeeling hill slope determines terracing and its characteristics. The greater the slope, the smaller the width of the fields. In sloping ground the field are terraced. The terrace walls have to be parallel to the local contour, otherwise the soil and water will not be conserved, and they will be washed away. The relation between slope and ground moisture is one of the most important factors which determine significantly on the growth, quality, yield and out turn of crops.

10.03 River System

The Darjeeling and Kurseong division is drained by two major rivers such as Tista and Great Rangeet river and their tributaries viz. Mahananda and Balson. (Fig. 10.2) The major water parting of the area, the Senchal and Mahaldhiram range is being dissected on all sides by the fast flowing streams. Torrential streams are also flowing from young valleys. Innumerable 'jhoras' and 'kholas' originating from the rapid run off resulting from heavy monsoon rains have also made the surface of the land rugged with excessive amount of soil erosion.

Tista and its tributaries are flowing through Kalimpong division. Only a small portion in the eastern side forms a part of the river Jaldakha basin. A large number of parallel streams are dissecting this area.

In Siliguri subdivision of the Darjeeling district, rectangular drainage pattern is noticed. The tributaries of the Tista in the plain areas of Darjeeling are Lish, Ghish, Saldanga, Karla and Dhalk. The great Rangeet river joins Tista at the northern

DISTRICT DARJEELING
RIVER SYSTEM

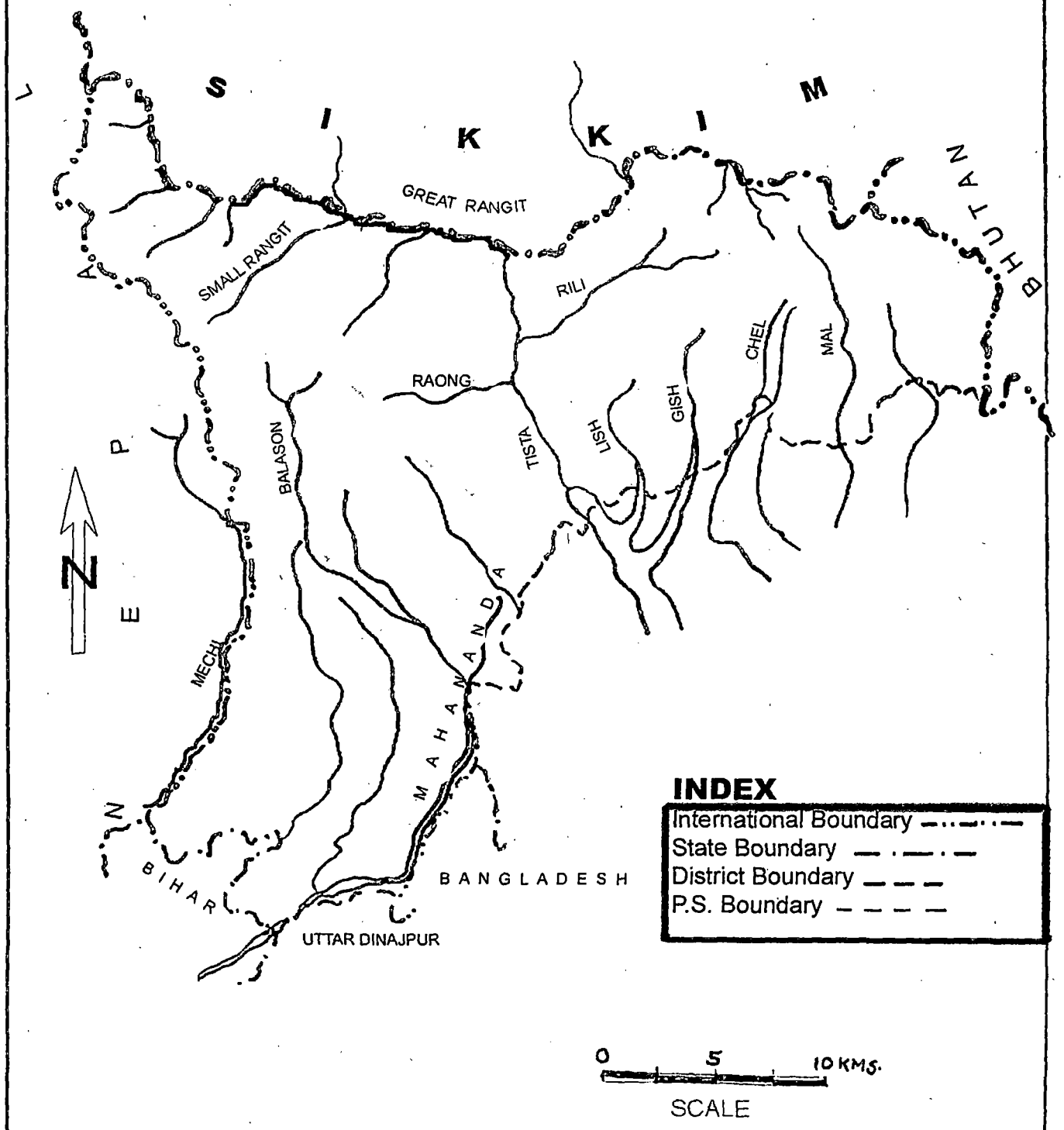


Fig- 10.2.

junction of Kalimpong and Darjeeling sub-divisions. From there, with the name Tista it flows southward and near Sevok the river comes down into the plain areas. Here the river bed is full of rocks and boulders. After a short course Tista enters the Jalpaiguri district.

The Mechi is flowing from north-south direction. It flows along the western border of Siliguri subdivision. The Mahananda river originating from the Mahaldarim range a few kilometer east of Kurseong and reaches the plain areas of Siliguri sub-division. It receives a number of hilly streams the most important being the Balason. It flows southward and forms boundary between Jalpaiguri and Darjeeling several small streams rising in the valleys west of Kurseong, join together to form the Balason which ultimately joins the Mahananda river in the lower reaches.

There are sharp changes in the volume of water of these rivers depending upon rains. The swelling Mechi also creates havoc during monsoon. Although there is an extensive network of drainage system of rivers, rivulets and streams flow down below the valleys but they are of not very much useful to provide irrigational facilities. Rivers are not navigable.

10.04 Flood and Drought

Heavy rainfall and hailstorm are common features in Darjeeling district. Hill streams and 'Jhoras' during monsoon become most unpredictable in their course and behaviour. So far flood is concerned it does not occur due to natural slope of hill areas. Silting of riverbeds owing to erosion in the catchment areas and upper reaches of Darjeeling is an important factor leading to floods. Generally heavy rainfall is favourable for agriculture but excessive rain causes flood and water logging in the plain areas. Experts have recommended soil conservation in the catchment areas, which would minimize the ravages of rivers on the rampage.

Sometimes drought affects the plain areas of the district either by delayed monsoon or uneven distribution of rainfall. Drought has devastating effects on the crops and land

use of this region. Soil drought has been described as a condition in which the amount of water required for transpiration and direct evaporation exceeds the amount water available in soil (Thornthwaits, 1948)[1].

The occurrence of drought can be determined from the annual seasonal distribution of rainfall and its intensity, dependability and the form of precipitation. Drought damages the crops when plant are inadequately supplied with moisture from the soil. Again different crops have different moisture requirements. In Darjeeling district delay in the on set of summer monsoon may be disastrous as kharif sowing may be delayed in the rain fed areas.

10.05 Irrigation

In the hill areas of Darjeeling the only available source of irrigation is the spring. The water from the springs collect into 'khola' from there the water is diverted by digging channels or pipelines. Irrigation is carried out in rice field by well defined channels and water flows from one terrace to another. In Darjeeling hill areas perennial springs are limited. Most of the springs which are only source of irrigation are seasonal and functioning during rainy season. Recently deep tube well are used for the irrigational purpose in majority of the hill areas as can see from the table no. 10.01.

Irrigation is common in terai areas, the slope of the land and the numerous small streams and the river Mahananda and Balason making irrigation abundantly feasible. The table 10.01 shows the source of irrigation and areas irrigated by different sources in the blocks of Darjeeling district for the year 2001-2002.

The sources of irrigation vary with in the district of Darjeeling, corresponding to the variations in topography and water table.

[1] Tharnthwaite, C.W., 1948; An approach towards rational classification of climate – Geographical review, 38, pp.- 55-94.

Table-10.01

Sources of Irrigation and areas irrigated by different sources in the Blocks of Darjeeling for the year 2001-02

Sl. No.	Name of Block	Canal Area (hect)	Tank		R.L.I.		DTW		S.T.W.		O.D.W.		DTW		Total	
			No.	Area (hect)	No.	Area (hect)	No.	Area (hect)	No.	Area (hect)	No.	Area (hect)	No.	Area (hect)	No.	Area (hect)
1.	Darjeeling-Pulbazar	—	—	—	—	—	—	—	—	—			6	74	6	74
2.	Sukhipokhri-Jurebunglow	—	—	—	—	—	—	—	—	—	—	—	3	43	3	43
3.	Rangli-Rangliot	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
4.	Kalimpong-I	—	—	—	—	—	—	—	—	—	—	—	2	25	2	25
5.	Kalimpong-II	—	—	—	—	—	—	—	—	—	—	—	3	37	3	37
6.	Gorubathan	—	—	—	—	—	—	—	—	—	—	—	-	-	-	-
7.	Kurseong	—	—	—	—	—	—	—	—	—	—	—	1	25	1	25
8.	Mirik	—	—	—	—	—	—	—	—	—	—	—	2	27	2	27
9.	Matigara-	—	—	—	2	120	—	—	—	—	—	—	—	—	3	120
10.	Naxalbari	—	—	—	12	540	—	—	—	—	—	—	—	—	12	540
11.	Kharibari	—	—	—	22	1380	—	—	135	337	—	—	—	—	42	1380
12.	Phasidewa	—	—	—	24	1200	—	—	47	117	—	—	—	—	24	1200

Note: HDTW = High Capacity Deep Tubewell
MDTW = Middle Capacity Deep Tubewell
LDTW = Low Capacity Deep Tubewell
STW = Shallow Tubewell
RLI = River Lift Irrigation
ODW = Open Dug Well
DTW = Deep Tubewell = HDTW+MDTW+LDTW

Source: 1) Asstt. Engg. Agri. Minor Irrigation, Darjeeling.
2) Asstt. Engg. (Agri. Irrigation Sub. Division), Siliguri.
3) Asstt. Engg. (Agri Mech. Sub. Division), Siliguri.

In plain areas of Darjeeling district river lift irrigation is practiced. In some areas of Kharibari and Phansidewa shallow tube well are used for cultivating the field.

Irrigation is the most important package of practices for intensive cultivation. Without assured irrigation farmers cannot use with confidence chemical fertilizers, which are a costly input.

10.06 Land Slide

Land slide is another common feature in Darjeeling hills where the landform is far from stable. Prior to independence land slide was not so devastating in nature. But of late, deforestation has caused widespread ~~and~~ land slipping in the hill areas. Heavy rainfall, light soil, hailstorm are the main causes of land slips. Land slide and continuous washing of top soil due to rugged and steep slope during monsoon and hail storm during the month of April and May are the physical constraint in the process of cultivation.

The soil slips are generally of small magnitude where as debris slips are generally of greater magnitude and devastating, percolation of water causes reduction in shearing resistance of the material forming the slope and land slips, and it usually follow a period of rainfall. Thus a soil or talus material, which ordinarily stable in a certain slope may cease to be so due to the decrease of shearing resistance.

Remedial Measures

The occurrence of landslides is a serious threat to life, property and agriculture in the district of Darjeeling. Effective control measures must therefore be taken up immediately to rejuvenate affected areas of the district. These measures include proper drainage at the upstreams and towards safe outlets followed by good vegetative growth on exposed surfaces. Thus deep rooted local grasses, shrubs are to be grown on the exposed surfaces of the land. These trees and grasses work as a binding force to soils. Stability of damaged slopes can be increased simply by grading it to a practical limit. This practice however offer some limitations when a huge soil mass has to be displaced and a large vegetation and trees are affected. Trees grow naturally at damaged site by successional tree species.

10.07 Soil Erosion

The removal of plant food and organic matter from the top layer is influenced by the nature of soil, the length and steepness of slope, climate especially rainfall and by the crops grown (Husain, 1979)[2]. Erosion is negligible in the level land.

Soil erosion is a perennial environmental problem in the hills. Soil erosion is severe in Darjeeling district where lime and acid soils are present. Soil erosion is caused by the (i) removal of forest cover whereby soil is directly exposed to the effect of the whethering. (ii) traditional and new intensive agricultural system. The diminishing land-man ratio has resulted in more intensive cultivation, which is one of the many reasons of soil erosion. Moreover, because of encroachment of agriculture forest area has been dwindled. A large-scale deforestation over the fragile hill slopes, uncontrolled grazing, dependence on forests for fuel and fodder, construction of roads and destruction of forests for commercial purposes are other factors responsible for soil erosion. Soil erosion is a regular feature in Darjeeling district mainly due to deforestation. Erosion occurs mainly in the form of landslides. Other causes of soil erosion in the hill areas of the district are defective cropping practices and cropping pattern. Rivers in the hill areas are quite active in eroding hill sides.

Afforestation, terrace cultivation, introduction of suitable cropping pattern and treatment of gullies and jhoras (streams) are some of the steps which can control soil erosion effectively.

[2] Husain, M., 1979; Agricultural Geography, Inter India Publications, Delhi, pp. 41-42.

CHAPTER - ELEVEN

11.0 Landuse Pattern of Darjeeling District (Agriculture)

Land resources play a vital role in the socio-economic development of the nations. Agricultural land resource has always played an important role since time immemorial engaging highest percentage of the people in the world. With gradual push in socio-economic development the simple land use has been changed into complicated one. With rise in population, urbanization, industrialization, optimal use of land became a part and parcel of our developmental policy.

Land is natural gift to the mankind, which is limited in size, therefore, special efforts are to be made to prevent its misuse and degradation.

The present thesis is an attempt to analyse and assess the impact of terrain on agricultural development in Darjeeling district. The effects of terrain can be observed significantly in the mountainous region of higher altitudes. Agricultural patterns are mainly dependent on conditions of terrain, topography and altitude. For example, paddy requires leveled field but tea cultivation requires undulating topography (Hussain, 1996)[1]. The soils of mountains and valleys vary over short distances. Soils of mountainous regions are immature and shallow because of steep slopes and rapid erosional processes.

Growth and development of agriculture during the past few years was not encouraging due to some physical and socio-economical constraints in the district of Darjeeling. The pattern of agriculture within the district changes from one place to another. As a result there is a wide variation in the patterns of agriculture within the hill and plain areas of the district.

[1] Hussain, M. (1997) Systematic Agricultural Geography, pp.- 91-93.

11.01 Landuse in Darjeeling

The differences in topography and elevation makes agricultural conditions extremely diverse. The two distinct divisions of the district are mountainous region to the north forming the greater part and the alluvial plains to the south. There is also poor sandy tract, which cannot be brought under cultivation. Altitudes vary from 74m. above the sea level in the plains to about 3500m. in the hills. Most of the area in the district is under forest. Cultivation is suitable between 300m. and 600m in the hill areas[2]. Table 11.01 illustrates the landuse pattern of Darjeeling district.

Table 11.01

Landuse in Darjeeling District

Area	Area in hectare	Percentage to total area
Total area	325469	
Forest including reserve and unreserved forest	124574	38.2
Nonagricultural use – Homestead river temple etc.	36020	11
Unculturable waste land	4777	1.46
Grazing land	1321	0.40
Bamboo miscellaneous trees and groves	2234	0.68
Culturable waste land	1945	0.59
Old fallow	4211	1.29
Current fallow	8704	2.67
Net cropped area	141683	43.53

Source: District Agriculture Officer, Siliguri.

[2] Dash, A. J., Bengal District Gazetteers Darjeeling Calcutta 1947, pp.-99.

Total geographical area of the district is 325469 hectares according to 2001 census. Forest area covers 38.2 p.c. of the total land area of the district. Non-agricultural use of land accounts for 11 p.c. of the district. Unculturable waste land and grazing lands together account 1.86 p.c. of the total area. Bamboo, miscellaneous trees and groves have less than one percent of land area. Old fallow, current fallow account for 1.29 p.c. and 2.67 p.c. respectively. Table 11.01 reveals the more than 43 p.c. and or 141683 hectares of land is under net cropped area. (Fig. 11.1)

11.02 Cropping Pattern

Cropping pattern means most efficient use of land and other resources. An efficient cropping pattern must ensure greatest efficiency of land, irrigation, fertilizer and other inputs. The ideal cropping pattern implies farming activity throughout the year. Usually, farmers allocate their stock of land to raise a number of crops in consonance with the available opportunities. Hence three basic determining factors are composed of three subsystems – viz. natural environment, economic condition and cultural aspect of that area. These sub-systems inter act between themselves and as a result of such interaction get compounded differently between tracts. It can be mentioned here that any natural environment can support a variety of vegetative life. Consequently, the farmers enjoy some options, one of these is given by the cultural trait of the society to which the farmers belong and is expressed in terms of some preferred crops for consumption. The preferred cropping pattern emerges as a means of self-preservation of societies that are bounded by their specific cultural norms[3].

The crops of Darjeeling district broadly fall into two groups – (a) plantation crops like, tea, orange, cinchona and (b) non-plantation crops like rice, wheat, maize, jute, potato, vegetables etc. The area and production of various crops in the district of Darjeeling are plotted in Table 11.02 and 11.03 respectively. It appears from the table that rice occupies the largest are under cultivation.

[3] Changing pattern of Agricultural landuse in Rangli-Rangliot-Geographical review of India, Vol. 43-44.

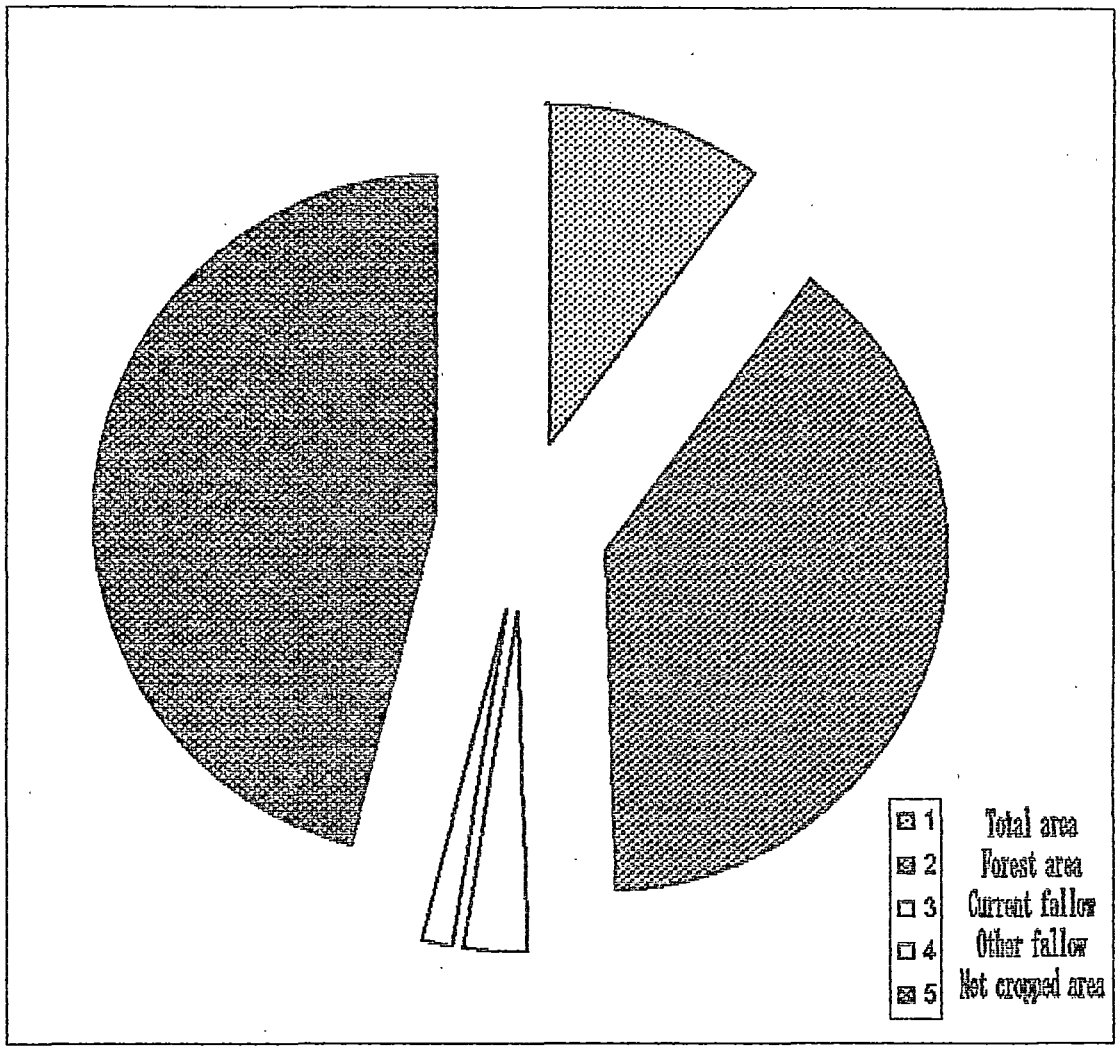


Fig11.1 Some classification of land utilisation Statistics in the district of Darjeeling(2001-02)

Table 11.02

Area under Principal Crops in the district of Darjeeling

(Thousand hectares)

Crop	Year					
	1996-97	1997-98	1998-99	1999-2000	2000-2001	3001-02
Foodgrains						
1. Rice	36.7	35.5	36.4	35.734.2	34.2	36.44
Aus	6.1	6.5	6.2	5.2	5.4	36.0
Aman	30.5	28.9	29.9	30.1	28.3	28.9
Boro	0.1	0.1	0.5	0.4	0.5	1.0
2. Wheat						
3 Barley	-	-	-	-	-	-
4. Maize	12.2	22.6	21.5	19.1	12.9	12.9
5. Other Cereals	11.7	11.8	11.8	11.8	11.7	12.3
Total Cereals	63.2	74.3	73.5	69.5	62.1	64.3
6. Gram	-	-	-	-	-	-
7. Tur	-	-	-	(a)	(a)	(a)
8. Other Pulses	1.8	1.9	-	1.8	1.9	2.1
Total Pulses	1.8	1.9	1.7	1.8	1.9	2.1
Total Foodgrains	65.0	76.2	75.2	71.3	64.4	64.4
Oil Seeds						
1.Rape & Mustard	0.1	(a)	(a)	0.1	0.1	0.1
2. Linseed	0.1	0.8	0.1	-	0.1	0.1
3. Other oilseeds	0.3	0.3	0.2	0.2	0.3	0.2
Total Oilseeds	0.5	1.1	0.3	0.3	0.5	0.4
Fibre						
1. Jute	1.8	2.3	2.4	2.3	2.2	2.9(a)
2. Mesta	-	-	-	-	-	(a)
3. Other Fibre	-	-	-	-	-	-
Total Fibre	1.8	2.3	2.4	2.3	2.2	2.9
Misc. Crop						
Sugarcane (+)	-	-	-	-	-	-
Potato	5.8	6.9	6.9	4.6	7.1	4.9
Tobacco	-	-	-	-	-	-
Tea(M)	19.6	-	26.3	26.3	26.0	35.6
Chilies (dry)	0.4	0.4	0.4	0.4	0.4	0.4
Ginger	2.0	2.0	2.0	2.1	2.1	2.0
Total Misc. Crop	27.8	-	35.6	33.4	35.6	42.9

(a) = less than 50 hectares

Table 11.03

Production of Principal Crops in the district of Darjeeling

(Thousand hectares)

Crop	Year					
	1996-97	1997-98	1998-99	1999-2000	2000-2001	3001-02
Foodgrains						
1. Rice	38.8	39.5	39.3	61.5	52.9	59.2
Aus	5.0	4.2	5.5	7.5	82	8.8
Aman	33.5	35.0	32.5	42.9	43.5	48.3
Boro	0.3	0.3	1.3	1.1	1.2	2.1
2. Wheat	3.8	6.4	3.1	4.6	6.3	4.7
3 Barley	-	-	-	-	-	-
4. Maize	61.2	87.1	77.6	41.7	39.9	44.9
5. Other Cereals	14.2	14.3	14.2	14.2	14.3	14.4
Total Cereals	117.0	147.3	134.2	112.0	113.4	123.2
6. Gram	-	-	-	-	-	-
7. Tur	-	-	-	(b)	(b)	(b)
8. Other Pulses	1.1	1.3	-	1.3	1.2	1.3
Total Pulses	1.1	1.3	1.1	1.3	1.2	1.3
Total Foodgrains	119.1	148.6	135.3	113.3	114.6	124.5
Oil Seeds						
1.Rape & Mustard	0.1	(b)	(b)	0.1	(b)	0.1
2. Linseed	(b)	0.3	(b)	-	(b)	(b)
3. Other oilseeds	0.2	0.1	0.1	(b)	0.2	0.2
Total Oilseeds	0.3	0.4	0.1	0.1	0.2	0.2
Fibre*						
1. Jute	16.2	20.0	21.4	22.5	18.1	30.9
2. Mesta	-	-	-	-	-	(b)
3. Other Fibre	-	-	-	-	-	-
Total Fibre	16.2	20.0	21.4	22.5	18.1	30.9
Sugarcane	-	-	-	-	-	-
Potato	71.6	98.6	88.2	57.3	97.2	74.1
Tobacco	-	-	-	-	-	-
Tea(M)	11.3	-	28.6	27.5	28.9	61.8
Chilies (dry)	0.2	0.3	0.3	0.4	0.3	0.3
Ginger	5.9	5.3	5.8	6.0	6.0	6.1
Total Misc. Crop	89.0	-	122.9	91.2	132.4	347.5

(b) = less than 50 tonnes

* Production in thousand bases of 180 kgs. each

(+) Production in terms of gur

Sources: (i) Directorate of Agriculture, Govt. of W.B.

(ii) B.A.E. & S. Govt. of W.B.

(iii) Darjeeling Plantation Association.

(iv) Tarai Tea Garden Association.

The area of rice has remained more or less same but there is 20 p.c. increase in production from 1996-97 to 2002. The area of wheat has increased with occasional variation but the production is showing an increasing trend till 2000-2001 but it falls by nearly 20 thousand tones in 2002. The area of wheat production also decreased over the last four years. Maize is the most important crop in hill areas. Its production was more during the 1997-1999 but fell sharply in 2001 and showing an increasing trend the next year. Like maize, potato is also showing an increased area under its cultivation with occasional variations. The production is also showing an upward trend. The area under total pulses is very less but in 2001-02 the area increased by 1 to 2 thousand hectares. Production of pulses remain stagnant for the last six years. The area under jute has increased to 8 thousand hectares from 1996-97 till 2002. The production of jute is increasing and it was almost double compared to 1996-97. Tea, another important cash crop of the district has always been showing increasing trend in area. Production of tea shoot up form 11.3 thousand tones in 1996-97 to 62 thousand tones in 2001-02. Cultivated area also increased from 19.5 to 35.6 thousand hectares in the same period.

The agricultural cropping pattern, which dominates in the hills of Darjeeling comprise of maize-millet and maize-rice crop cycle, both of which lead to considerable soil loss through rain water run-off. In plain areas of Darjeeling rice and jute dominates the cropping patter. Table 11.04 shows yield rate of some selected crops of the district.

Table 11.04

Yield rate of some selected crops in the district of Darjeeling and West Bengal

Kg/hect

Crops	1997-98	1998-99	1999-00	2000-01	2001-02
Rice	1112	1 079	1443	1 549	1645
Wheat	1472	808	1566	1920	1548
Jute	1602	1631	1764	1458	1944
Rape Seed & Mustard	619	633	712	126	776
Potato	14363	12702	12395	13759	15234
Tea	-	2036	1838	3719	1736

Sources : 1) Bureau of Applied Economics & Statistics Govt. of West Bengal. 2) Directorate of Agriculture Govt. of West Bengal. 3) Tea Board, 2002.

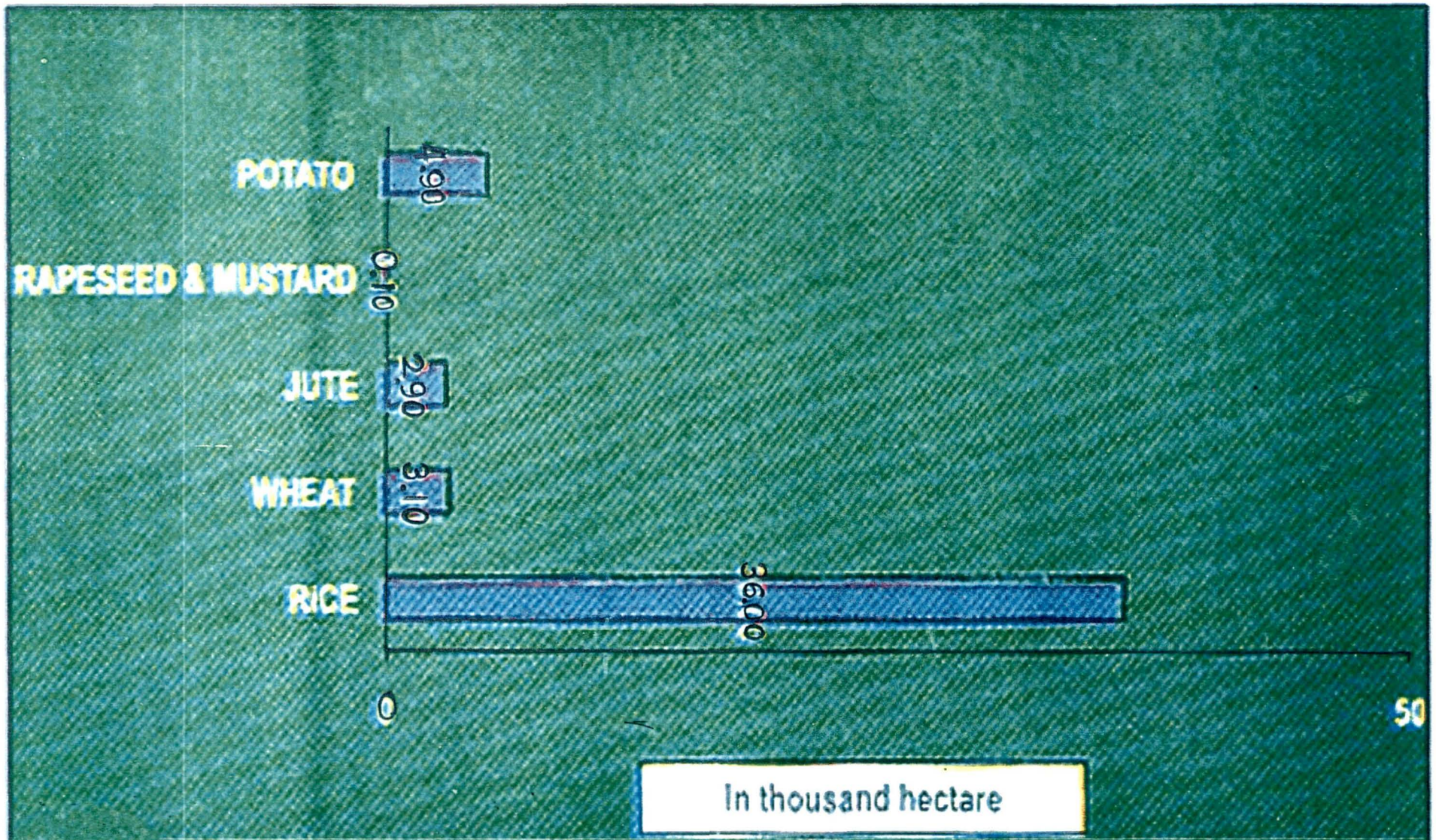


Fig- II. 2 Bar diagram showing area of Rice, Wheat, Jute, Rapeseed & Mustard and Potato in Darjeeling District in the year 2001-2002

Rice is the dominant crop of the district. It grows well in the plain areas and on terrace land in the hill. Yield rate of the rice is steadily increasing with occasional variation Wheat production is also showing increasing yield rate. Jute which grows only in plain areas is again showing upward trend of production. Over the last five year from 1997 to 2001 which covers the study period mustard and potatoes are showing increasing yield rate. In case of mustard yield rate dropped in 2000-01 to nearly one fourth of the previous year (Fig. 11.2).

The cultivable land undergoes frequent changes as it is influenced by number of physical factors. The present study of landuse in Darjeeling district is based on the data of 5 years from 1997-98 to 2001. To understand in a better way the influence of altitude, relief and other physical factors the cropping intensity, net sown area, land productivity and yield rate of crops are analysed block wise. The introduction of high yielding varieties, sources of irrigation, and application of fertilizers will also will be discussed.

The study area of Darjeeling district can be divided into two distinct physical units, the hills consisting of eight C. D. blocks of Darjeeling-Pulbazar, Jorebunglow-Sukhiapokhri, Rangli-Rangliot, Kalimpong-I, Kalimpong-II, Gorubathan, Kurseong and Mirik. The plain area comprising of two blocks – Siliguri-Naxalbari, Khoribari-Phansidewa. The general landuse of each block is discussed below :–

11.03 Darjeeling-Pulbazar

This block comprises of two police stations, i.e. Darjeeling and Pulbazar. It is one of the three blocks of sadar subdivision with its headquarters at Bijanbari which is 40 km. away from Darjeeling. This block has varying altitudes. Landuse in Darjeeling-Pulbazar (1995-96 to 1999-2000) is shown in table 11.05.

Table 11.05

Landuse in Darjeeling-Pulbazar

(Area in hectare)

Land Utilization	1995-96		1996-97		1997-98		1998-99		1999-2000	
	Area in hectares	P.C. of total area	Area in hectares	P.C. of total area	Area in hectares	P.C. of total area	Area in hectares	P.C. of total area	Area in hectares	P.C. of total area
Forest reserved and unreserved	18392	45	18392	45	18392	45	18392	45	18392	45
Non-agricultural use home river temple	2408	6	2408	6	2408	6	2408	6	2408	6
Unculturable waste	472	1.5	472	1.5	472	1.5	472	1.5	480	1.17
Gazing land	17	0.04	17	0.04	17	0.04	17	0.04	10	0.02
Bamboo miscellaneous trees groves	37	0.1	37	0.1	37	0.1	37	0.1	36	0.04
Culturable waste	134	0.33	134	0.33	134	0.33	134	0.33	130	0.32
Old fallow	518	1.27	518	1.27	518	1.27	518	1.27	526	1.29
Current fallow	4038	10	4038	10	4038	10	4038	10	4087	10
Net cropped area	14871	36	14871	36	14871	36	14871	36	14871	36
Total area	40887		40887		40887		40887		40887	
Grossed cropped area	16604	41	16604	41	16604	41	16604	41	16604	41

Source: Department of Agriculture, Govt. of W.B., Siliguri, 2000.

The total area of the block is 40887 hectares. About 45 p.c. of the Darjeeling and Pulbazar area is covered by forests. Net cropped area is 14871 hectares which is 36 p.c. of the total area of the block. The gross cropped area from 1995-96 to 99 has remained same but has declined in 1999-2000 by 11 p.c. The area of grazing land has increased marginally from 1.5 p.c. in 1995 to 1.17 p.c. in 2000. Marginal decrease in

cultivable wasteland and grazing land is also noticed. Grazing land in 1995 was 0.04 p.c. of the total area and in 2000 it was only 0.02 p.c. The cultivable wasteland was 0.03 p.c. in 1995 and in 2000 it was 0.32. The statistical figure of current fallow remained unchanged from 1995 to 2000, Area, production and yield rate of principal crops are plotted in Table 11.06.

Table 11.06

Area, production and yield rate of major crops in Darjeeling-Pulbazar

Name of crop	Area (in hectares)	Production in tones	Yield kg./hect.
Aus	(a)	(b)	1525
Aman	4.3	9.5	2207
Boro	(a)	(b)	2586
Potato	9.5	145.9	15419

(a) Less than 5 hectares.
(b) Less than 5 tonnes.
Source: (1) Bureau of Applied Economics and Statistics.
(2) Directorate of Agriculture, 2001.

The area and yield rate of both aus and boro is less than 5 hectares and 5 tonnes respectively. Aman rice is grown in 4.3 hectares of area and yield rate is 2586 kg./hect. Potato is suitable for the high altitude area and grows well. The area under potato is 9.5 hect. and yield is 15419 kg/hect. Agricultural development is not showing any remarkable progress and progressive farmers are few in number. Beside these crops maize, vegetables, wheat, millet, ginger and cardamom are also grown in this block. Recently cultivators are using chemical fertilizer, insecticides and modern technological implements. Climate of this block is suitable for temperate fruits, which can be grown in abundance. Maize and cardamom are other important crops of this block. (Fig. 11.3)

11.04 Jorebunglow-Sukhiapokhri

This block consists of two police stations with its head quarter ঠ্ঠ Sukhiapokhri. This block covers total area of 39086 hectares. Land use in this block is showing in table 11.07.

Table 11.07

Landuse in Jorebunglow-Sukhiapokhri

(Area in hectares)

Land Utilization	1995-96		1996-97		1997-98		1998-99		1999-2000	
	Area in hectares	P.C. of total area	Area in hectares	P.C. of total area	Area in hectares	P.C. of total area	Area in hectares	P.C. of total area	Area in hectares	P.C. of total area
Forest reserved and unreserved	22171	57	22171	57	22171	57	22171	57	22171	57
Non-agricultural use home river temple	498	1	514	1	514	1	514	1	557	1
Unculturable waste	526	1	533	1	528	1	528	1	527	1
Gazing land	58	0.15	82	0.21	82	0.21	82	0.21	77	0.20
Bamboo miscellaneous trees groves	36	0.1	420	1.1	416	1.1	428	1.1	405	1
Culturable waste	414	1.1	420	1.1	416	1.1	428	1.1	405	1
Old fallow	-	-	13	0.03	12	0.03	-	-	28	0.07
Current fallow	260	0.67	178	0.45	170	0.43	270	0.69	283	1
Net cropped area	15123	39	1535	39	15143	39	15043	38	14483	38
Total area	39086	-	39086	-	39086	-	39086	-	39086	-
Grossed cropped area	16604	43	16297	41	16375	42	16181	-	17097	44

Source: Agriculture Department.

The block has 57 p.c. of forest area. One percent of land area is used for non-agricultural purposes. Grazing land, unculturabel waste land and miscellaneous trees account for 0.20 p.c. 1 p.c. and 0.14 p.c. of land area respectively. Cultivable waste land is one percent and area under old fallow land is 0.07 p.c. Current fallow land is one percent. The block has 44 p.c. and 38 percent of gross cropped area and net cropped area. Due to rugged terrain only a few types of crops are grown in this area.

Table 11.08

Area, Production and Yield Rate of Major Crops in Jorebunglow-Sukhiapokri

Name of crop	Area (in hectares)	Production in tones	Yield kg./hect.
Aus	(a)	(b)	1528
Aman	(a)	(b)	2202
Boro	(a)	(b)	2586
Potato	2.3	53.8	23105

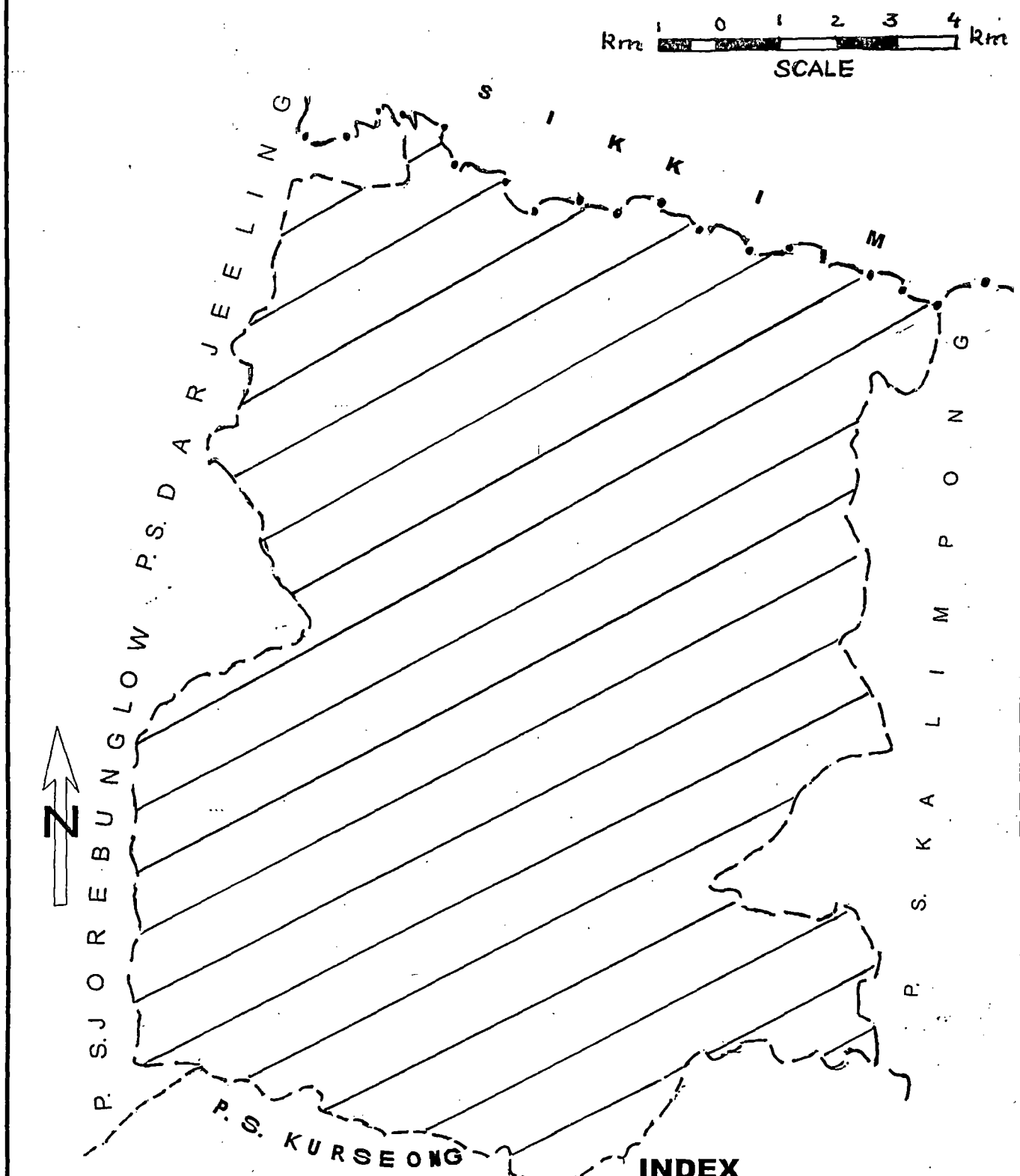
(a) Less than 5 hectares.
(b) Less than 5 tonnes.
Source: (1) Bureau of Applied Economics and Statistics.
(2) Directorate of Agriculture, 2001.

Moreover yield rate (Table 11.08) is very poor except potato, which grows well in high altitude. Rice of various seasons grows below five hectares of land and at the same time yield is also below 5 tonnes per hectare. This shows the poor condition of agriculture in the region. Maize is the most important crop of the hill areas, which also grows well in high altitudes. Gross cropped area and net-cropped area has changed marginally from 1995 to 2000. (Fig 11.4)

11.05 Rangli Rangliot

The total area of the block is 19811 hectares. About 31 p.c. of the total land area is covered by the forest area. Non-agricultural use, unculturable waste land and bamboo and groves has 4 p.c., 1 p.c. respectively. Culturable waste land, old fallow and

C.D. BLOCK RANGLI-RANGLIOT
CROPPING PATTERN



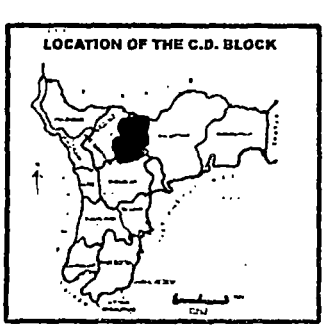
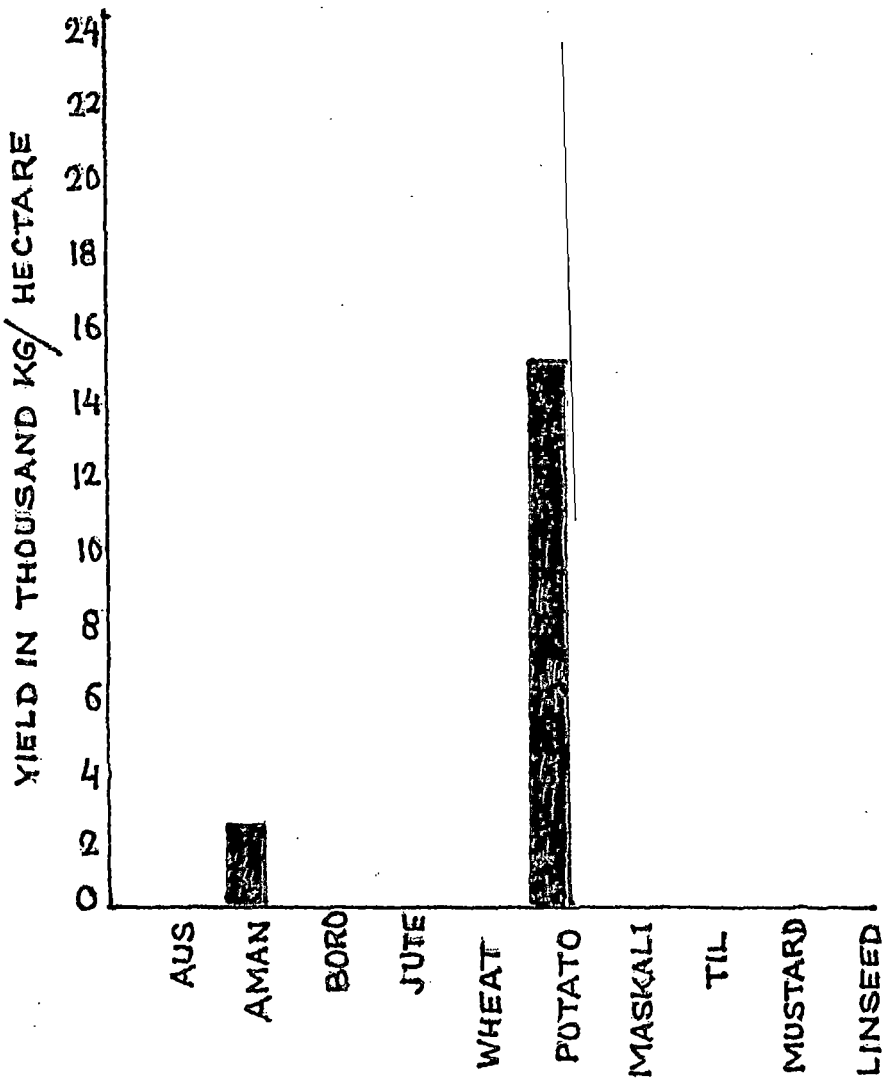


Fig- 11.5

INDEX

- International Boundary
- State Boundary
- District Boundary
- P.S. Boundary
- URBAN AREA
- CROP COMBINATION POTATO, MAIZE, MILLET



RANGLI - RANGLIOT
2001 - 2002

Fig. II.5

current fallow has also less than one p.c. of land area. Gross cropped area is 80 p.c. and 61 p.c. of land is net sown area. (Table 11.09)

Table 11.09

Landuse in Rangli-Rangliot

(Area in hectares)

Land Utilization	1995-96		1996-97		1997-98		1998-99		1999-2000	
	Area in hectares	P.C. of total area	Area in hectares	P.C. of total area	Area in hectares	P.C. of total area	Area in hectares	P.C. of total area	Area in hectares	P.C. of total area
Forest reserved and unreserved	6171	31	6171	31	6171	31	6171	31	6171	31
Non-agricultural use home river temple	757	4	757	4	758	4	758	4	765	4
Unculturable waste	190	0.1	190	0.1	190	0.1	190	0.1	187	0.1
Gazing land	3	0.02	3	0.02	3	0.02	3	0.02	-	-
Bamboo miscellaneous trees groves	181	1	181	1	181	1	181	1	192	1
Culturable waste	-	-	-	-	-	-	44	0.23	35	0.18
Old fallow	244	1.23	244	1.23	204	1	160	1	106	0.53
Current fallow	219	1	219	1	173	0.87	140	1	178	1
Net cropped area	12046	61	12046	61	12131	61	12164	61	12177	61
Total area	19811		19811		19811		19811		19811	
Grossed cropped area	16465	86	16465	86	16969	86	16090	81	15905	80

Source: Department of Agricultural, Govt. of W.B., Siliguri, 2000.

So far yield rate is concerned, table 11.10 shows potato is the only crop, which is suitable for the soil of the region. Production of rice is very low and very less area is under rice cultivation. Maize, millet and vegetables are other important crops of the block. (Fig 11.5)

Plate-5 Rice cultivation in kalimpong

Plate-6 Paddy cultivation in Tarabari,Siliguri P.S.,Darjeeling District

Table 11.10

Area, Production and Yield Rate of Major Crops in Rangli-Rangliot

Name of crop	Area (in hectares)	Production in tones	Yield kg./hect.
Aus	(a)	(b)	1528
Aman	(a)	(b)	1528
Boro	(a)	(b)	2586
Potato	5.7	90.0	15732

(a) Less than 5 hectares.
(b) Less than 5 tonnes.
Source: (1) Bureau of Applied Economics and Statistics.
(2) Directorate of Agriculture, 2001.

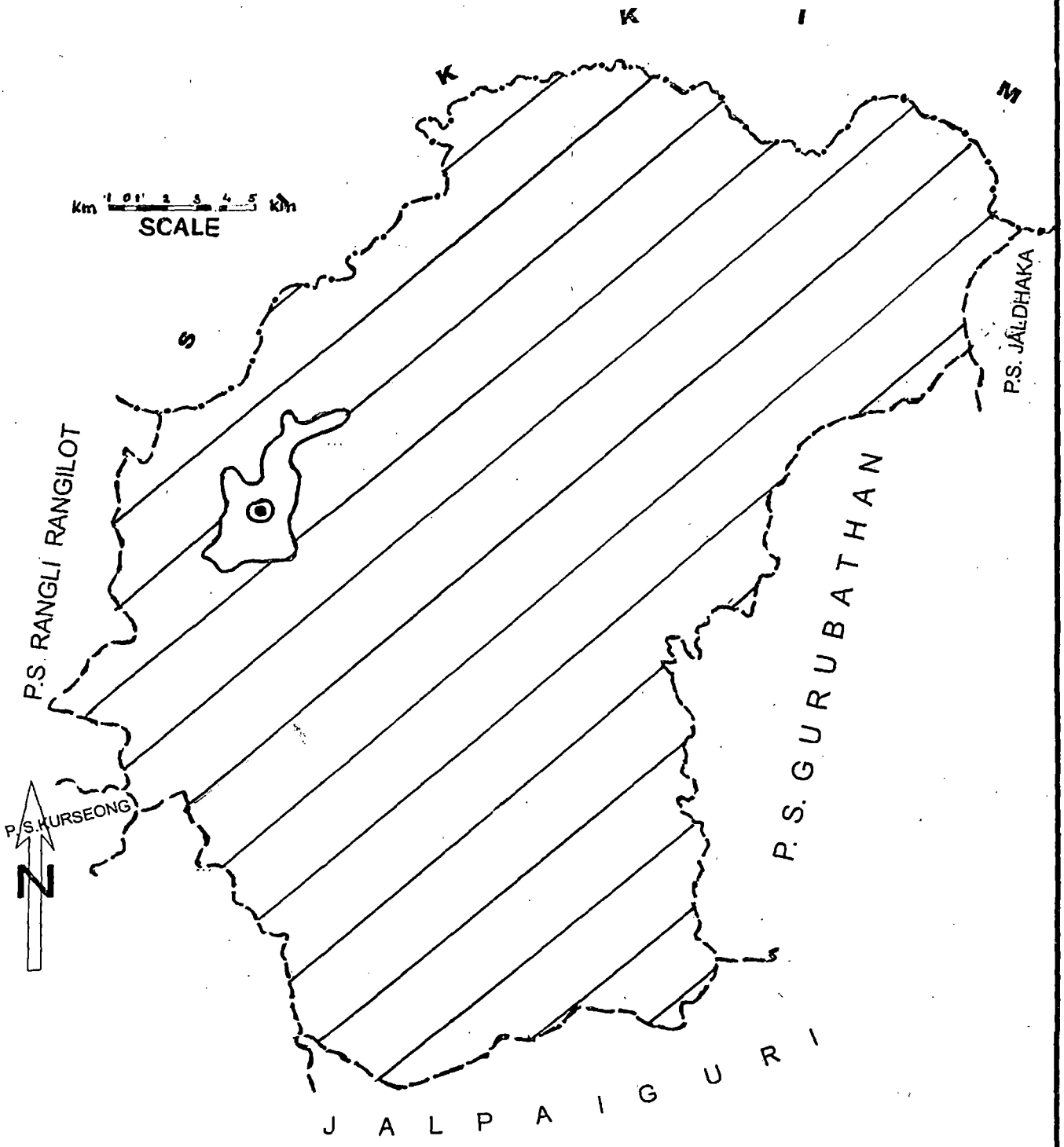
Gross cropped area was 86 p.c. in 1995-96 and showing a decreasing trend from 1998 and it is only 80 p.c. in 2000. But net sown area remained unchanged for the period.

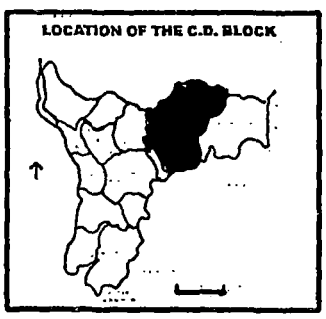
11.06 Kalimpong-I

C.D. block Kalimpong-I has 33997 hectares of land area and 47 p.c. of the total area is under forest cover. Non-agricultural use, unculturable waste land and grazing land have 11, 8 and 1 p.c. of area respectively. Bamboo, miscellaneous trees culturable waste land, old fallow, current fallow have more or less than one p.c. of area each. Gross cropped area of the block is 33 p.c. and net sown area is 30 p.c. (Table 11.11) Aman variety of rice grows in this block. The area under rice is 11.5 hectare and yield rate is 1907 kg./hect. Potato is also grown in some areas of this block Maize and millet is cultivated in many areas of this block. (Table 11.12) This block had 45 p.c. of gross cropped area but cultivation decreased to 33 p.c. The net sown area has remained unchanged during these five-year periods. (Fig. 11.6)

C.D. BLOCK KALIMPONG I, II

CROPPING PATTERN

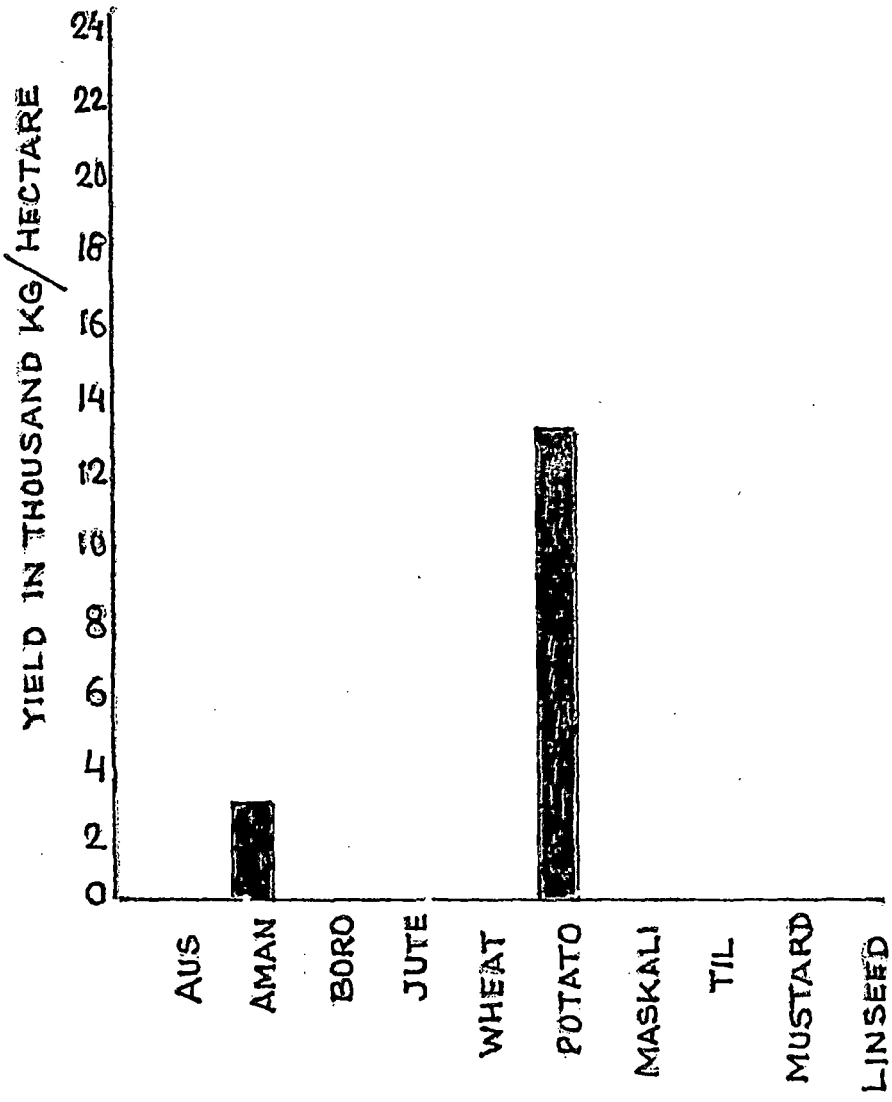




INDEX

- International Boundary
- State Boundary
- District Boundary
- P.S. Boundary
- URBAN AREA
- CROP COMBINATION (POTATO, MAIZE, MILLET)

Fig- II.6 & 7.



KALIMPONG - I
2001 - 2002

Fig. 11.6

Table 11.11
Landuse in Kalimpong-I

(Area in hectares)

Land Utilization	1995-96		1996-97		1997-98		1998-99		1999-2000	
	Area in hectares	P.C. of total area	Area in hectares	P.C. of total area	Area in hectares	P.C. of total area	Area in hectares	P.C. of total area	Area in hectares	P.C. of total area
Forest reserved and unreserved	16119	47	16119	47	16119	47	16119	47	16119	47
Non-agricultural use home river temple	3616	11	3640	11	3640	11	3640	11	3719	11
Unculturable waste	2791	8	2798	8	2798	8	2798	8	2706	8
Gazing land	587	2	590	2	590	2	590	2	362	1.1
Bamboo miscellaneous trees groves	443	1.30	450	1.32	450	1.32	450	1.32	558	1.64
Culturable waste	34	0.10	-	-	9	0.02	-	-	21	0.06
Old fallow	-	-	109	0.32	100	0.29	109	0.32	96	0.28
Current fallow	311	1	176	2	205	1	176	0.1	314	1
Net cropped area	10096	30	10115	30	10115	30	10115	30	10102	30
Total area	33997	-	33997	-	33997	-	33997	-	33997	-
Grossed cropped area	151777	45	8837	25	8873	26	8873	26	11049	33

Source: Department of Agricultural, Govt. of W.B., Siliguri, 2000.

Table 11.12

Area, Production and Yield Rate of Major Crops in Jorebunglow-Sukhiapokri

Name of crop	Area (in hectares)	Production in tones	Yield kg./hect.
Aus	(a)	(b)	1528
Aman	11.5	22.0	1907
Boro	(a)	(b)	2586
Potato	0.1	0.8	16350

(a) Less than 5 hectares.
(b) Less than 5 tonnes.
Source: (1) Bureau of Applied Economics and Statistics.
(2) Directorate of Agriculture, 2001.

11.07 Kalimpong-II

Kalimpong-II block has 26986 hectares of land. Forest covers 43 p.c. of the block. Only 7 p.c. of land is under non-agricultural use. Unculturable waste land, grazing land miscellaneous trees and current fallow have less than 2 p.c. of land under use. Gross cropped area is 44 p.c. of which only 36 p.c. is net sown area. (Table 11.13)

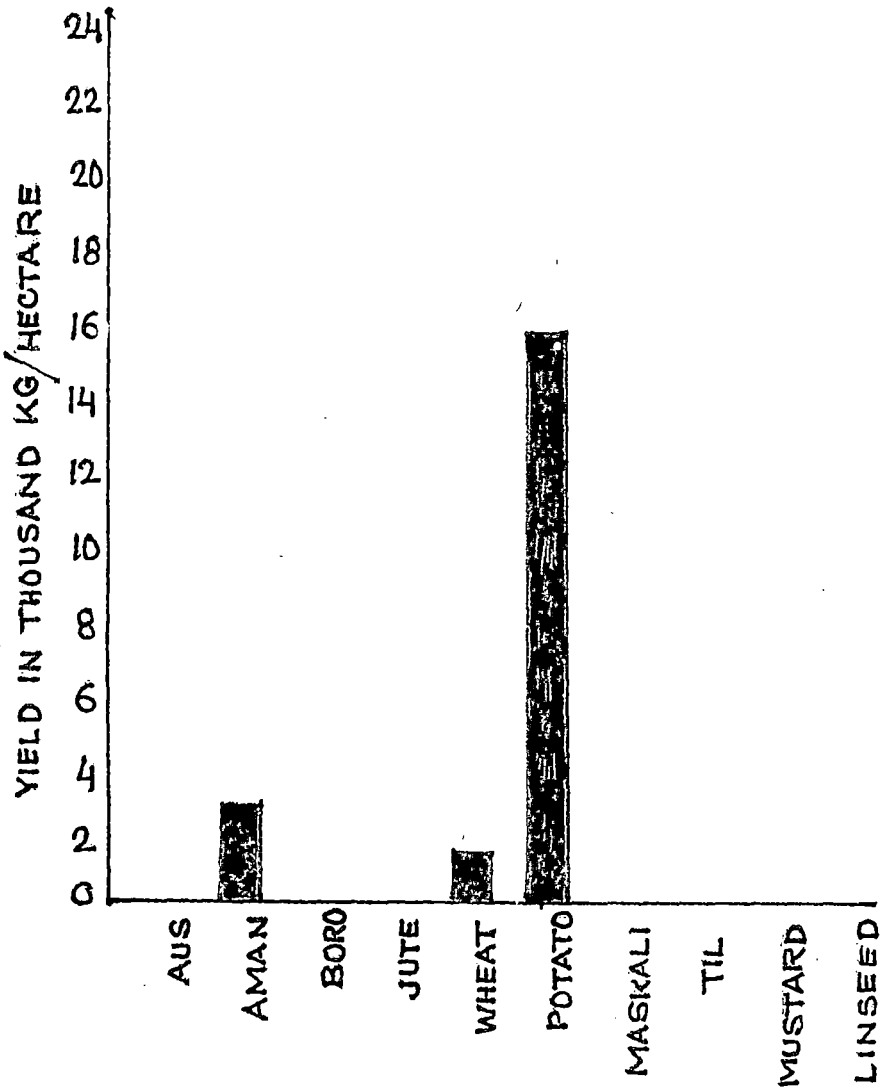
Table-11.13

Landuse in Kalimpong-II

(Area in hectares)

Land Utilization	1995-96		1996-97		1997-98		1998-99		1999-2000	
	Area in hectares	P.C. of total area	Area in hectares	P.C. of total area	Area in hectares	P.C. of total area	Area in hectares	P.C. of total area	Area in hectares	P.C. of total area
Forest reserved and unreserved	11625	43	11625	43	11625	43	11625	43	11625	43
Non-agricultural use home river temple	1594	10	1607	6	1610	6	1610	6	1785	7
Unculturable waste	146	1	151	1	150	1	150	1	155	1
Gazing land	629	2	629	2	628	2	628	2	615	2
Bamboo miscellaneous trees groves	161	0.61	165	0.61	611	0.61	164	0.61	237	0.87
Culturable waste	1	0.00	-	-	7	0.02	17	0.06	-	-
Old fallow	2641	-	2398	-	2341	-	2331	-	2396	-
Current fallow	433	2	395	1	431	2	628	2	422	2
Net cropped area	9756	36	10066	37	10050	37	9833	36	9751	36
Total area	26986	-	26986	-	26986	-	26986	-	26986	-
Grossed cropped area	10172	38	12376	46	11576	43	11433	42	11869	44

Source: Department of Agricultural, Govt. of W.B., Siliguri, 2000.



KALIMPONG - II
2001 - 2002

Fig. 11.7

Table 11.14 shows Aman variety of rice also grows in Kalimpong-II and yield rate is 1760 kg./hect. Potato also grows well and yield is as high as 10887 kg./hect. Like other blocks of the district, maize gross in abundance in this region.

Table 11.14

Area, Production and Yield Rate of Major Crops in Kalimpong II

Name of crop	Area (in hectares)	Production in tones	Yield kg./hect.
Aus	(a)	(b)	1528
Aman	15.6	27.5	1760
Boro	(a)	(b)	2586
Potato	5.2	56.3	10887

(a) Less than 5 hectares.

(b) Less than 5 tonnes.

Source: (1) Bureau of Applied Economics and Statistics.

(2) Directorate of Agriculture, 2001.

Cardamom and millet also occupy some area of the block. Gross cropped area is 44 p.c. in 2000 which was only 38 p.c. in 1995-96. But net sown remained unchanged during this period. (Fig. 11.7)

11.08 C.D. Block Gorubathan

C. D. Block Gorubathan has total land area of 44372 hectares. Forest covers 66 p.c. of the block, 8 p.c. of land is under non-agricultural use. Culturable waste land, grazing land, miscellaneous trees and current fallow each have less than one p.c. of land area. Culturable waste land and old fallow land have 2.22 p.c. and 1.17 p.c. of the total area respectively. Table 11.15 shows the block has 32 p.c. of gross cropped area and is net sown area is 21 p.c. Aman rice is cultivated in Gorubathan and yield is 1635 kg./hect.

Table 11.15

Landuse in Gorubathan

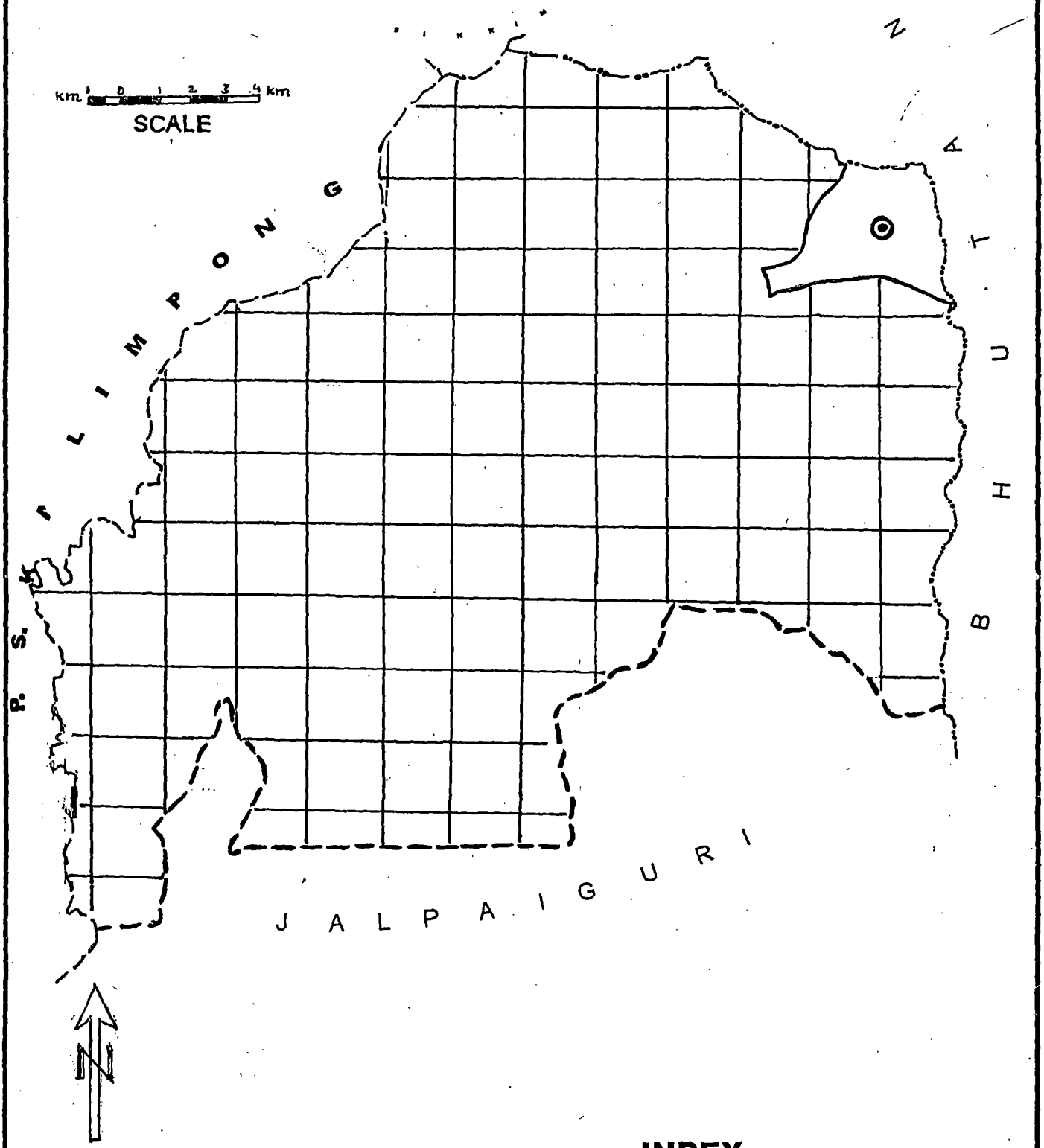
(Area in hectares)

Land Utilization	1995-96		1996-97		1997-98		1998-99		1999-2000	
	Area in hectares	P.C. of total area	Area in hectares	P.C. of total area	Area in hectares	P.C. of total area	Area in hectares	P.C. of total area	Area in hectares	P.C. of total area
Forest reserved and unreserved	29169	66	29169	66	19269	66	29169	11	29169	66
Non-agricultural use home river temple	3301	7	3310	7	3348	8	3348	8	3399	8
Unculturable waste	366	1	366	1	366	1	366	1	278	0.62
Gazing land	64	0.14	77	0.17	77	0.17	77	0.17	48	0.10
Bamboo miscellaneous trees groves	371	0.83	371	0.83	371	0.83	370	0.83	385	0.86
Culturable waste	1049	2.36	1024	2.30	1020	2.29	1078	2.42	989	2.22
Old fallow	547	1.23	550	1	516	1.16	458	1.03	521	1.17
Current fallow	247	0.56	2.05	0.46	190	0.42	160	0.36	193	0.43
Net cropped area	9258	20	9300	21	9351	21	9345	21	9390	21
Total area	44372		44372		44372		44372		44372	
Grossed cropped area	12719	29	9897	22	10774	24	7909	17	14197	32

Source: Department of Agricultural, Govt. of W.B., Siliguri, 2000.

Some area is also under maize and millet cultivation. (Table 11.16) In 1995-96 there was 29 p.c. of gross cropped area and it increased to 32 p.c. in 1999-2000. Net sown area does not show any increase in cultivation. (Fig. 11.8)

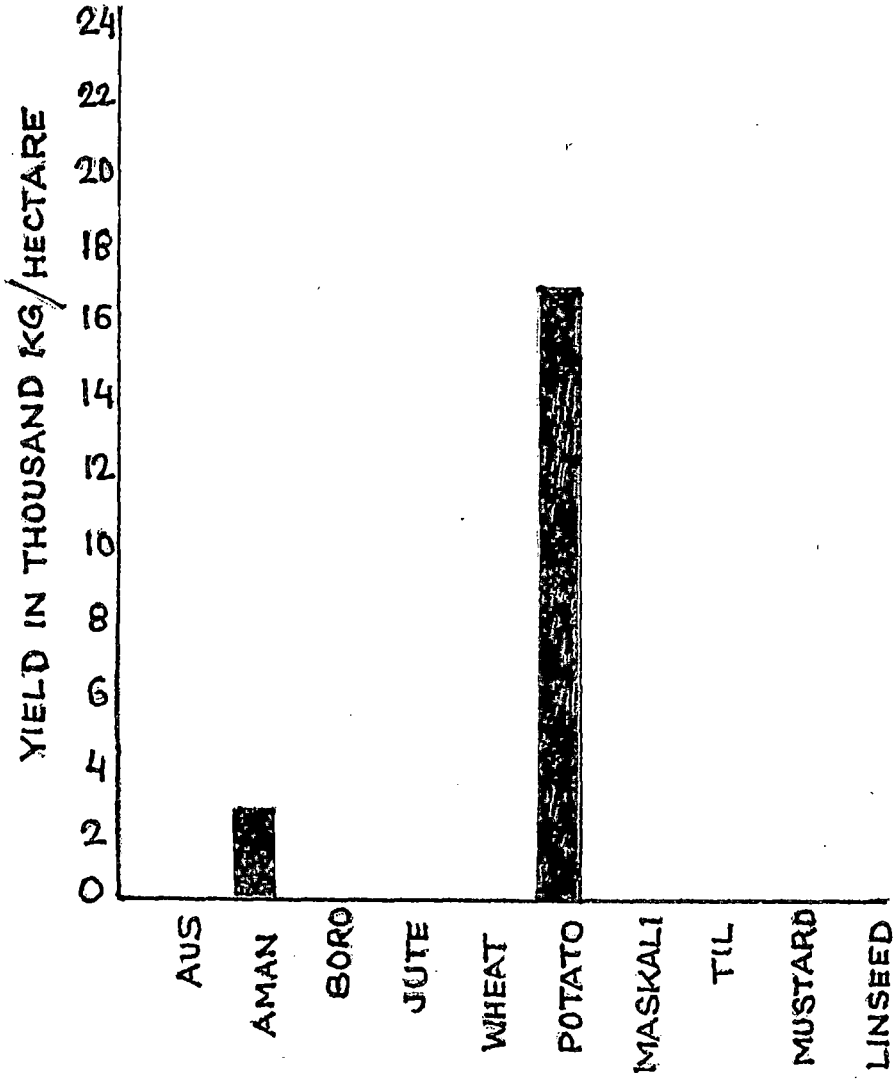
C.D. BLOCK GORUBATHAN
CROPPING PATTERN



INDEX

International Boundary
State Boundary
District Boundary
P.S. Boundary
URBAN AREA
CROP COMBINATION
AMAN(RICE)POTATO,MAIZE)

Fig- II.8



GORUBATHAN
2001 - 2002

Fig. 11.8

Table 11.16

Area, Production and Yield Rate of Major Crops in Gorubathan

Name of crop	Area (in hectares)	Production in tones	Yield kg./hect.
Aus	(a)	(b)	1528
Aman	4.1	6.7	1635
Boro	(a)	(b)	2586
Potato	0.1	17.9	11808

(a) Less than 5 hectares.

(b) Less than 5 tonnes.

Source: (1) Bureau of Applied Economics and Statistics.

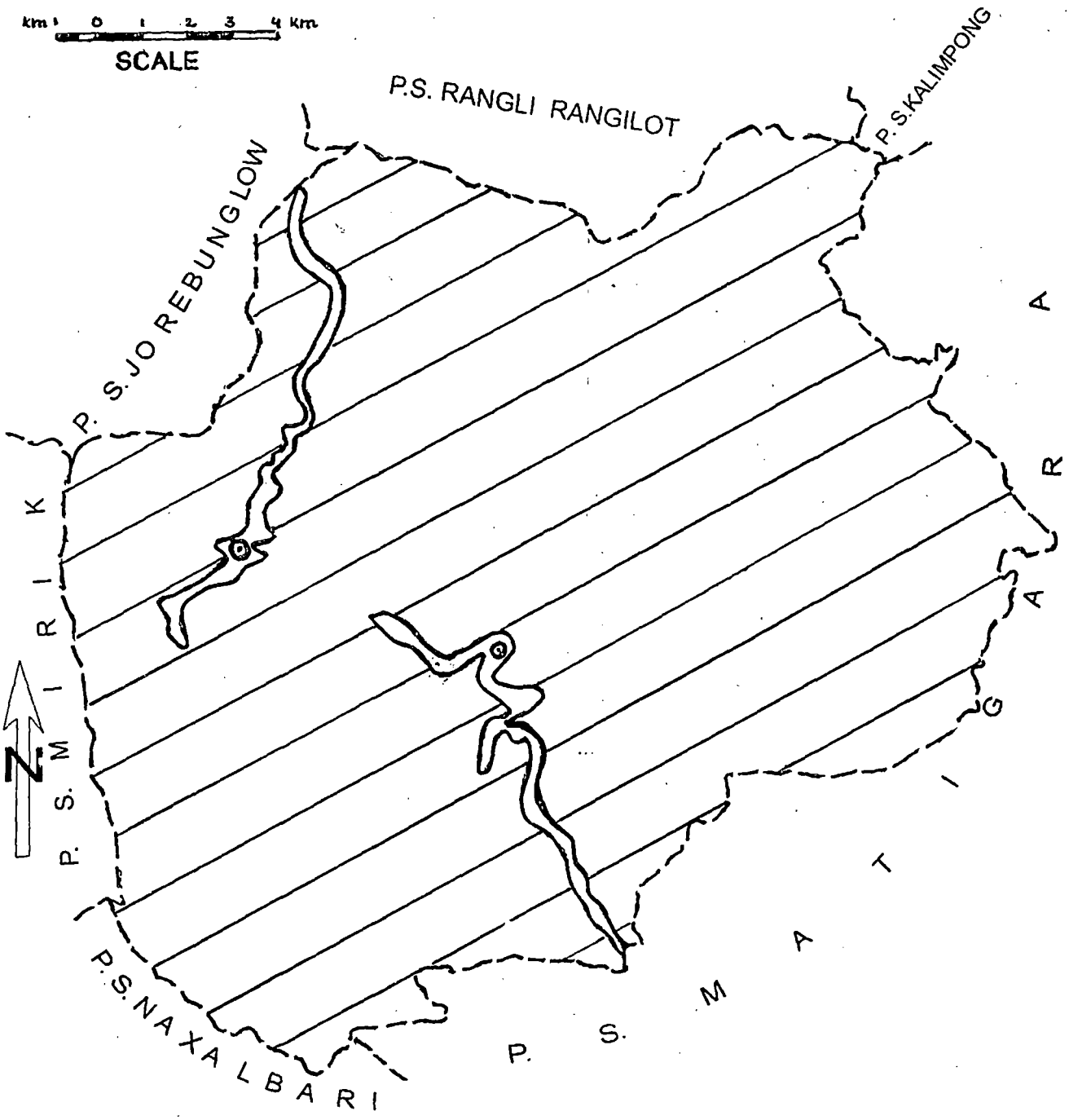
(2) Directorate of Agriculture, 2001.

11.09 Kurseong

Kurseong has 26952 hectares of land area. Forest covers 27p.c. of land and 7p.c. of land is under non-agricultural use. Grazing land, unculturable waste land, current fallow and old fallow each occupy less than one percent of land. Net cropped and gross cropped area of the block has 64p.c. and 74p.c. of the total area. (Table 11.17)

Rice is cultivated in this block. Potato and wheat is also grown in this region. The yield rate of potato is 22822 kg./hect., rice is grown below 5 hectares land and yield be less than 5 tonnes. (Table 11.18) Gross cropped area and net sown area has marginally increased from 1995-96 to 2000 with occasional variations. Besides the above-mentioned crops maize millets and vegetable of various kinds are grown in this block. (Fig. 11.9)

C.D. BLOCK KURSEONG
CROPPING PATTERN



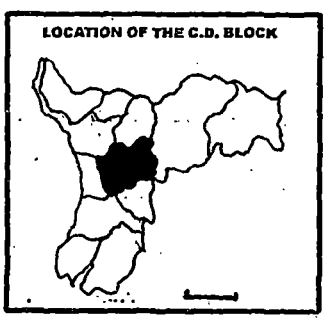
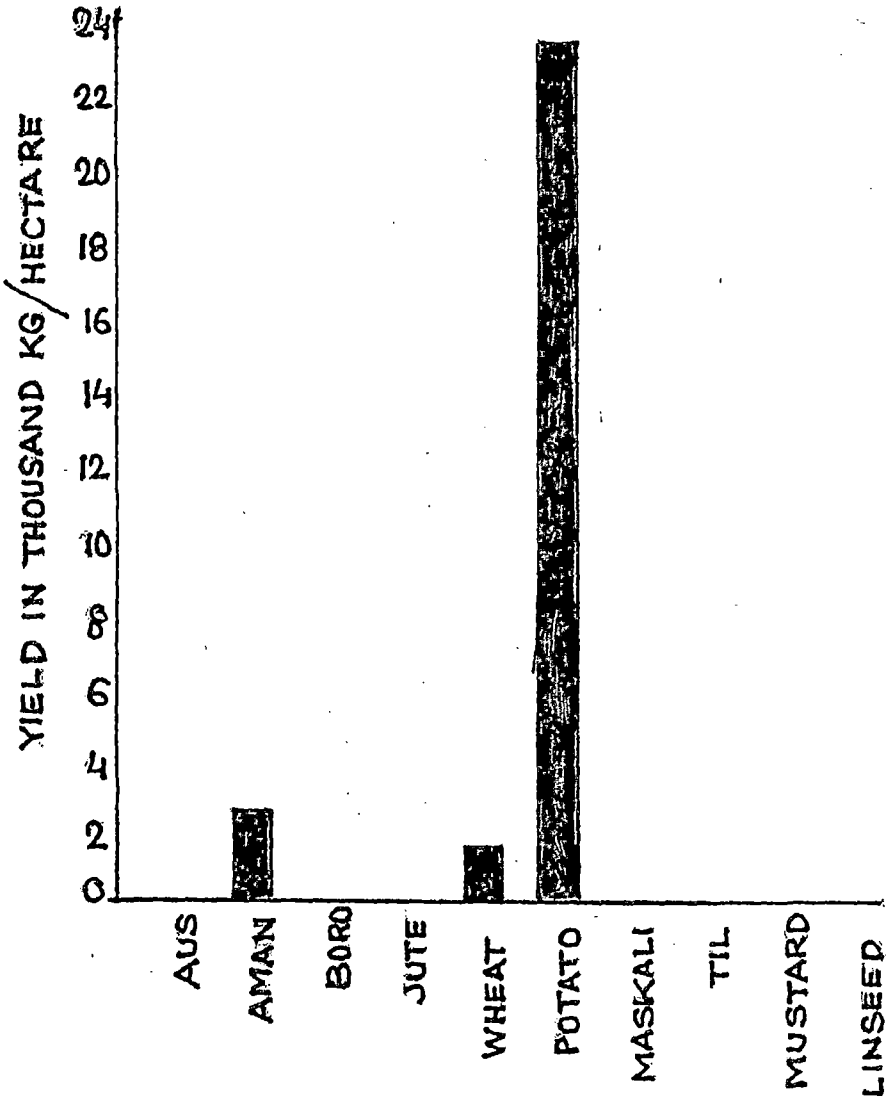


Fig- 11.9

INDEX

International Boundary
State Boundary
District Boundary
P.S. Boundary
URBAN AREA
CROP COMBINATION
POTATO, MAIZE,MILLET



KURSEONG
2001 - 2002

Fig. 11.9

Table 11.17
Landuse in Kurseong

(Area in hectares)

Land Utilization	1995-96		1996-97		1997-98		1998-99		1999-2000	
	Area in hectares	P.C. of total area	Area in hectares	P.C. of total area	Area in hectares	P.C. of total area	Area in hectares	P.C. of total area	Area in hectares	P.C. of total area
Forest reserved and unreserved	7291	27	7291	27	7291	27	7291	27	7291	27
Non-agricultural use home river temple	1684	6	1684	6	1702	6	1702	6	1802	7
Unculturable waste	155	0.57	122	0.45	122	0.45	122	0.45	103	0.38
Gazing land	23	0.08	52	0.19	52	0.19	52	0.19	47	0.17
Bamboo miscellaneous trees groves	355	1.31	360	1.33	360	1.33	360	1.33	361	1.33
Culturable waste	61	0.22	65	0.24	60	0.22	67	0.24	60	0.22
Old fallow	305	1.13	300	1.11	287	1.06	280	1.02	58	0.21
Current fallow	196	0.72	128	11	74	0.27	51	0.19	102	0.37
Net cropped area	16882	63	16950	63	17004	63	17027	63	17128	64
Total area	26952		26952		26952		26952		26952	
Grossed cropped area	19164	71	19038	71	19535	72	22757	84	19814	74

Source: Department of Agricultural, Govt. of W.B., Siliguri, 2000.

Table-11.18
Area, Production and Yield Rate of Major Crops in Kurseong

Name of crop	Area (in hectares)	Production in tones	Yield kg./hect.
Aus	2463	26	2464
Aman	02	0.6	0.90
Boro	(a)	(b)	2586
Potato	4.7	107.0	228.31

(a) Less than 5 hectares.
(b) Less than 5 tonnes.
Source: (1) Bureau of Applied Economics and Statistics.
(2) Directorate of Agriculture, 2001.

11.10 Mirik

C. D. Block Mirik has 9452 hectares of land and forest covers 26 p.c. of the total area. (Table 11.19) Non-agricultural land covers 10 p.c. of the block. Grazing and unculturable waste land, miscellaneous trees, current fallow, old fallow have less than one present of land area each. Nearly 68 p.c. of the land is gross cropped area and 64 p.c. is net shown area.

Table 11.19

Landuse in Mirik

(Area in hectares)

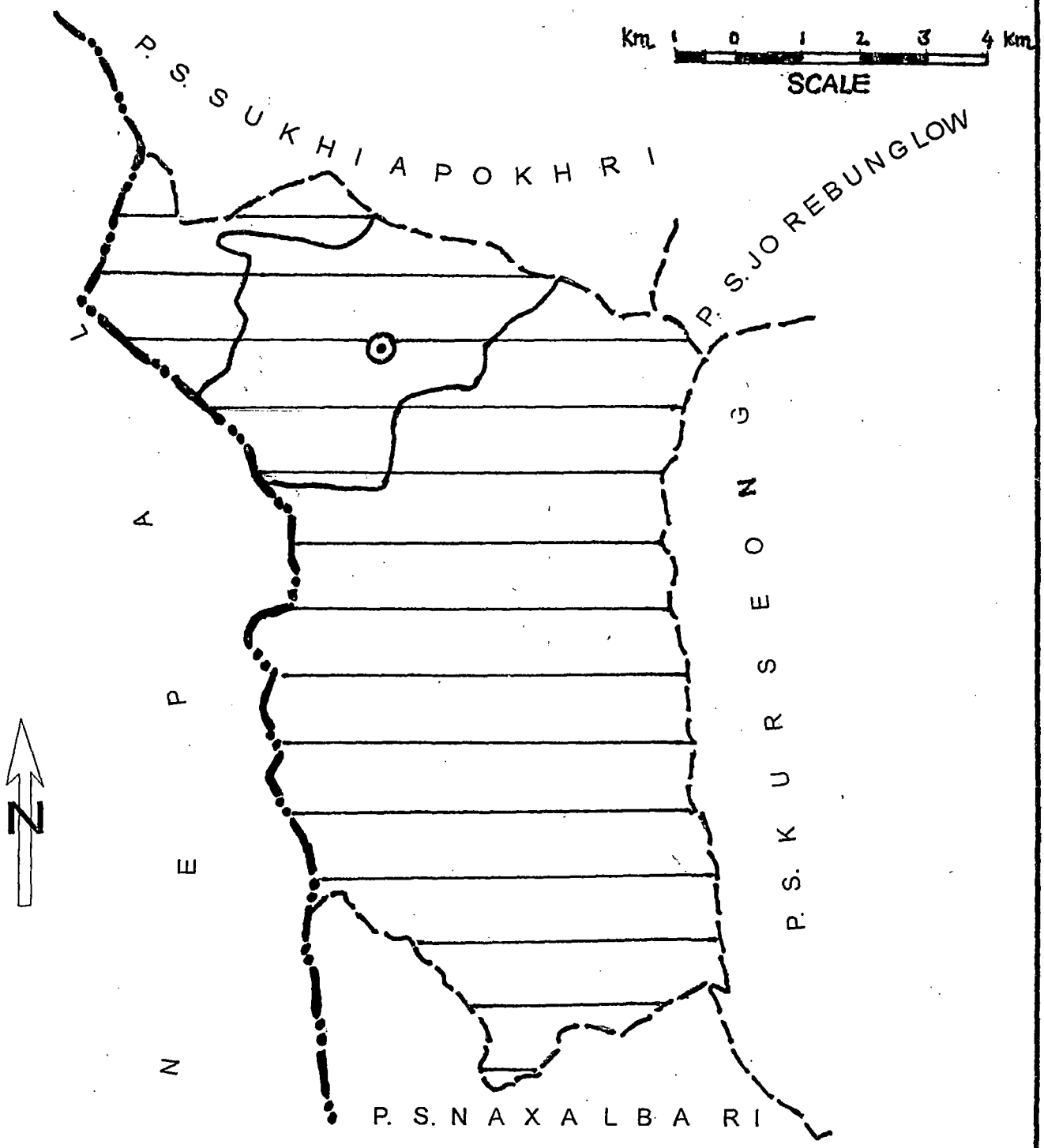
Land Utilization	1995-96		1996-97		1997-98		1998-99		1999-2000	
	Area in hectares	P.C. of total area	Area in hectares	P.C. of total area	Area in hectares	P.C. of total area	Area in hectares	P.C. of total area	Area in hectares	P.C. of total area
Forest reserved and unreserved	2463	26	2463	26	2463	26	2463	26	2463	26
Non-agricultural use home river temple	910	10	888	9	903	10	908	9.60	9.10	10
Unculturable waste	-	0.18	18	9234	18	0.19	18	0.19		0.19
Gazing land	-	-	-	-	-	-	-	-	-	-
Bamboo miscellaneous trees groves	30	0.31	24	0.25	28	0.29	28	0.29	30	0.31
Culturable waste	2	0.02	26	0.27	7	0.07	2	0.02	2	0.02
Old fallow	-	-	-	-	-	-	-	-	-	-
Current fallow	7	0.01	-	-	6	0.01	9	0.1	7	0.07
Net cropped area	6022	64	6033	64	6027	63	6024	64	6022	64
Total area	9452		6452		6452		6452		9452	
Grossed cropped area	6266	66	6097	65	6044	64	6246	66	6451	68

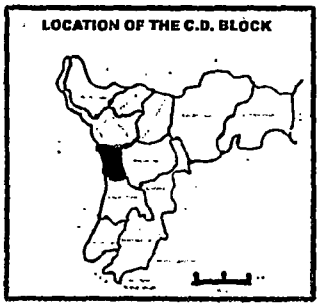
Source: Department of Agricultural, Govt. of W.B., Siliguri, 2000.

Plate-7 Tea cultivation in Mirik, Darjeeling

Plate-8 Tea cultivation in Darjeeling

MIRIK
CROPPING PATTERN





INDEX

- International Boundary
- State Boundary
- District Boundary
- P.S. Boundary
- URBAN AREA
- CROP COMBINATION (POTATO, MAIZE)

Fig- 11.10

YIELD IN THOUSAND KG/HECTARE
0
2
4
6
8
10
12
14
16
18
20
22
24
AUS
AMAN
BORO
JUTE
WHEAT
POTATO
MASKALI
TIL
MUSTARD
LINSEED
MIRIK
2001-2002

Fig. 11.10

Plate-9 Balasonriver-bed overlooking the forest, Siliguri P.S.,Darjeeling

Plate-10 Mirik forest in Darjeeling Dist.

Mirik has very less area under different varieties of rice. (Table 11.20)

Table 11.20

Area, Production and Yield Rate of Major Crops in Mirik

Name of crop	Area (in hectares)	Production in tones	Yield kg./hect.
Aus	(a)	(b)	1528
Aman	(a)	(b)	1530
Boro	(a)	(b)	2586
Potato	0.1	1.7	16570

(a) Less than 5 hectares.

(b) Less than 5 tonnes.

Source: (1) Bureau of Applied Economics and Statistics.

(2) Directorate of Agriculture, 2001.

Some area is also under potato cultivation and yield rate is not high as compared to other blocks. Area of net sown crops gross cropped have not increased since 1995-2000. (Table 11.20) (Fig. 11.10)

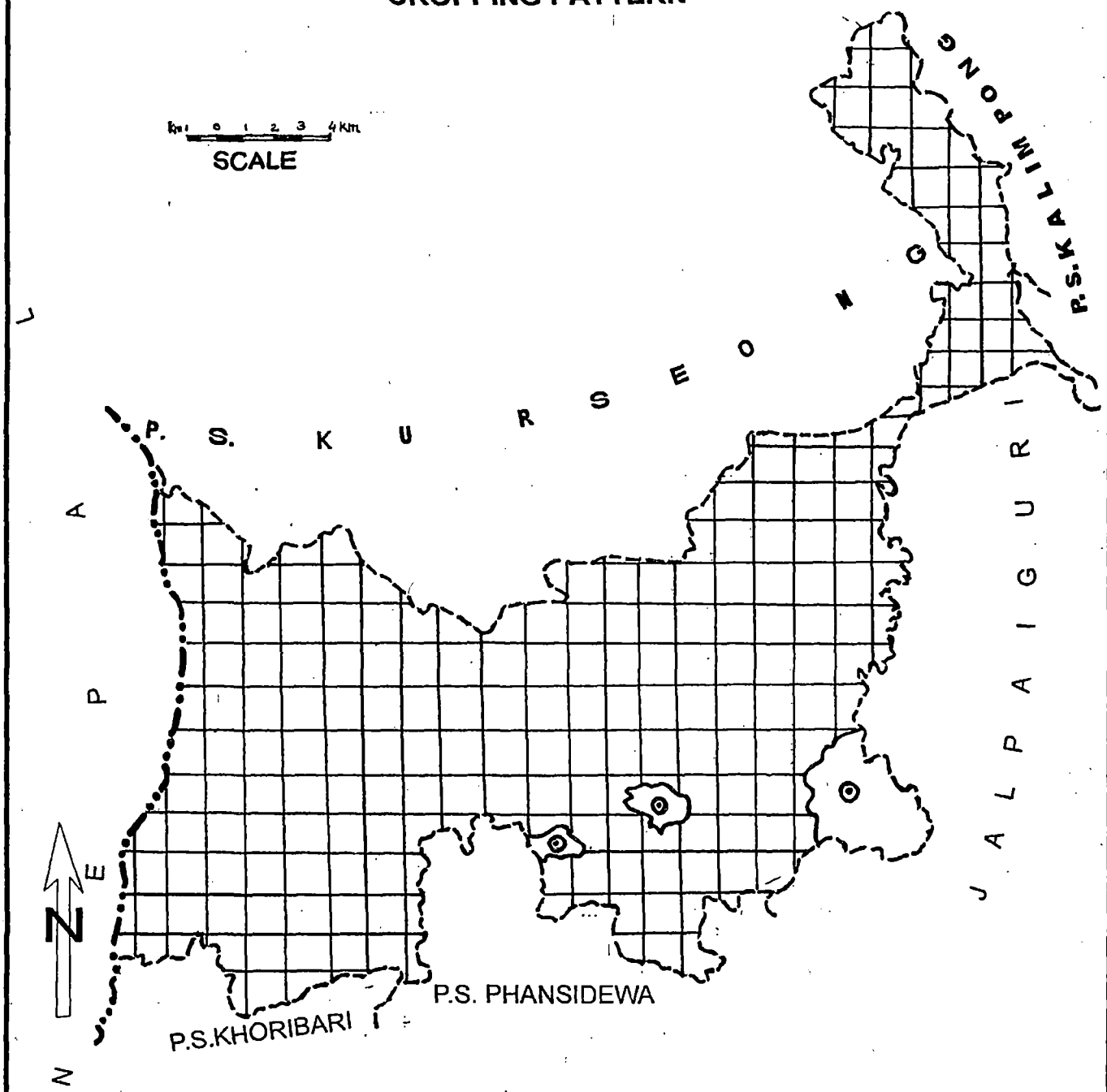
11.11 Siliguri-Naxalbari

Total land area of Siliguri-Naxalbari is 38163 hectares. Due to flat surface of the land this block has 28 p.c. and 17 p.c. of forest and non-agricultural land respectively (Table 11.21). Like other blocks of the district grazing land, miscellaneous trees, unculturable waste land, current fallow and old fallow have less than one percent of land area. Nearly 55 p.c. of the total land is gross cropped area and 51 p.c. is net sown area.

Plate 11 Jute cultivation in Siliguri P.S.

Plate 12 Maize cultivation in Naxalbari

C.D. BLOCK SILIGURI-NAXALBARI
CROPPING PATTERN



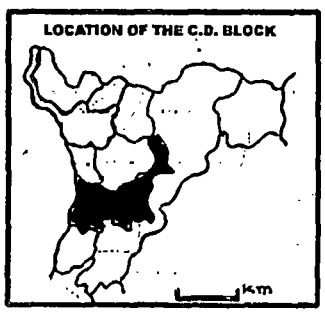
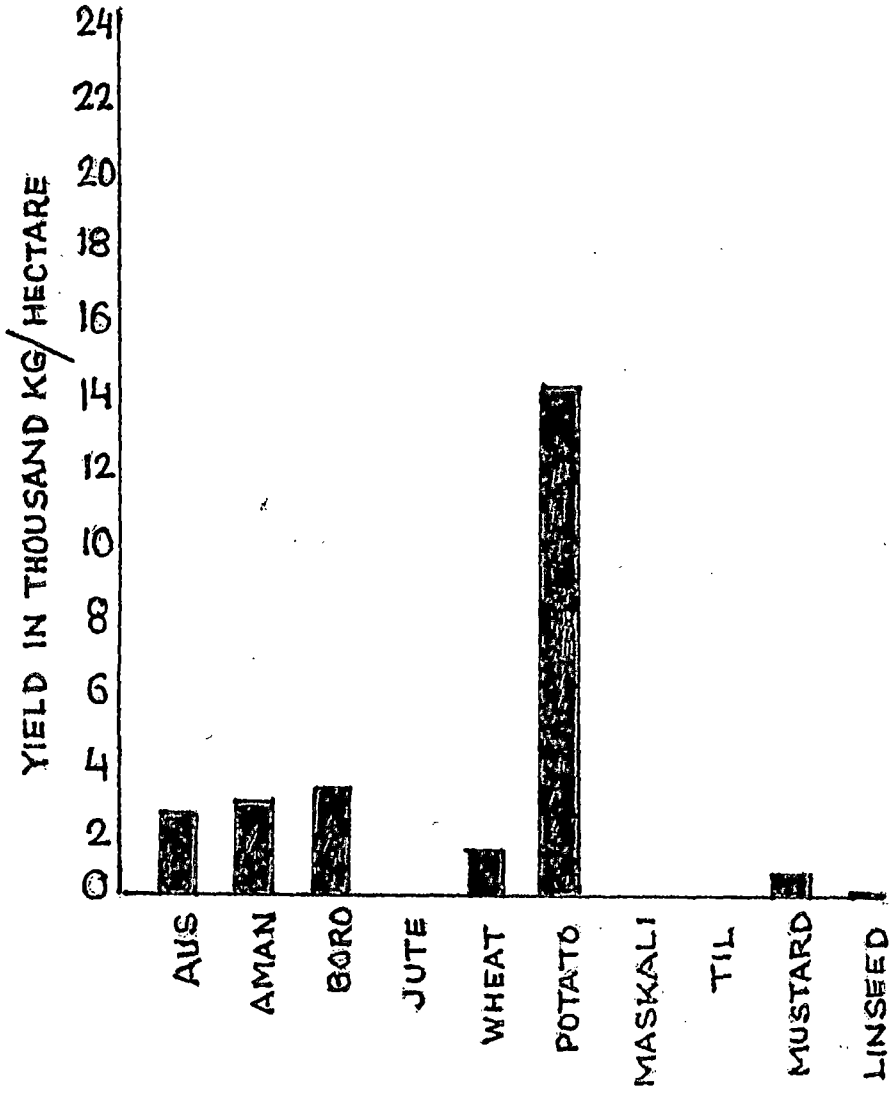


Fig- 11.11

INDEX

International Boundary
State Boundary
District Boundary
P.S. Boundary
URBAN AREA
CROP COMBINATION
AUS,AMAN,BORO
(RICE)JUTE,POTATO



MATIGARA
2001 - 2002

Fig. 11.11

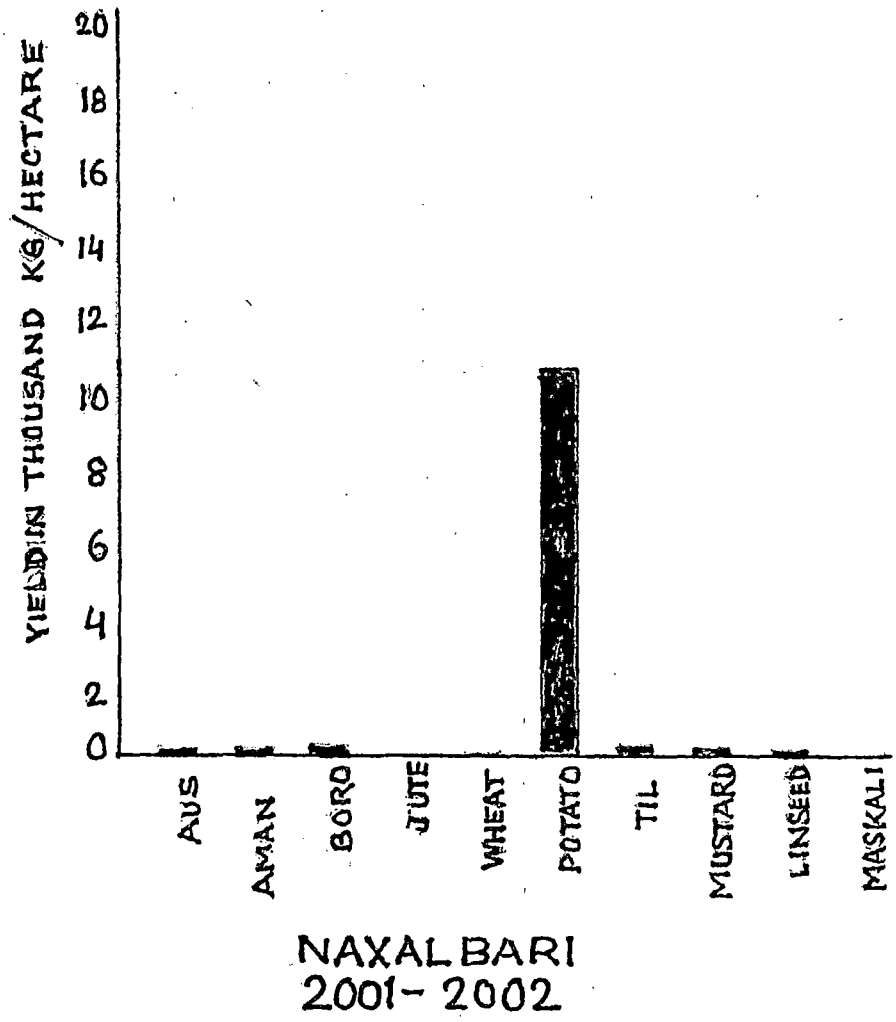

YIELD IN THOUSAND KG/HECTARE
20
18
16
14
12
10
8
6
4
2
0
AUS
AMAN
BORO
JUTE
WHEAT
POTATO
TIL
MUSTARD
LINSEED
MASKALI
NAXALBARI
2001- 2002

Fig. 11.11

Table 11.21

Landuse in Siliguri-Naxalbari

(Area in hectares)

Land Utilization	1995-96		1996-97		1997-98		1998-99		1999-2000	
	Area in hectares	P.C. of total area	Area in hectares	P.C. of total area	Area in hectares	P.C. of total area	Area in hectares	P.C. of total area	Area in hectares	P.C. of total area
Forest reserved and unreserved	10611	28	10611	28	10611	28	10611	28	10611	28
Non-agricultural use home river temple	5764	15	5775	15	5784	15	5784	15	6545	28
Unculturable waste	144	0.37	144	0.37	144	0.37	144	0.37	243	0.63
Gazing land	176	0.46	176	0.46	176	0.46	176	0.46	152	0.39
Bamboo miscellaneous trees groves	193	0.50	205	0.53	206	0.53	206	0.53	204	0.53
Culturable waste	215	0.56	245	0.64	240	0.62	252	0.63	238	0.62
Old fallow	270	0.70	285	0.74	280	0.73	268	0.70	321	0.84
Current fallow	412	1.10	312	1	408	1	369	1	358	1
Net cropped area	20378	53	20410	53	20314	53	20353	53	19491	51
Total area	38163		38163		38163		38163		38163	
Grossed cropped area	26228	69	23505	62	20714	54	22811	60	21094	55

Source: Department of Agricultural, Govt. of W.B., Siliguri, 2000.

Different types of crop is grown in this block. They are aus, aman, boro varieties of rice, jute, wheat, potato, mustard and linseeds. Potato gives highest return to the farmers because yield rate is very high. Other crops also show (Table 11.22)

Plate 13 Maize cultivation in Tarabari,Siliguri P.S., Darjeeling.

Plate 14 Balason side cultivation

Table-11.22

Area, Production and Yield Rate of Major Crops in Siliguri-Naxalbari

Name of crop	Area (in hectares)	Production in tones	Yield kg./hect.
Aus	18.5	32.5	3558
Aman	59.1	93.8	3241
Boro	1.3	3.4	5111
Jute	2.8	(b)	14.9
Wheat	4.4	10.9	3938
Potato	2.0	23.4	23358
Till	0.3	0.2	574
Mustard	0.1	0.0	126
Linseed	(a)	(b)	158

(a) Less than 5 hectares.
(b) Less than 5 tonnes.
Source: (1) Bureau of Applied Economics and Statistics.
(2) Directorate of Agriculture, 2001.

Better yield rates per hectare. Gross cropped area shows a decreasing trend. It was 69 p.c. in 1995 and in 2000 it came down to 55 p.c. Net sown area has decreased marginally over the last five years (1995-2000) (Fig. 11.11).

11.12 Kharibari-Phansidewa

Kharibari and Phansidewa C. D. block has 45763 hectares of area and forest covers only one percent of the total geographical area of the block. Thirty-one percent of land is under non-agricultural use. Bamboo and groves covers 5 p.c. of the land area. Culturable wasteland grazing land, old fallow cover an each area of less than one percent each. Current fallow land covers 6 p.c. of the land. Gross cropped and net cropped area has 96 and 66 percent of the total area respectively. (Table 11.23)

C.D. BLOCK KHARIBARI-PHANSIDEWA
CROPPING PATTERN

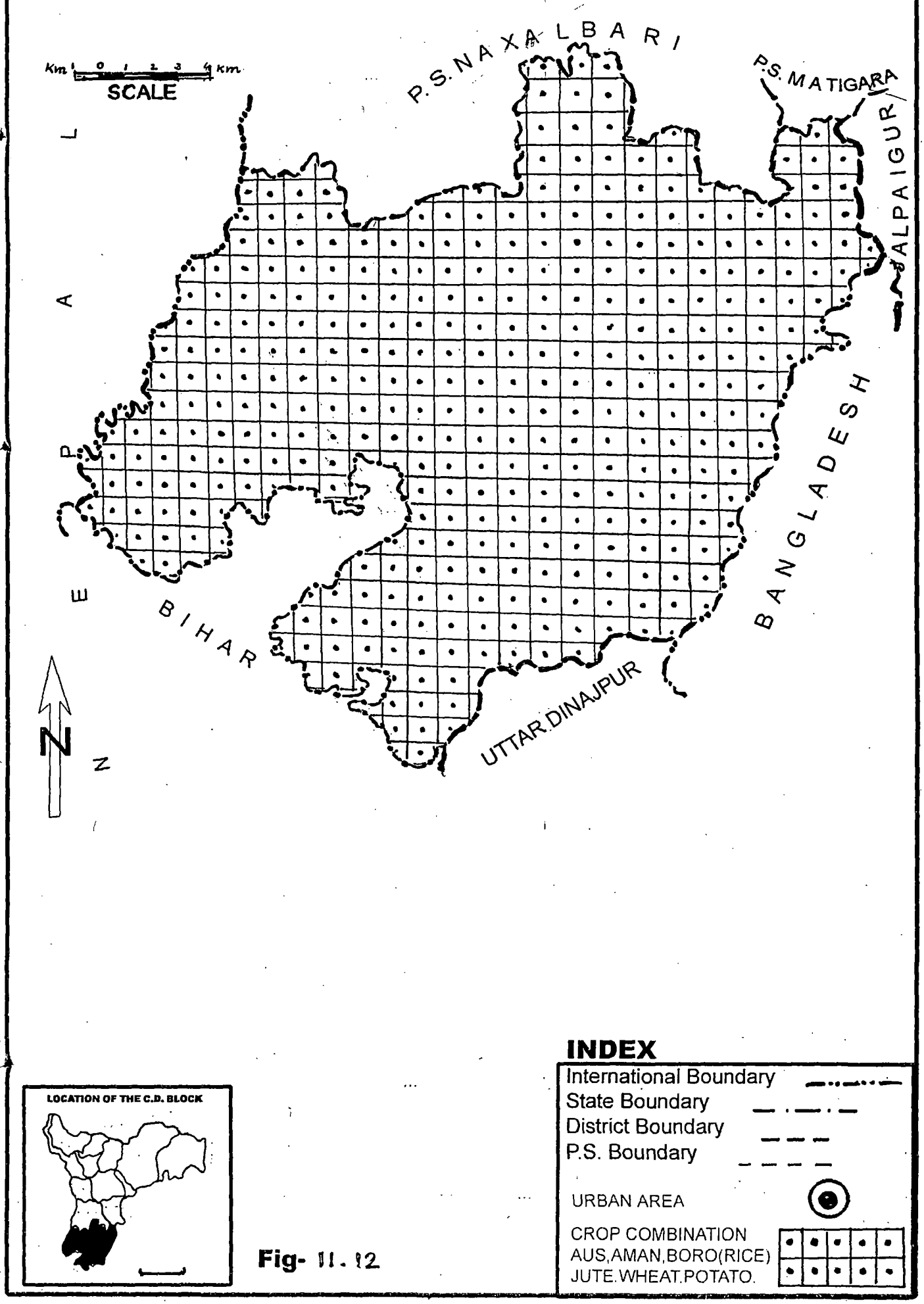


Fig- 11.12

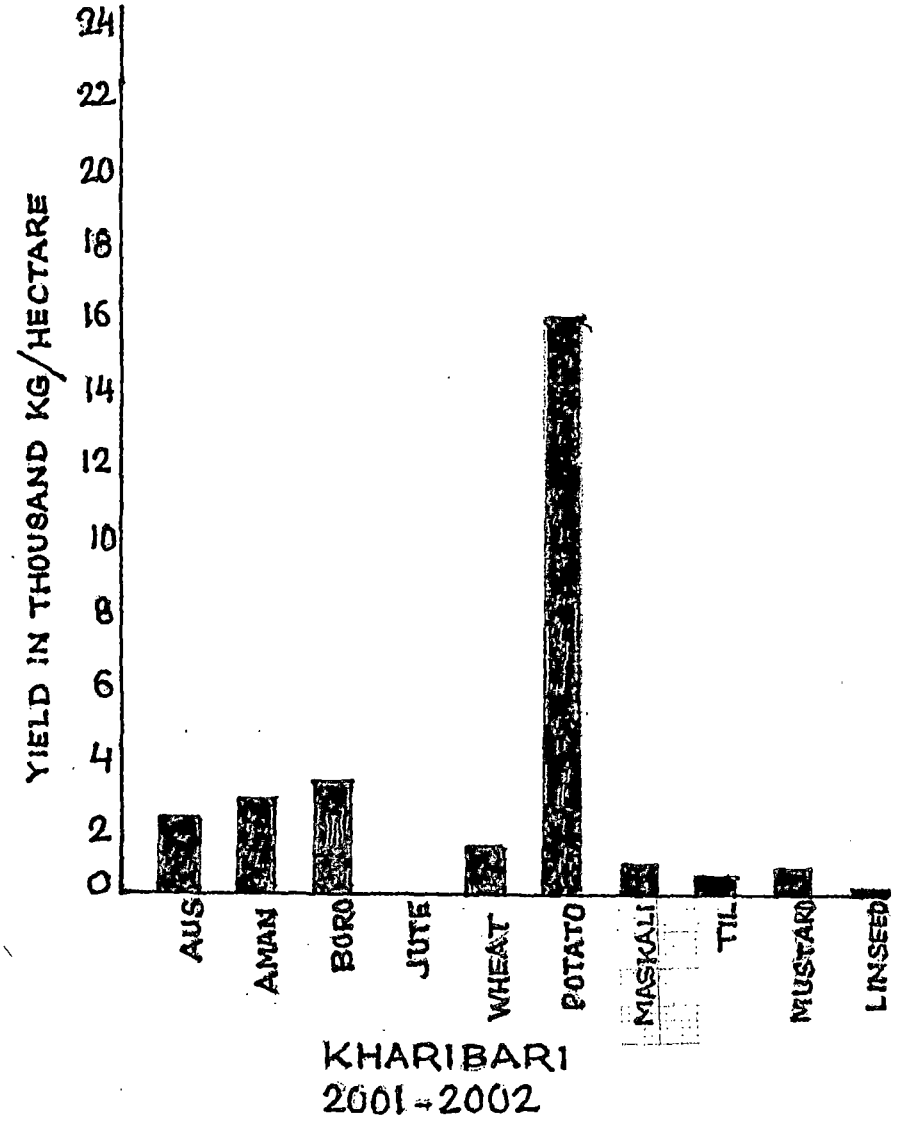

YIELD IN THOUSAND KG/HECTARE
24
22
20
18
16
14
12
10
8
6
4
2
0
AUS
AMAN
BORO
JUTE
WHEAT
POTATO
MASKALI
TIL
MUSTARD
LINSEED
KHARIBARI
2001-2002

Fig. 11.12

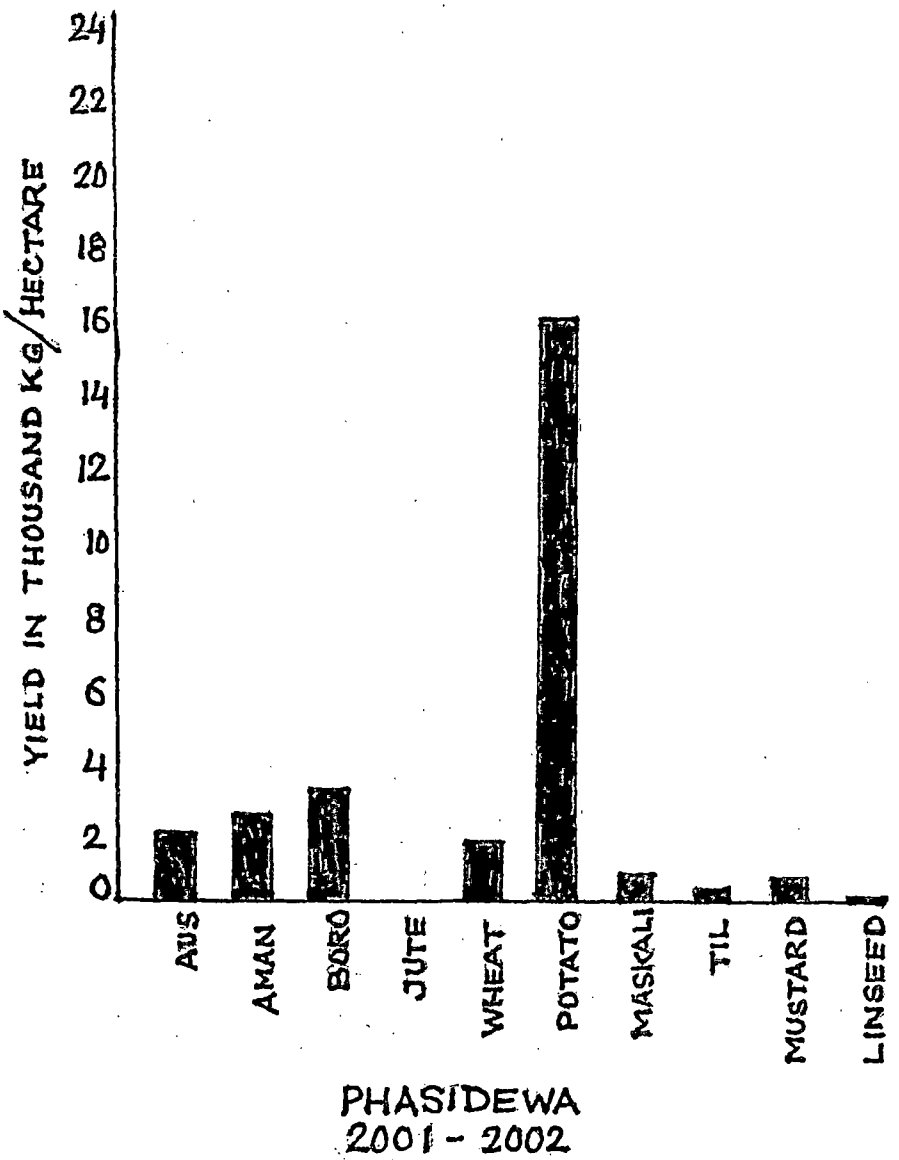

YIELD IN THOUSAND KG/HECTARE
24
22
20
18
16
14
12
10
8
6
4
2
0
AUS
AMAN
BORO
JUTE
WHEAT
POTATO
MASKALI
TIL
MUSTARD
LINSEED
PHASIDEWA
2001 - 2002

Fig. 11.12

Table 11.23

Landuse in Khoribari-Phansidewa

(Area in hectares)

Land Utilization	1995-96		1996-97		1997-98		1998-99		1999-2000	
	Area in hectares	P.C. of total area	Area in hectares	P.C. of total area	Area in hectares	P.C. of total area	Area in hectares	P.C. of total area	Area in hectares	P.C. of total area
Forest reserved and unreserved	562	1	562	1	562	1	562	1	562	1
Non-agricultural use home river temple	14032		14050		14055		14055		14095	31
Unculturable waste	375	0.81	474	1	470	1	470	1	80	0.17
Gazing land	13	0.02	13	0.02	12	0.02	12	0.02	10	0.02
Bamboo miscellaneous trees groves	25	0.05	30	0.06	30	0.06	30	0.06	176	4.84
Culturable waste	111	0.24	111	0.24	153	0.33	158	0.34	65	0.14
Old fallow	167	0.36	167	0.36	125	0.27	120	0.02	159	0.34
Current fallow	3119	6.82	2941	6	2980	7	3640	8	2760	6
Net cropped area	27359	60	27415	60	27376	60	26716	58	27856	61
Total area	45763		45763		45763		45763		45763	
Grossed cropped area	39152	86	40606	89	47056	103	44725	98	43834	96

Source: Department of Agricultural, Govt. of W.B., Siliguri, 2000.

Aus, aman (rice), jute, wheat, potato and cereals are cultivated in this block. Yield rate is also fairly high. (Table 11.24) (Fig. 11.12)

Table-11.24

Area, Production and Yield Rate of Major Crops in Khoribari-Phansidewa

Name of crop	Area (in hectares)	Production in tones	Yield kg./hect.
Aus	35.1	49.4	2796
Aman	188	274.6	2956
Boro	3.4	8.8	5172
Jute	3.4	0.2*	163**
Wheat	27.4	50.0	3634
Potato	16.3	230.3	13716
Maskalai	1.6	0.8	928
Till	2	1.2	1148
Mustard	0.8	(b)	252
Linseed	(a)	(b)	378

(a) Less than 5 hectares.

(b) Less than 5 tonnes.

* = Production in .00 bales of 180 kg. each.

** = in bales/hectares.

Source: (1) Bureau of Applied Economics and Statistics.

(2) Directorate of Agriculture, 2001.

But yield rate is of potato is 13716 kg/hect, which is much lower as compared to other blocks of the district. In 1995 86 p.c. was gross cropped area and in 2000 it has increased to 96 p.c. But the net sown area remain stagnant over the study period.

11.13 Net Cropped Area

The net sown area is the land, which is being actually cultivated for raising any type of crop food crop or cash crops. Table 11.25 and table 11.26 indicate the percentage of net-cropped area and intensity groups of net cropped area respectively.

Table 11.25

Percentage of Net Cropped Area in Darjeeling

Name of the Block	Total area of the block	1995-96	P.C. of N.S.A.	1996-97	P.C. of N.S.A.	1997-98	P.C. of N.S.A.	1998-99	P.C. of N.S.A.	1999-2000	P.C. of N.S.A.	Average P.C. of arable land
Darjeeling-Pulbazar	40887	14871	36	14871	36	14871	36	14871	36	14873	36	36
Jore Bunglow-Sukhiapokhri	39086	15123	39	15135	39	15143	39	15043	38	14983	38	38
Rangli-Rangliot	19811	12046	61	12046	61	12131	61	12164	61	12177		61
Kalimpong-I	33997	10096	30	10115	30	10115	30	10115	30	10102	30	30
Kalimpong-II	26986	9756	20	9300	21	9351	21	9345	21	9390	21	21
Gorubathan	44372	9258	20	9300	21	9351	21	9345	21	9390	21	21
Kurseong	26952	16882	63	16950	63	17004	63	17027	63	17128	64	63
Mirik	9452	6022	64	6033	64	6027	63	6024	64	6022	64	64
Siliguri-Naxalbari	38163	20378	53	20410	53	20314	53	20353	53	19491	51	53
Kharibari-Phansidewa	45763	27359	60	27415	60	27376	60	26716	58	27854	61	60

Source: Agricultural Department, Siliguri, Govt. of W.B., 2000.

Table 11.26

Intensity Groups of Net Sown Area

Intensity Groups	Average percentages to arable land (1995-96 1999-00)	No. of blocks	Name of blocks
High	51 – 75	5	Rangli-Rangliot, Kurseong, mirik, Matigara-Naxalbari, Khoribari-Phansidewa
Medium	26 – 50	4	Darjeeling Pulbazar, Jore Bunglow-Sukhiapokhri, Kalimpong-I, Kalimpong-II
Low	Less than 25	1	Garubathan

Source: Agricultural Department, Siliguri, Govt. of W.B., 2000.

Table 11.27

Intensity of Cropping in Darjeeling District

Name of the block	Total area of the block	1995 – 1996			1996 – 1997			1997 – 1998			1998 – 1999			1999 – 2000		
		Gross Cropped Area	Net Cropped Area	Intensity of cropping	Gross Cropped Area	Net Cropped Area	Intensity of cropping	Gross Cropped Area	Net Cropped Area	Intensity of cropping	Gross Cropped Area	Net Cropped Area	Intensity of cropping	Gross Cropped Area	Net Cropped Area	Intensity of cropping
Darjeeling Pulbazar	40887	16604	14871	112	40887	14871	112	40887	14871	112	40887	14871	112	11682	14783	79
Jorebunglow Sukhiapokhri	39086	16604	15123	109	16297	15135	107	16375	15143	108	16181	15043	107	17097	14983	114
Rangli-Rangliot	19811	16965	12046	140	16965	12046	140	16969	12131	140	16090	12164	132	15905	12177	132
Kalimpong-I	33997	10177	10096	100	8837	10115	87	8873	10115	87	8873	10115	87	11049	10102	109
Kalimpong-II	26986	10172	9756	104	12376	10066	122	11576	10050	115	11433	9833	116	11869	9751	121
Garubathan	44372	12719	9258	137	9897	9300	106	10774	9351	115	7909	9345	85	14197	9390	151
Kurseong	26952	19164	16882	113	19038	16950	112	19535	17004	114	22757	17027	133	19814	17128	115
Mirik	9452	6266	6022	104	6097	6033	101	6044	6027	100	6246	6024	104	6451	6022	107
Siliguri Naxalbari	38163	26228	20378	129	23505	20410	115	20714	20314	102	22811	20353	112	21094	19491	104
Khoribari Phansidewa	45763	39152	27359	143	40606	27415	148	47056	27376	172	44725	26716	167	43834	27856	157

Source : Agricultural Department, Siliguri, Govt. of W.B., 2000.

DISTRICT DARJEELING
PERCENTAGE OF NET SOWN AREA

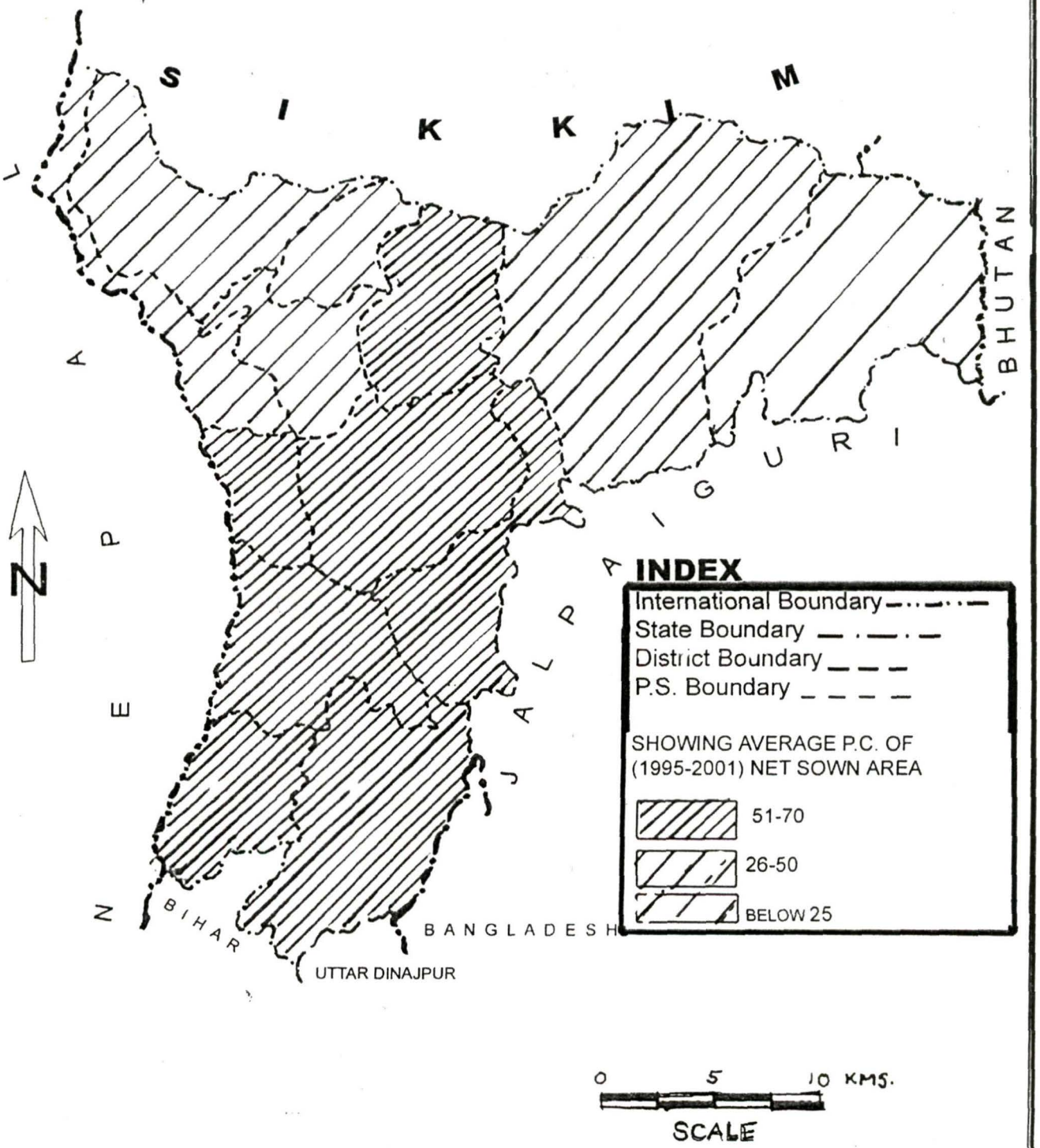


Fig- 11.13

Low intensity group of net sown area (table 11.26) i.e., Garubathan is characterized by rugged terrain and devoid of fertile soils for crop cultivation. The cultivated land is confined to valleys and low lands. The medium intensity group includes Darjeeling, Jore Bunglow, Sukhiapokhri, Kalimpong-I and Kalimpong-II. The last two blocks where altitude is less than 600 meters crops usually gives good yield rate. In high intensity group Matigara-Naxalbari, Khoribari-Phansidewa has high percentage of net area. (Fig. 11.13) On the other hand Rangli-Rangliot though located in hill areas but cultivation is practised near river valleys. The very slow rate of increase in net sown area and less percentage of net sown area in some blocks are due to several factors such as – rugged terrain is responsible for less area under cultivation, infertile and poor quality of soil, poor accessibility, high altitudes, lack of extensive, irrigational facilities, high variability of rainfall, lack of modern mechanized cultivation, and also major part of the some blocks are covered either by forest or tea cultivation.

11.14 Intensity of Cropping

Intensity of cropping pattern signifies the farming practises for extracting maximum output from a single unit of land by growing crops more than once a year when there is limited cultivated land or where the physical environment does not permit the expansion of cultivated land, the production has to be increased by multiple cropping. The landuse intensity depends on the intensity of cropping pattern. Index numbers of intensity of cropping pattern (Pathak 1977) computed by the formula –

$$\frac{\text{Gross Cropped Area}}{\text{Net sown area}} \times 100$$

Table 11.27 represents cropping intensity and cropping intensity groups (average of 1995-2000) for the district (table 11.28) The intensity groups of cropping pattern is plotted in fig. 11.14.

DISTRICT-DARJEELING

Intensity Groups of Cropping Pattern

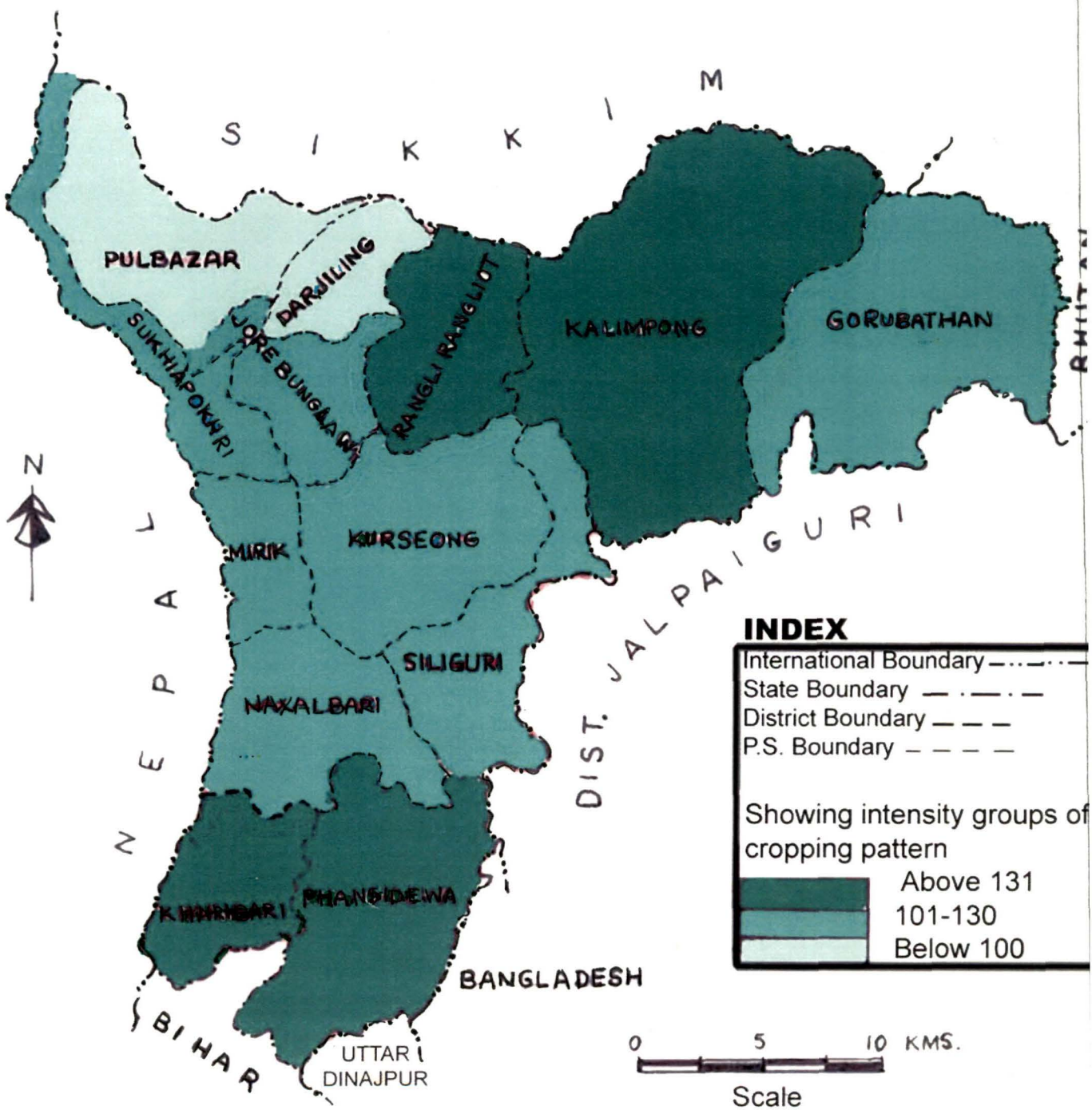


Fig- 11.14

Table 11.28

Representing Cropping Intensity Groups 1999-2000

Intensity Groups	Indices	No. of blocks	Name of blocks
High	131 and above	3	Rangli-Rangliot, Gorubathan Khoribari Phansidewa
Medium	101-130	6	Jore Bunglow-Sukhiapokhri, Kalimpong-I, Kalimpong-II, Mirik Matigara, Naxalbari
Low	Below 100	1	Darjeeling
District Average	119		

Source: District Agricultural Office, Siliguri, Govt. of W.B., 2000.

Intensity of cropping depends upon a several aspects of climate, soil, water availability and improved farming practises Darjeeling Pulbazar area has the lowest intensity of cropping. It can be seen from the statistical data that due to verifying altitudes ~~for~~ and rugged surface, agricultural production has not shown any improvement. Medium intensity groups are Jore Bunglow, Sukhia Pokhri, Kalimpong-I, Kalimpong-II, Mirik and Matigara (Siliguri-Naxalbari Blocks). Rangli Rangliot, Khoribari Phansidewa and Gorubathan have high intensity of cropping pattern. Rangli-Rangliot and Garubathan are hill blocks but due to presence of river valleys it is possible to cultivation the land for more than once a year. Phansidewa-Khoribari block is a level land. River lift irrigation and availability of fertilizers market and better communication facilities made it possible to grow crops throughout the year. (Fig. 11.1~~7~~5, 11.1~~8~~6)

11.15 Land Productivity

The productivity of land is related to contour map of slopes in the field, textures, depths, physical and chemical properties of various layers of soils with which the land is endowed. High efficient extraction of nutrients by the mountain system once covered much land area of this district. Most agricultural soils in the district are highly weathered and high percentage of nutrient losses is taking place by high intensity of rainfall. The amount of water that moves through the soil depends partly on topography and the rate of erosion determines the properties and fertility of the

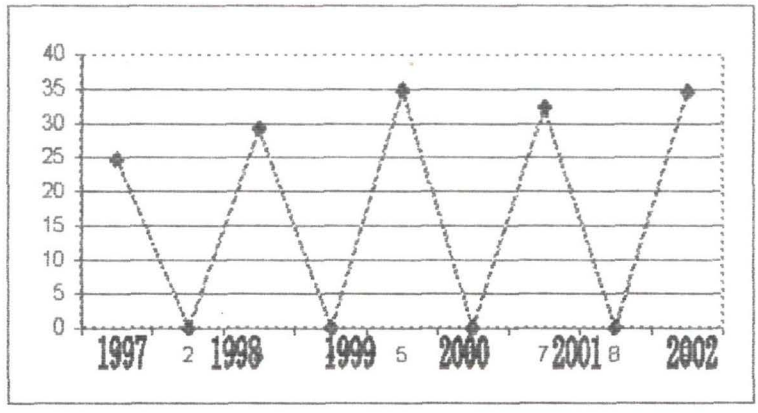


Fig 14.15 Fertilizer consumed in the district of Darjeeling (in tonnes).

Note : N = Nitrogen

P = Phosphate

K = Potash

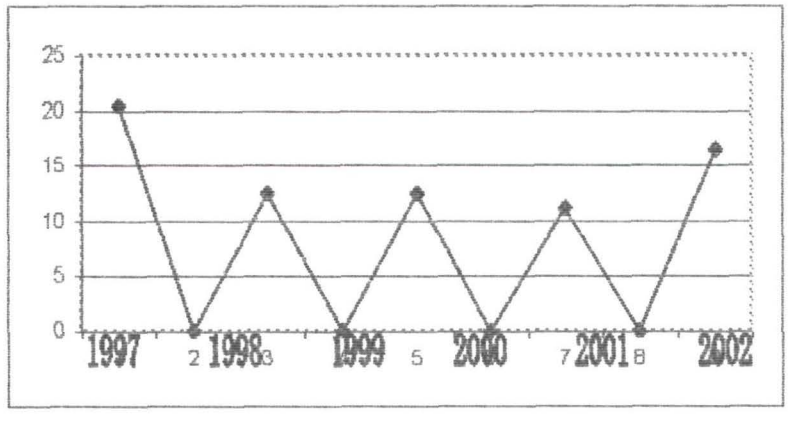


Fig. 14.16 Area irrigated by different sources in the district of Darjeeling (in '000 hectares)

soil. Therefore, output of rice is low in hill soil and land suitable for rice cultivation is limited. The quality of rice is not very good. The productivity of different crops shows regional variation due to rapid change in micro climatic and terrain factors. In plain areas yield rate of rice is much higher.

11.16 Introduction of high yielding variety of rice

In order to derive maximum return from a single unit of land H.Y.V. of seeds were introduced in the areas along with the multiple cropping patterns.

Prior to Fifth Five Year Plan H.Y.V. seeds were introduced in some paddy growing areas of land. But no substantial impact was created by this programme because only big farmers were benefited by this programme. At the beginning of Fifth Five Year Plan H.Y.V. Programme was introduced in the entire paddy, wheat and maize growing area[4]. It was found that average yield rate of maize is only 3.5 to 4quintals per acre while H.Y.V. varieties gave an average yield of 10 quintals to 14 quintals per acre from the same field. The programme covered entire wheat growing area and the yield rate increased substantially. But in case of paddy H.Y.V. programme could not make any success in hill areas of Darjeeling. In this context it is to be noted that H.Y.V. responses well only if water and fertilizers are supplied in prescribed quantities along with the measures to protect crops from diseases and pests[5]. There are some other factors, which is responsible for the development of agriculture.

The law of succession in India results in the Sub-Division and fragmentation of holdings. In fragmented land improved agricultural practises cannot be adopted. The small plots are difficult to work with modern machinery. Availability of water and access to the market are other factors responsible for agricultural development.

---

[4] Govt. of West Bengal, 1975-76 : Darjeeling Marches a read, A Review of Development Programme, Darjeeling : Development & Planning Department, Hill Branch Section, p. 3.
[5] Gupta. N.S., Singh, A. 1979 : Agricultural Development of States of India : Jammu & Kashmir, New Delhi-5, p. 86.

CHAPTER – TWELVE

12.0 Agro Forestry

12.01 Agro Forestry in India

India has a long traditions of agro-forestry; farmers and land owners in different parts of the country integrate a variety of woody perennials in their crop and livestock production fields depending upon the agro-climatic conditions and local needs.

Agro-forestry land uses fulfill both productive and service functions. The main productive outputs are foodgrains, fuel, wood and fodder but most important service function is soil conservation. It means not only control or erosion but also includes the maintenance as well as improvement of soil, organic, physical and nutrient status (Lyndgren, Nair, 1985)[1]. Management practices are the main deciding factors and determine the merits and demerits of various agro-forestry practices whether they are controlling or aggravating the soil erosion. Nitrogen fixing trees and shrubs growing within practical agroforestry systems are capable of fixing about 50-100/kilogram of nitrogen per hectare per year.

Forests are necessary to maintain ecological balance of the country, so much so that they are called the lungs of the society. The national forest policy, 1988 clearly stated – "National goal should have be to have a minimum of one third of the total land area of the country under forest or tree cover".

The forest of Darjeeling may be classified into broad groups viz. the hill forest and the plain forests. Figures 12.1 shows forest areas of Darjeeling.

[1] Lyndgren, B. and Nair, P.K.P. (1985) Agroforestry for Soil Conservation, Soil Erosion and Conservation, IOWA, U.S.A.

DISTRICT DARJEELING
FOREST

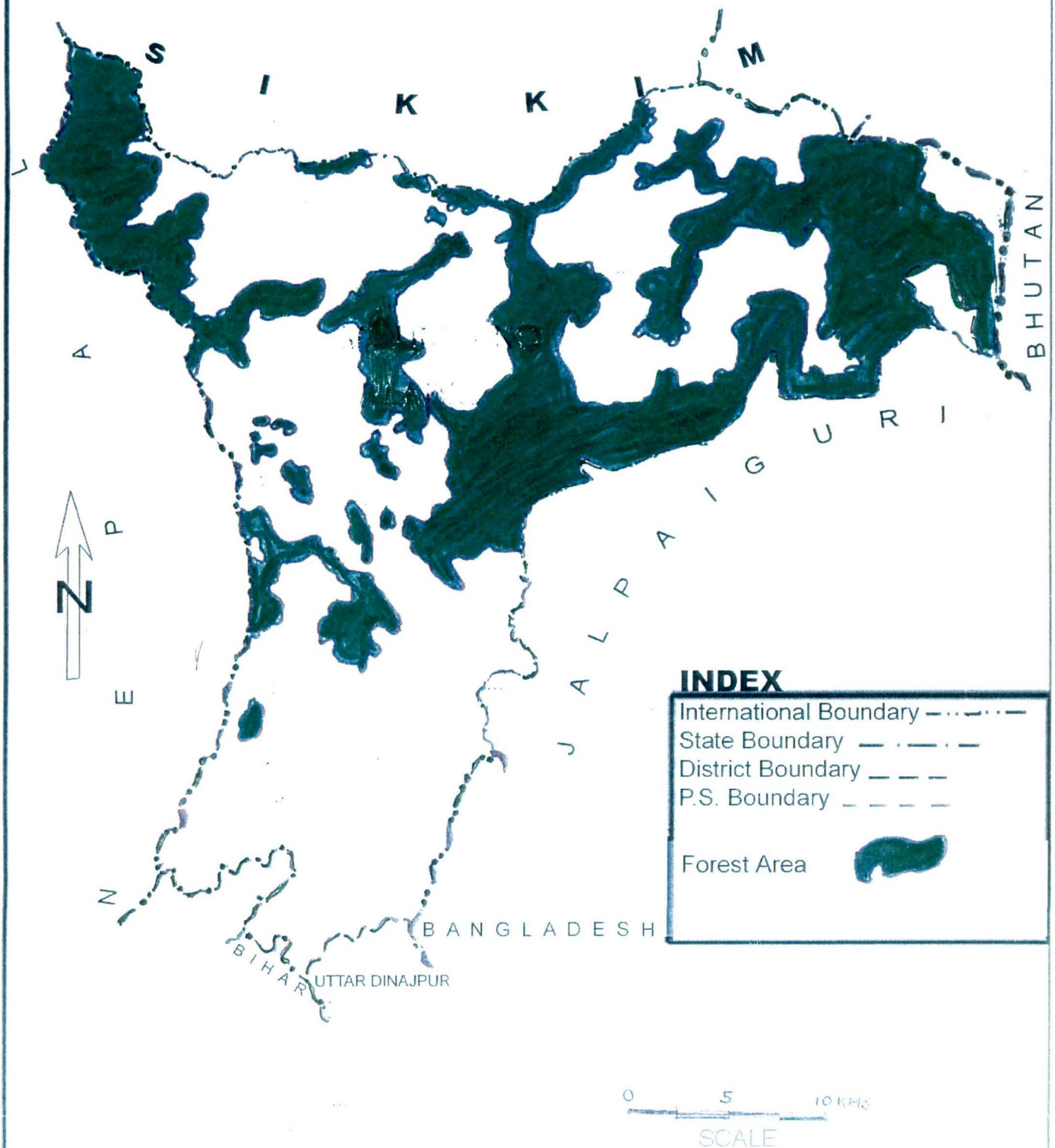


Fig- 12.1

The Darjeeling Himalayan tract belonging to a portion of the lower Himalaya has given rise to an unique forest eco-system. From 150 meters to 3600 meters different types of forest exist within a small area. In 1911 more than 59 percent (1554 sq.kms.) of the total area of Darjeeling district was under forest cover, but it comes down to 38 p.c. or 1204 sq.kms. area in 1987. In hills these forests extend over the ridges above 1800 meters. Forests of considerable extent also extend into the Tistan Rangit valleys. The forests of Darjeeling may be classified into two broad groups viz. the hill forest and the plain forests.

12.02 Hill Forests

The hill forest of the district can be divided into five classes – such as (i) lower hill forests upto 914.4 meter with three sub types (a) sal forests (b) dry mixed forests and (c) wet mixed forests and (ii) the middle hill forests ranging from 762 meters to 1676 meters (iii) the upper hill forests occurring between 1524 and 2743 meter.

(i) Lower hill forest : These forests occupy the Tista and Ranjit valleys within which three main subtypes may be distinguished.

(a) Sal Forest : In Darjeeling division sal is gregarious on ridges and spurs and is mainly confined to the Daling series. It is also found in other parts of the district in association with miscellaneous species. Around Badamtam in the Rangit valley pine is common and occurs naturally.

In Kurseong division sal grows pure or mixed with other deciduous species on northern ridges and on southern and eastern slopes of moderate gradient. Sal also grows at an altitude of 3500 feet in the northern portion of Kalimpong range, it occurs up to an elevation of 1500 feet only in the southern part of the range.

(b) Dry Moist Forest: Which are mainly deciduous and found on dry ridges spurs and slopes.

(c) Wet Moist Forests: Which occur in sheltered pockets in the valleys along jhoras and they are semi-evergreen in character.

12.03 (ii) Middle Hill Forests

Forests of this zone are not well represented in this division because substantial section of forests in this altitudinal range have been given over in the past to the tea estates or to cultivation in the past. Forests of this type are encountered in the upper reaches of the Sumbong and Reyang blocks and lock. The middle hill forest are closed evergreen forests, the trees being mostly short and branchy though of ten attaining considerable girth.

12.04 (iii) Upper Hill Forests

Which are most important in the division because they cover the bulk of its forest area. In composition they more or less correspond to east Himalayan wet temperate forests of the northern wet temperate group. Three altitudinal zones where these forests occur are –

(a) Lower Zone: Forests under Selimbong, Kankibong, Little Rangit and Lopchu blocks belong to this category. This forest area extends from around 1750 meters to around 2150 meters.

(b) Middle Zone, extending from 2150 meters to around 2500 meters. Forest in the south Rimbick, Kankibong and Selimbong blocks belong to this category. The important special grown are buk, falant and kotus.

(c) Upper Zone extending from 2500 meter to around 2750 meter characterized by sunguray katus. Upper forests in Kanikbong, south Rimbick and Raman blocks belong to this category. Oak-hamlock forests are encountered in the upper ranges of the Himalayan moist temperate groups.

(d) Alpine Forests corresponding more or less to birch and Rhododendron forests, which are found in Sandakphu.

12.05 Plain Forests

Riverain forests occur on sandy soils near river beds, the most important of which are the Acacia, Catechu, Dalbargia, Sissoo forests found along the beds of Tista, Sevok, Mahananda, Rakti, Balason, Mechi, Lish, Gish, Chel rivers. Different types and subtypes of forests are noticed here. Viz. Simul-Siris, Sal, Tun-Gamari, Khair-Sissu, Dry-Mixed and Wet-Mixed.

The Khair-Sissu forest appear where the on sandy soil near the river beds. Along the beds of the Tista Sevok, Mahananda Rikti, Balason and Mechi rivers. Pure Khair associated with a small number of Sissu is found while Siris, Kadam Pitali and Gamari appear to be very widely spaced.

SimulSiris : These forests appear further inland where soil is stable. Khair and sissu get gradually sparce and simul seris and some similar species form more or less open forest.

TunGamari : The soil here is richer and species appear in intimate mixture with those of the forgoing type. Species usually found are Tun, Gamari, Maina, Khira.

Sal forest : In the sal forest sal trees are grown on loamy soil in association with other species such a Pakassi, Chikrassi, Sidha, Kumbhi, Parari etc.

Dry mixed : forests occur on foot hills and on dry soil. Density of vegetation is much lower. Las is found scattered in this area. Wet-Mixed forests are found where water table is shallow and drainage is bad. The common species found are chapalish, lali. The crop density is thick and principal vegetations are evergreen. The undergrowth is dense and numerous climbers are found in this region.

12.06 Medicinal Plants

Medicinal plants are found in the plain forests are bask, akanda, dhutura, sati, afim and many others.

12.07 Agro Forestry

The term agro forestry may be defined as multiple landuse of an area simultaneously to meet the various needs of the cultivators by getting multiple outputs in a sustainable manner. The policy of govt. is to motivate farmers to plant grafts and enable them to supplement their income in years to come. The govt. is trying to increase the area under forest by planting trees by using some of the new terms like – agro-forestry, social forestry and farm forest. In addition to that medicinal forestry (Banerjee, 1982)[2]. Environmental forestry and trees outside forest (TOF) are used for success of the governmental programmes of the forestry. This can be partially done by planting commercially important fuel, fodder and fruit trees. This programme ensures good tree cover of environmental importance (Khatu, 1995)[3]. Agro forestry practices have been used all over the world but mainly found in tropics. By the end of 19th century mixed planting concept was used by the foresters. Geographers (Shah, 3000)[4] and environmental scientists have maintained that agro-forestry would occupy a pride in the 21st century and beyond. Since last few decades degradation of natural resources and degradation of natural resources and deforestation became an issue of the scientists. Hence, the need was felt of interplanting forest trees with food crops. Agro forestry yields, food, fodder, fruit, fuelwood and industrial raw material (Mughal, 2000).[5]

---

[2] Banerjee, B., 1982: Resource Utilization of Darjeeling Himalaya and Conservation of Ecology – Geographical Review of India, vol. 44, pp. 1-15.
[3] Khatu, K.K., 1995: Advances in Kharland Development in Gujarat and Maharashtra, The Deccan Geographer, vol.-33, No.-2, pp. 83-93.
[4] Shah, S. A., 1999: Forest Management Objectives in the Twenty First Century the Indian Forster, Vol. 126, No.-2, pp. 111-118.
[5] Mughal, A.H., Ara, Tabasum and Bhattacharjee, p. 2000: Socio-Economic Aspects of Agro-forestry in Rural Srinagar of Kashmir Valley, The Indian Forests, Vol. 126, No. 3, pp. 234-240.

It has been found in the Darjeeling district that during first two years of laying out a forest plantation, many food crops such as paddy, maize, and mustard combine with the forest trees such as Sal. After a few year, climbers, creepers herbs, shrubs are allowed to grow freely underneath the main forest area. After 15 to 20 years in the older plantation some minor crops such as ginger and turmeric are grown successfully. Cotton and ramic, a kind of tough natural fibres are found suitable as inter cropping in forest plantation. Introduction of indigenous species of economic plant like amlesho, narkat, ginger were introduced to establish an association for plantation activity with individual economic interests of Forest Protection Committee (FPC) members Medicinal Plant like *Chirata* have also been successfully introduced, as inter crops.

In addition to that agro-forestry may work as a supporting tool for livestock, the welfare of rural population and protection of environment (Shelton, 2000)[6]. Tree outside forest (TOF) (Kleinn, 2000) is of the opinion that trees outside forest (TOF) comprise tree formations ranging from single discrete trees to systematically managed trees in agro-forestry systems. Food and agriculture organization (FAO) of the United Nations defines TOF as "Trees on land not defined as forest and other wooded land". TOF land are classified as follows:

1) Trees in urban areas.

2) Trees in the core of urban areas.

3) Trees associated with permanent crops.

4) Trees associated with annual crops.

5) Trees associated with pastures.

6) Trees along railways, borders, roads, canals, creeks etc.

[6] Shelton, H.M., 2000: Tropical Forage Tree Legumes in Agroforestry Systems, Unasyalva Vol. 51, No. 200, pp. 25-32.

7) Trees along ponds, lakes, dams, playing grounds, research centres, agricultural universities, educational institutions etc.

8) Tree groups.

9) Trees on uncultivated land.

10) Trees on land with low management input.

Carucci (2000)[7] suggested the importance of TOF as the essential tools of controlling desertification. It may be mentioned here that trees are planted in various forms for the purpose of environmental balance, commercial use, natural protection for horticulture and to inhance natural beauty.

[7] Carucci, R. 2000: Trees outside Forests An essential Tool for Desertification Control in the Sahel Unasylva, Vol. 51, pp, 18-24.

CHAPTER – THIRTEEN

13.0 Population, Settlement including Agriculture

13.01 Population

Land is the ultimate asset of the nation and in view of the rapidly increasing population, land must be made productive to feed the additional month every year. The earth's resources, physiographic conditions and human population are inherently connected. The fundamental relationships are: people rely on food air and water for life. The earth's resources provide energy and raw materials for human activities and those activities in turn have an impact on earth's resource systems.

Population and resources have always been a matter of concern to the scholar of various disciplines with the increasing pressure of population and land resources, agriculture has by and large expanded horizontally and vertically. The changing pattern of land use as a result of increasing number of population could be realized in a micro level in a predominantly agricultural land. Agriculture is a very important resource of occupation in rural areas of Darjeeling district. It is relatively less important as a resource of employment compared to other plain areas of North Bengal. According to 2001 census (Table 13.01) the population of the Darjeeling district was 1299919 persons. In 2001 the number has gone up to 1605900. The density of population per square kilometer in 1991 was 413 but in 2001 the density of population has gone up to 510 persons per sq.km. It can be seen from the table 13.01 that density of population is highest in Siliguri Municipal Corporation and the number is 14160 persons per/sq.km. followed by Darjeeling Municipality and density is 10173 persons per square kilometers, Kurseong has 7934 density per sq.km. and Kalimpong has 4952 density per sq.km. However, in hilly areas of Rangli Rangliot density of population is lowest in the district. Excluding the municipality areas of the hill areas of Darjeeling district other regions of the hill shows low density of

DISTRICT-DARJEELING

Density of Population

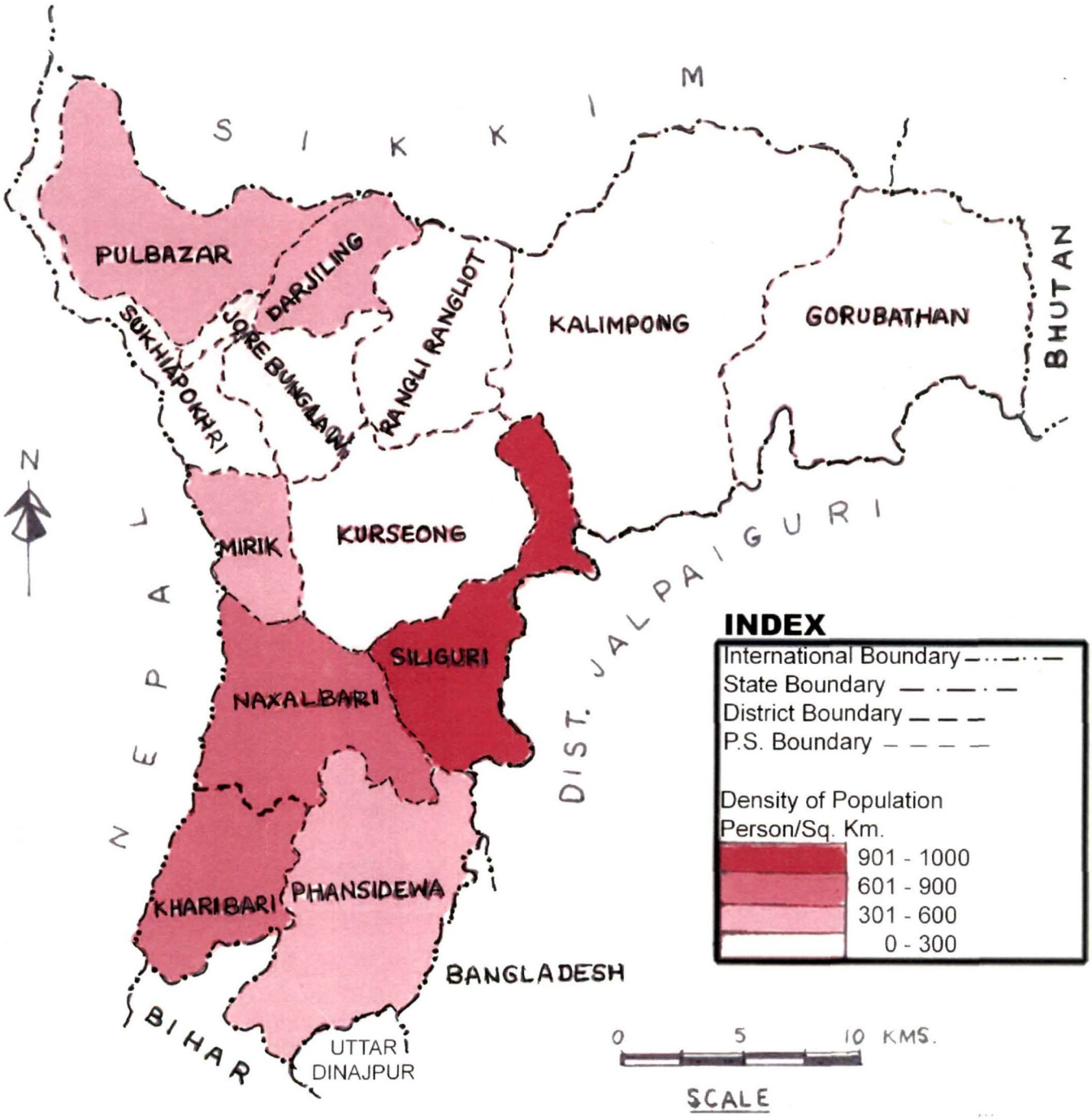


Fig- 13.1

population. In Siliguri subdivision density of population is lowest in Phansidewa (509 persons) and Kharibari (615 persons) Matigara and Naxalbari have more or less same density of population. Table 13.02 will given more idea about the growth of population by sex since 1901 till 2001 according to census of India 2001. Fig. 13.1 shows density of population in Darjeeling district.

Table 13.01

Area, Population and Density of Population in the District of Darjeeling, 2001 (P)

Sub-division/C.D.Block /M/MC/NA	Area in Sq. K.M.	Population (Number)	Density Per Sq.K.M.	P.C. of population to district population
Sadar Sub Division	915.09(P)	38821	424	24.08
Darjeeling/Pulbazar	212.71	115821	545	7.21
Rangli Rangliot	305.83	64296	210	4.00
Jore Bunglow-Sukhiapokhri	385.98	100674	261	6.27
Darjeeling(M)	10.57	107530	10173	6.70
Kalimpong Sub Division	1074.81(P)	225143	209	14.02
Kalimpong-I	321.16	67672	211	4.21
Kalimpong-II	303.00	60216	199	3.75
Gorubathan	441.97	54275	123	3.38
Kalimpong(M)	8.68	42980	4952	2.68
Kurseong Sub-Division	476.41(P)	176585	370	11.0
Kurseong	342.58	85109	248	5.30
Mirik	122.28	42230	345	2.64
Kurseong(M)	5.05	40067	7934	2.49
Mirik(N.A.)	6.50	9179	1412	0.57
Siliguri Sub Division	822.27(P)	815851	992	50.80
Matigara	140.60	126704	901	7.89
Naxalbari	181.51	144942	799	9.03
Kharibari	143.50	88206	615	5.49
Phansidewa	336.56	171384	509	10.67
Siliguri(M.C.)	20.10	284615	14160	17.72
District: 1991	3149.00	1299919	413	100.00
2001	3149.00	1605900	510	100.00

M = Municipality, M.C. = Municipal Corporation, N.A. = Notified area.
Source: Census of India, 1991 & 2001.

Table 13.02

Growth of Population by Sex on Different Censuses in the District of Darjeeling

Year	Total Population	Index with 1901 as base	Male	Female	No. of Urban females per 100 males	Urban	Rural	P.C. of rural population to total population
1901	265780	100	141697	124083	88	21393	244387	91.95
1911	279899	105	149636	130263	87	24579	255320	91.22
1921	294237	111	155014	139223	90	28703	265534	90.24
1931	332061	125	176551	155510	88	43479	288582	86.91
1941	376369	147	199891	176478	88	58167	318202	84.55
1951	459617	173	246738	212879	84	94481	365136	79.44
1961	624640	235	335036	289604	86	144637	480003	76.84
1971	781777	294	415442	366335	88	180212	601565	76.95
1981	1024269	385	542567	481702	89	282153	742116	72.45
1991	1299919	489	679323	620596	91	396060	903859	69.53
2001(P)	1605900	604	826334	779566	94	520877	1085023	67.56

Source: Census of India, 2001.

From the table 13.02 it is clear that the percentage of the rural population to total population in 1901 was 92 percent, till 1941 the figure was 85 percent. After independence the percentage was around 80 percent but gradually rural population has been decreasing. In 2001 rural population to total population in the district has gone down to 67.56 percent.

The growth of urban population in the district of Darjeeling has increased steadily over decades with varying growth rates from one decade to another. This higher rate of growth of urban population is mainly due to the fact that the hill areas of Darjeeling opened up by the British gave a number of opportunities to the immigrants. With the establishment of tea gardens new roads were constructed, new commercial centres as well as new settlement were started. The growth rate of urban population in the hill

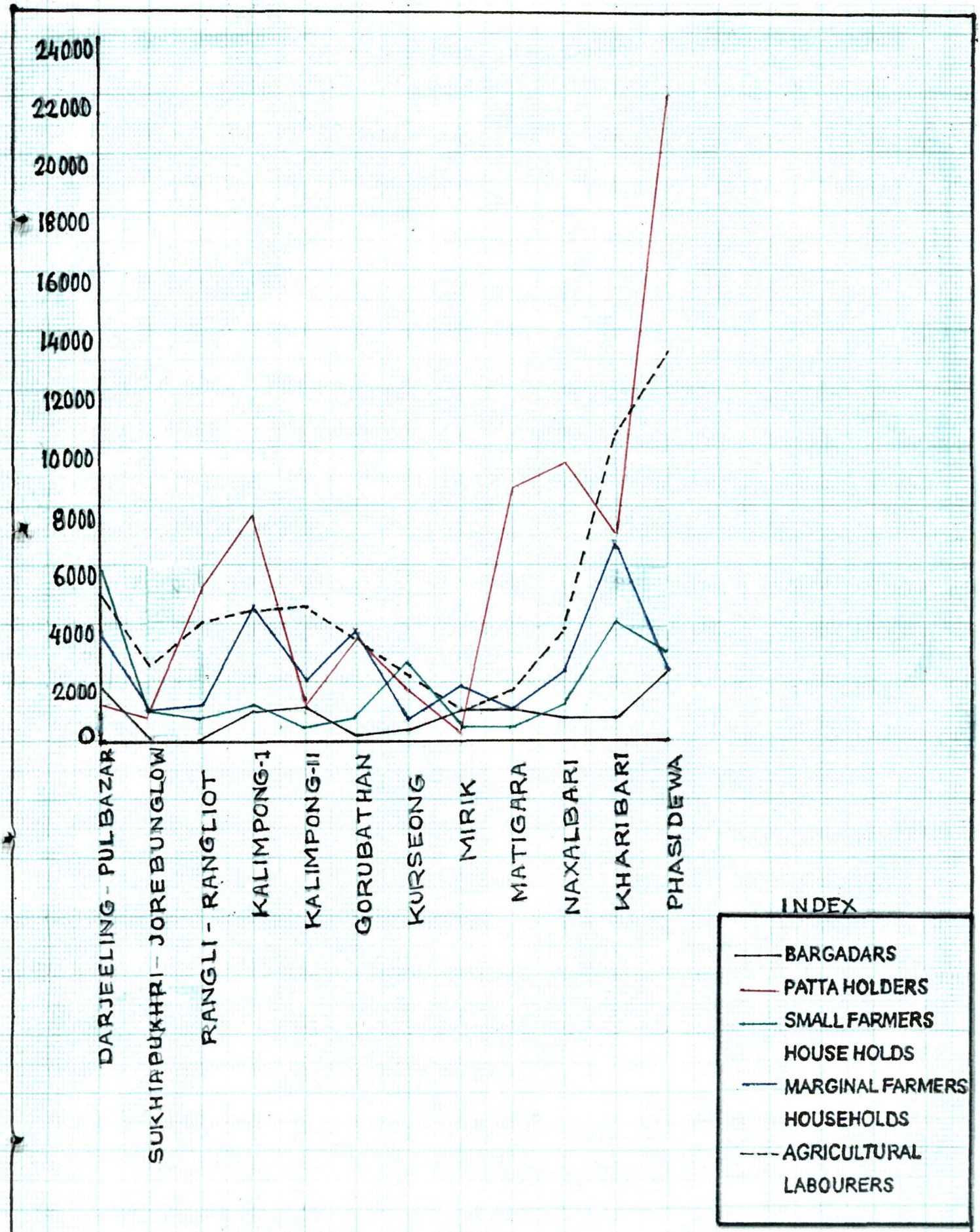


Fig. 13.2 **POPULATION FEATURES OF FARMERS IN THE BLOCKS OF DARJEELING FOR THE YEAR 2001-2002**

areas as a whole are found to be more or less stagnant during 1931-61. It has increased in 1981. The increase in the rate of growth of urban population can be explained by recent increase in the employment opportunities.

But the decline in the rate of growth population in the hill areas of Darjeeling in 1971 and from 1931 to 1961 is the result of establishment of Siliguri town in the 1931. In the same year the percentage of population in Siliguri town to the total population was 13.95 percent in 1981 due to immigration of people from near by states and hill areas of Darjeeling. Because of the strategic location of the Siliguri town which is an important trade centre of not only West Bengal but that of whole North-Eastern India is connected with different part of India by railway, roads and airways.

Population features of farmers in the blocks of Darjeeling is plotted in the table 19.03 and Fig 13.2 respectively.

Table 13.03
Population features of Farmers in the Blocks of Darjeeling for the year 2001-02*

(Number)

Sl. No.	Name of Block	Bargadars	Patta holders	Small farmers households	Marginal farmers households	Agricultural labourers (2001)
1.	Darjeeling-Pulbazar	1946	12139	5810	3795	5159
2.	Sukhipokhri-Jurebunglow	27	881	1051	1668	2675
3.	Rangli-Rangliot	115	5308	979	1327	4031
4.	Kalimpong-I	1116	7778	1248	4710	4441
5.	Kalimpong-II	1221	546	415	2156	4657
6.	Gorubathan	114	3524	885	3927	3650
7.	Kurseong	132	956	2789	851	2214
8.	Mirik	23	252	215	1986	1353
9.	Matigara	1008	8665	430	1105	1820
10.	Naxalbari	1676	9485	1128	2453	3960
11.	Kharibari	803	7147	4015	6862	10445
12.	Phasidewa	2221	22035	3088	2059	13182

Notes: 1. Marginal farmers household possessed agricultural land measuring upto 2.5 acres (7.5 bighas)
2) Small farmer household possessed agricultural land measuring more than 2.5 acres and upto 5 acres (15 bighas).
Sources: 1) Census of India, 2001. 2) B.L. & L.R.O., Darjeeling, 2002.

Table 13.03 shows Kalimpong I, Kalimpong II, Matigara, Naxalbari and Phansidewa have more than 1000 bargadars in each block. Pattaholders are highest in number in Phansidewa block (22035 pattaholders) Darjeeling Pulbazar has more than 12,000 thousand pattaholders of land. But Mirik block has only 23 Bargadar 252 pattaholders, and 215 number of small farmers. Other Blocks such as Phansidewa, Kharibari, Naxalbari, Kurseong, Darjeeling, Pulbazar have between 6000 to 2000 number of marginal and small farmers. The rest of the blocks have between 2000 to below 500 numbers of marginal and small farmers. Kharibari and Phansidewa have more than 10,000 agricultural labourers. Other blocks of the district have less than 5000 agricultural labourers Agricultural farmers gives an idea about the agricultural practices in the district. The plain blocks have more farmers and agricultural labourers and agriculture is practiced throughout year. Less number of agricultural labourers and small farms indicate that agriculture is not practiced extensively.

13.02 Settlement and Agriculture

The complex physiographic conditions occupy large part of the district of Darjeeling. Terrain altitude, drainage pattern, soil fertility and socio-economic factors have influenced the distribution of settlement patterns. In hill areas of the district rural settlements are found scattered and in great isolation. These settlements are mainly concentrated near rivulets or small streams in local term, which is known as '*jhoras*'. The scarcity of water in hill areas is one of the reasons for this type of settlements. There are 620 inhabited villages and 243872 households in Darjeeling district. Total number of inhabited villages and households are shown blockwise in Table 13.04.

Table 13.04

Inhabited Villages and Household – 1991

Sub-division	C.D.Block/M/MC	Inhibited Villages	Households
Sadar		**120**	**66274**
	Darjeeling-Pulbazar	48	22643
	Sukhiapokhri-Jorebunglow	43	18283
	Rangli-Rangliot	29	12123
	Darjeeling(M)	-	13225
Kalimpong		**96**	**34240**
	Kalimpong(M)	-	6853
	Kalimpong I	43	9513
	Kalimpong II	22	8915
	Gorubathan	31	8959
Kurseong		**68**	
	Kurseong(M)	-	4525
	Kurseong	57	15385
	Mirik(M)	-	1410
	Mirik	11	6670
Siliguri		**336**	**115368**
	Matigara	162	38070
	Naxalbari	-	-
	Khoribari	174	37827
	Phansidewa	-	-
	Siliguri(MC)	-	-
District		**620**	**243872**

Note: M = Municipality, MC = Municipal Corporation.
Sources: 1) Directorate of Panchayat W.B.
2) Census of India, 1991.

The rugged topography of the district of Darjeeling is a handicapped for the development of larger settlements. The northern hilly tract of the region has sparsely spaced settlements due to uneven surface, the presence of large forest areas and prevailing climatic conditions of the region. Hills with ridges, spurs, deep and wide valleys offer a settlement pattern strikingly different from each other. Statistical data available from the census of 1991 (Table 13.04) presents the settlement pattern of both hill and plain areas of Darjeeling. It has been observed that hill region has 284 number of inhabitated villages and plain areas of Siliguri Sub-division though it has less land area but number of inhabited villages are 336.

There is no general pattern in the distribution of different social and cultural amenities and therefore, no general pattern of settlement is found in villages of hill areas. Landuse in the ordinary villages of the hill region has no similarity with rural settlement of Siliguri Sub-division. In villages the entire settlement is surrounded by agricultural land. Other settlements in the village have developed within this village settlement and outer boundary of the village is not in a systematic manner. In Darjeeling district one to two houses form a hamlet. The houses are made of timber and bamboo, which are easily available. The roof is made of corogated iron sheets. The houses have one or two doors a few windows and varandah is found in most of the houses. There is no village in urban centers like Darjeeling Sadar Kurseong, Kalimpong due to low agricultural activity. Villages are found with cluster of houses in a few markets to which people go for their weekly purchase.

In hill areas of Darjeeling settlements have grown in a dotted fashion following the national highway and district roads. The presence of mountains and hills in this area has limited land available for cultivation and agricultural productivity is very low. However, administrative, commercial and civic amenity services occupy central locations. Though their number is insignificant. For example, concentration of settlement is observed in market areas of Takdah, Pulbazar hat, Mirik, Reshi hat, Budhbari hat, Dhangia Bazar and Singla Bazar. Bijanbari, Sonada, Sukhiapokhri,

Tindharia have major road links with administrative center and have some settlements which are more urban in character. In plain areas of Siliguri Sub-division dotted patterns of settlements are found along the National Highways, State High Way, district road, unmatalled roads and Hill Cart road. In various mouzas of the region a number of houses are found to be clustered together in one place consisting one hamlet separated from similar hamlet by a tract of agricultural land. Excluding tea gardens and some urban, semi-urban centers settlements are found around market centers or along the roadside. In villages land is dotted with many hamlets with individual cultivated land and all hamlets are linked by kuccha or unmetalled road. This type of loosen pattern is termed as amorphous pattern of settlements. (Singh 1965)[1] Siliguri Sub-Division is also covered with some patches of forest settlements.

13.03 Types of settlement

There are some broad divisions of settlements observed in Darjeeling district. These are plantation settlement, Forest settlement, Khasmahal settlement, market settlement agricultural settlement and urban settlement. Tea plantation predominates in Kurseong and Darjeeling Sub-divisions. Occupying 16.19 p.c. and 12.12 p.c. of the total land area respectively There are 49 tea gardens in Darjeeling and 35 in Kurseong. The rural character of settlement is observed in tea gardens. There are 26 tea gardens in Terai region. The tea garden settlement is self sufficient and provided with primary schools and co-operatives etc.

There are about 50 government estates known as Khasmahal in Kurseong. The government has distributed Khasmahal areas and house sites to landless cultivators and thus the area is becoming populated. Major part of Kalimpong Sub-division is covered by forests. Yet the number of forest village is only 11. These villages are established by the forest department in the fringe areas of the forests and villagers are employed in different activities of the forest. There are 33 forest villages in Darjeeling and its in Kurseong. The low density of population has resulted in dispersed

[1] Singh, R.L., 1965 : The Terai Region of U.P. : A Study in Human Geography, University of Allahabad, India, p. 159.

settlements in this region. Some forest settlements are also observed in Siliguri sub-division. Market settlement in hill areas are situated along the trade route and also by the side of the roads joining the main road leading to plains. As it has already been mentioned that market settlements are found in Takdah, Pulbazar hat, Mirik region. In plain areas as well as in hill areas concentration of commercial activities are on main roads which divides settlement almost into two halves. Agricultural settlements are surrounded by the agricultural land in the villages. This type of settlement is observed throughout the district. In urban areas road plays a vital role in the distribution and development of settlements. Residences are built by the side of the main roads and are also found in the areas served by lanes,commercial areas occupy the two fronts of the main roads in urban settlement. It may be concluded that the northern hilly tract of the region presents sparsely spaced settlements because of the relief and large tract of forest cover. Agricultural activities are mainly governed by the environmental conditions of the region. The plain areas of the district are densely populated and cultivation is practiced throughout the year except in urban areas.

PART – THREE

APPLICATION IN NATIONAL ECONOMY

CHAPTER – FOURTEEN

14.0 Comparative Study of the Existing Agricultural Practices in Hills and Plains

In this chapter an attempt has been made to analyse the comparative landuse pattern of hill and plain areas of Darjeeling district.

The Darjeeling district primarily consists of two distinct units – (1) Hill areas in the north consist of three subdivisions and (2) Siliguri Sub-division, which is a plain area, lies in the south. The total area of the district according to 2001 census is 325469 hectares. The hill area has three Sub-divisions viz., Darjeeling sub-division, Kalimpong sub-division and Kurseong sub-division. These sub-divisions have eight blocks. The Siliguri sub-division has only four blocks. (Fig. 14.1)

The hill area occupies 2466.31 sq.kms. of the total district area. Siliguri sub-division has 822.27 sq.kms. geographical areas. Altitudinal variation ranges from less than 100 m. to more than 3600 m. in the district.

The pattern of agriculture within the district changes from one place to another due to varied physiographical conditions. The types of corps cultivated are also different from one block to another. As a result there is a wide variations in the production and yield rate of crops.

The crops of the district of Darjeeling can be broadly catagorised into two groups – plantation crops like tea and orange and non-plantation crops like rice, wheat, maize, millet, potato, barley, pulses, oilseeds and jute.

In order to assess the progress and expansion of agricultural sector an attempt has been made to study Hill agriculture and plain agriculture separately

DISTRICT DARJEELING
SHOWING HILL AND PLAIN AREAS

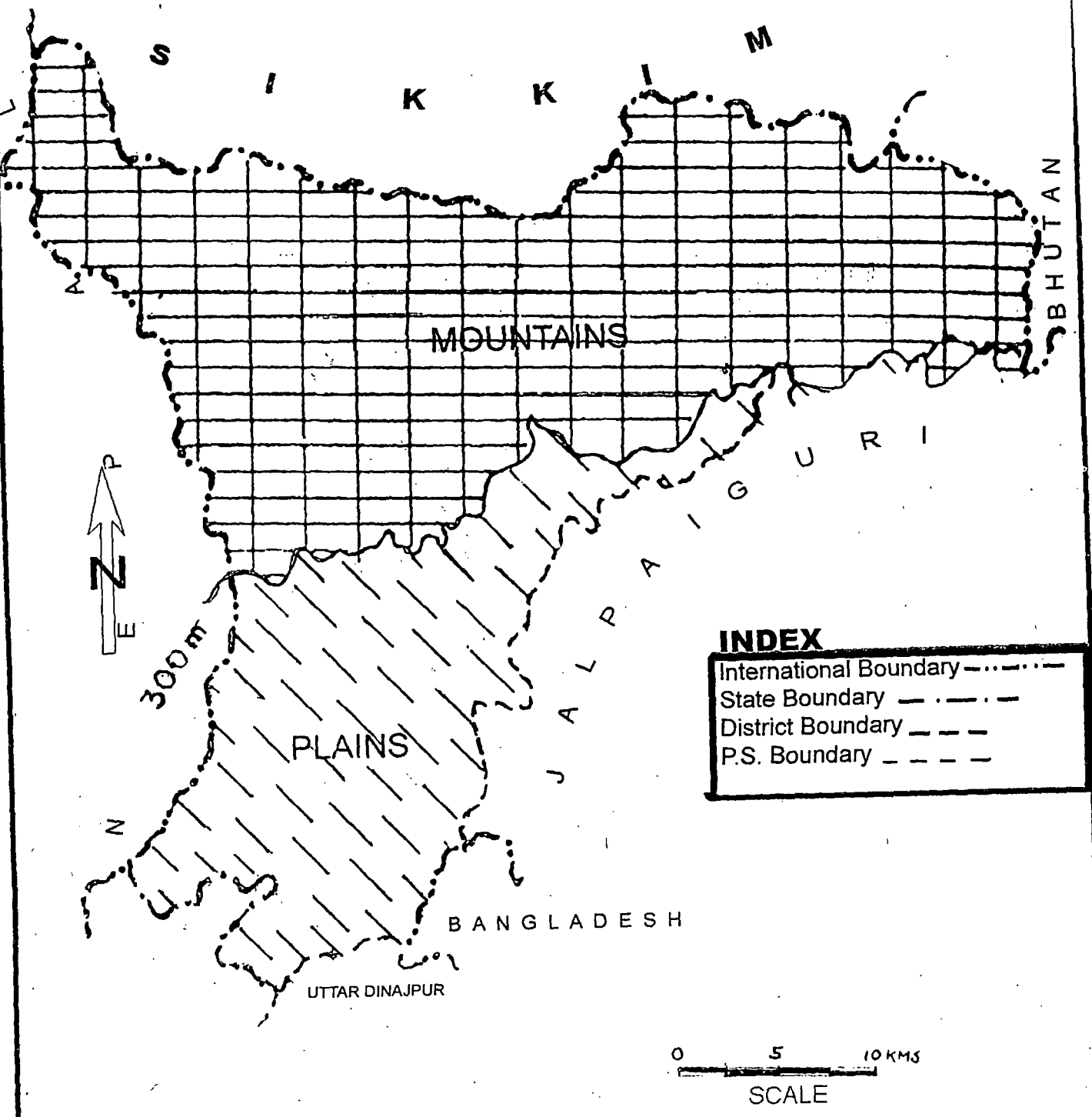


Fig- 14.1

Geographical area of the Darjeeling hill is much bigger than the plain area of the district. Land available for cultivation is extremely low in hill area than the plain area of the district. The use and distribution of land in the hill and plain areas of Darjeeling are given in Table 14.01 and 14.02 respectively.

Table 14.01

Use and distribution of land (in hect.) in the hills of Darjeeling

Name of Block	Net area under cultivation	Area under pasture and orchard	Cultivable waste land	Home stead land	Forest land	Area in which more than one crop grown
Darjeeling-Pulbazar	5855	770	440	1425	623	4240
Sukhia Pokhri – Jore Bunglow	-	-	-	-	1072	-
Rangli Rangliot	295	152	32	3	15248	404
Kalimpong I	28135	11637	2295		9332	326
Kalimpong II	10547	-	324	150	-	-
Gorubathan	2504	3010	650	257	3289	3192
Kurseong	3845	111	821	160	466	5482
Mirik	4588	100	1121	7	7360	-

Source: District Statistical Handbook, 2002.

Table 14.02

Use and distribution of land (in hect.) in the plains of Darjeeling

Name of Block	Net area under cultivation	Area under pasture and orchard	Cultivable waste land	Home stead land	Forest land	Area in which more than one crop grown
Matigara	5538	32	310	370	33	33
Naxalbari	6605	-	90	-	4173	-
Kharibari	2085	11	13	13	2196	20819
Phansidewa	-	-	-	-	1397	-

Source: District Statistical Handbook, 2002.

Area available for cultivation in the hill region is 55769 hectares. Pastures and Orchard occupy 15780 hectares of land followed by 37390 hectares of forests. Cultivable waste occupies 5683 hectares of land. Net area under cultivation and area cropped more than once are 55769 and 20852 hectares respectively.

In plain areas 14228 hectares of land is under cultivation. Pastures and Orchard occupy 43 hectares; and cultivable wasteland covers an area of 413 hectares. Forest occupies 7799 hectares of land and in 20852 hectares of land crops are grown more than once.

Topography and altitudes of the hill and plain area of Darjeeling is different from each other. Altitudinal variation of the hill area ranges from 312 m. to 3600 m. altitude has immense influence on the nature of the cultivation in the hill areas of Darjeeling. In higher altitude, the higher the production of potatoes, and barley and in lower altitude maize, paddy, millet and vegetables are grown.

Most of the cultivated areas are located between 312 m. to 625 m. The local climate depends largely on the elevation. On account of the hilly nature of the terrain there are sharp variations of temperature and rainfall between nearby areas. However rainfall is generally heavier in the southern Terai, ridges and slope near the plains. Owing to adverse physical conditions in the hills such as – steep mountains, heavy rainfall, land slip and soil erosion etc; cultivation is carried out with the greatest difficulties. The relief of the plain area represents nearly level land. Climate of the plain is also different from hill region. On the plain areas hot to warm weather remains for nearly nine months and rainfall is generally heavy between May to September.

In hill areas of the district 37390 hectares of land is under forest cover whereas 7799 hectares of land in the plain areas is under forest cover.

The area available for cultivation in the hill areas of the district is very less and constitutes about 17 percent of the total area of the district. In plain area a little more than 4 percent area is under cultivation. In Pulbazar, Rangli-Rangliot, Kalimpong I,

Gorubathan and in Kurseong blocks more than one crop is grown in total area of 13644 hectares. In plain area of Kharibari 20819 hectares of land is utilized for growing more than one crops. This shows the intensity of cropping pattern in plain area. In Matigara Block more than one crop is cultivated in 33 hectares of land.

In table 14.03 a comparison of the area and yield rate of some selected crops between the hill and plain areas of Darjeeling district is given. The study period covers 1993-94 and 2001-2002. In order to assess agricultural development in hill and plain areas, some crops have been selected for the study.

Table 14.03

Area and yield rate of some selected crops, 1993-94.

Name of Crop	Hill		Plain	
	Area in '00 hect	Yield kg/hec.	Area in '00 hect	Yield kg/hec.
Rice				
a) Aus	1.3	2524	83	3222.12
b) Aman	62.7	12369.32	289.6	2781.01
c) Boro	-	-	3.8	3173.63
Wheat	2.3	6046.42	49.5	3971.42
Potato	37.7	94428.85	07.7	24995.68
Mashkalai	-	-	0.8	644.47
Mustard	1.1	631.92	6.7	1263.84
Jute	-	-	25.2	13.7
Linseed	1.9	-	-	-
Till				

Table 14.04

Area and yield rate of some selected crops, 2001-02.

Name of Crop	Hill		Plain	
	Area in '00 hect	Yield kg/hec.	Area in '00 hect	Yield kg/hec.
Rice				
a) Aus	0.1	2159	61.4	8936
b) Aman	37.3	14568	251.4	9999
c) Boro	-	-	10.3	12660
Wheat	0.8	3096	29.8	5619
Potato	29.3	124123	19.3	56103
Mashkalai	0.9	844	1.7	1696
Mustard	-	-	0.8	2641
Jute	-	-	28.7	43
Linseed	-	-	0.6	198
Till	-	-	2.1	1461

Source: District Statistical Handbook, Govt. of W.B., 2002.

Rice

Cropwise analysis of data shows that aman rice is grown in all the hill blocks except Sukhiapokhri and Mirik. In April and May seeds are sown in seed beds and in July or August transplantation takes place to terrace land. Crops are harvested in December. Aus rice cover an area of 0.1 hundred hectares and yield rate is 2159 kg./hec. Aman rice in the plain covers an area of 250.4 hundred hectares and yield rate is 9999 kg./hec. Aus is sown in 61.4 hundred hectare and yield rate is 8936 kg.hec. Boro rice is also grown in the plain area of the blocks namely Matigara, Naxalbari, Kharibari, Phansidewa. The ideal cropping pattern implies farming activity throughout the year. In the plain areas multiple cropping is possible because of fertile land and improved irrigational facilities and use of fertilizer.

Wheat

Available data for 2002 shows that wheat is grown in 0.8 hundred hectares of land in the hill area. Yield is 3096 kg./hec. and is grow only in Kalimpong and Kurseong blocks of the hill region. It can be seen that in all the block of plain area wheat is cultivated in 29.8 hectares of land and yield is 5619 kg./hec.

Potato

Potato is the most important cash crop of the hill region. This crop gives good return in all the hill blocks. There is a great demand for Darjeeling potatoes. Total area is available for potatoes are 29.3 hundred hectares and yield rate is quite high, as good as 124123 kg. per hectare. In plain areas potato is cultivated in all the four blocks of Siliguri sub-division. In 19.3 hundred hectares of land 56103 kg./hec. potato is cultivated.

Maize

Maize is the most important crop of the hill area. It gown in almost all the blocks of the district. Seeds are gown either by broad casting or sown in rows. The crops are harvested in August or September. Maize is also grows in plain areas of Darjeeling.

Millet

Another important crop of the hill area. It is sown in April and May and harvested in October.

Mashkalai

This crop grows in 0.9 hundred hectares and yield is 844 kg. per hec. In Kharibari and Phansidewa blocks, maskalai is cultivated successfully. The area devoted to this crop is 1.7 hundred hectares and yield is 848 kg./hec.

Mustard

Cold weather crops in the hill areas are buckwheat mustard, barley and sugarcane. Barley and mustard are cultivated in very small areas of the hill. Area under mustard seeds is 0.8 hundred hectares and yield rate is 2641 kg./hec. in plain areas. This crop is sown in Matigara, Naxalbari and Phansidewa blocks.

Linseeds and Til

These crops require warm temperature. Except Matigara block Til is cultivated in other three blocks of the plain area. Linseed is not very significant so far area is concerned and yield is 1461 kg./hec.

Fruits

A large variety of fruits such as orange, plums, peaches, guava, apples are grown in hills. Oranges of Darjeeling, especially Mirik block is famous for its sweetness and aroma. In plain areas oranges are grown but they are of not of very high quality.

Vegetables

Seasonal vegetables such as peas, beans, carrot, radish, turnip, leafy vegetables, squash, ginger and chilies are extensively grown in hill region. Different types of vegetables such as bitter gourd, carrot, sweet gourd, tomato, bringal, ladies finger and many more are cultivated in fertile soil of Siliguri division. Cardamom is grown some blocks of hill areas.

Tea

Tea plantation predominates in Kurseong and Darjeeling sub-division occupying 16.19 percent and 12.12 percent of total area respectively, the corresponding figure in Kalimpong sub-division being 1.6 percent. Tea is also grown in plain areas of the

district. The total amount of tea grown in the district is from the period 1998 to 2002 is shown in table-14.05.

The yield rates of tea and jute from 1998 to 2002 are given in table 4.05.

Table 4.05

Yield Rate of Tea and Jute

'000 hectare (kg./hec)

Product	Area	1998-99	Area	1999-00	Area	2000-01	Area	2001-02
Tea	26.3	2036	26.3	1838	18.2	2771	35.6	1736
Jute and Mesta	2.4	9.1	2.3	9.8	2.2	8.1	2.9	10.8

Source: District Statistical Handbook, Govt. of West Bengal, 2002.

The total area under tea activation is 35.6 thousand hectare of the total area of the district. The table 4.05 shows decreasing trend in tea production with occasional variation. In 2000-01 the yield rate of tea was much higher than previous two years. It may be mentioned that due to clouser of some tea gardens in recent years, the production is showing a decreasing trend. The total but area has increased and production has decreased due to labour unrest and clouser of tea gardens.

Jute

Jute is the most important crop of Siliguri Sub-Division. It grows in 2.9 thousand hectares of land but the area is increasing every year. For example it was 2.3 and 2.4 thousand hectares of land allotted for jute cultivation in 1997 and 98 respectively. Similarly yield rate of the crop is also showing an increasing trend. It may be mentioned here that good climatic condition and use of improved fertilizer is responsible for the high rate of yields.

Method of Agriculture in the Hills vary with the crops selected for the cultivation. Food crops are grown both in dry and wet cultivation. Dry cultivation or in local term 'sukkakhet' does not receive irrigation. Crops grown in dry cultivation are maize and

buckwheat which is an inferior kind of millet. For dry cultivation manuring is essential and cow dung and little quantity of fertilizer is also used. Agricultural tools and implements used are 'hoes and kodalies where ploughing is not possible. Weeding and harvesting are done by the farmers and their family members. Neighbour also help in a reciprocate basis. Wet cultivation is practiced in plain areas. Aman or winter rice is first sown in nurseries, in May or early June after the first rainfall. The fields in which the seedlings are to be transplanted in July or August have in the meantime been heavily ploughed and surrounded by 'alis'. 'Bhadoi' crops are grown on higher land and ploughing begins in February and the land is ploughed for five to six times. Weeding is done and fields as then leveled. Germinated seeds are grown in the field and the crop is harvested in August. Due to non-availability of agricultural inputs, traditional methods of cultivation are followed both in hill areas as well as in plain areas of the district. However, recently many big farms are using tractors and harvesting machines in plain areas.

Agriculture laboures and number of cultivators both for hill and plain areas of the Darjeeling are plotted in table no 14.06 and 14.07 respectively.

There are 60548 cultivators in the hill areas of which 22410 are in sadar sub-division followed by 32489 in Kalimpong and 5649 farmers in Kurseong division. Kalimpong II has the highest percentage (20.76 p.c.) of cultivators. The percentage of cultivator in other blocks are – Kalimpong-I 18.41 p.c., Darjeeling-Pulbazar 14.38 p.c. and Gorubathan 13.77 p.c. Other hill blocks have less than 6 p.c. cultivators. Kalimpong also has 12849 agricultural labours. Sadar sub-division and Kurseong has 11892 and 3618 laboures respectively. As the farmers are more in number, agricultural laboures are also highest in Kalimpong division. There are less than eight percent of agricultural laboures in all the blocks of the hill area. But Mirik block has the lowest number of farmers and agricultural labourers.

Table 14.06

Percentage distribution of population according to different categories of workers and non-workers in the district of Darjeeling, 2001(P)

(Population in number)

Sub-Division/ C.D.Block/ M/MC/NA	Total workers		Class of Total Workers			
	Population	P.C.	Cultivators		Agricultural laboures	
			Population	P.C.	Population	P.C.
Sadar Sub-Division	133235	34.31	22410	5.78	11892	3.06
Darjeeling/Pulbazar	45539	39.31	16658	14.38	5.59	4.45
Rangli Rangliot	20810	32.36	3342	5.29	4031	6.26
Jorebunglow/ Sukhiapokhri	33819	33.59	2381	2.36	2675	2.67
Darjeeling(M)	33067	30.75	21	0.02	27	0.02
Kalimpong Sub-Division	87319	38.78	32489	14.43	12849	5.71
Kalimpong-I	27163	40.14	12461	18.41	4441	6.56
Kalimpong-II	24054	39.95	12503	20.76	4657	7.73
Gorubathan	22708	41.84	7475	13.77	3650	6.72
Kalimpong(M)	13394	31.16	50	0.12	101	0.23
Kurseong Sub-Division	59327	33.60	5649	3.20	3618	2.05
Kurseong	30228	35.52	3374	3.97	2214	2.60
Mirik	15874	37.59	2273	5.38	1353	3.20
Kurseong(M)	10162	25.36	2	0.00	7	0.02
Mirik(N.A.)	3063	33.37	0	0.00	44	0.48

Table 14.07

Siliguri Sub-Division	286791	35.15	22129	2.71	29470	3.61
Matigara	45846	36.18	1379	1.09	1820	1.44
Naxalbari	48702	33.69	3681	2.54	3960	2.73
Khoribari	33972	38.51	7957	9.02	10445	11.84
Phansidewa	61930	36.14	9050	5.28	13182	7.69
Siliguri(M.C.)	96341	33.85	62	0.02	63	0.02

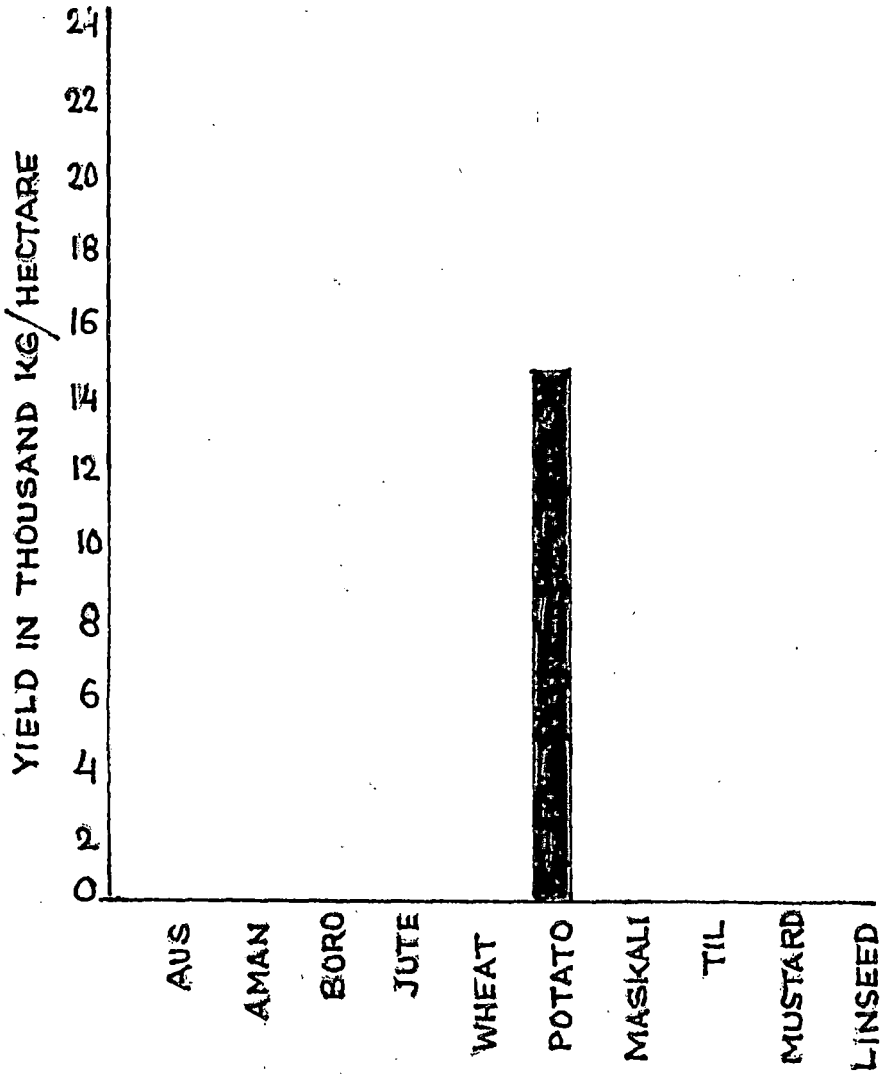
Source: District Statistical Handbook, 2002.

It can be attributed that less number of farms, farmers and labourers are due to the presence of many tea gardens in the hill areas. Majority of the people earn their livelihood from tea plantation and are associated directly or indirectly with the tea cultivation.

In plain areas of the district, total number of cultivators are 22129 according to 2001 census. Though Siliguri has less geographical area as compared to hill areas but more people are engaged in cultivation. Phansidewa blocks has 9050 farmers followed by Khoribari 7956, Naxalbari 3681 and Matigara 1379. Khoribari has 9 p.c. of farmers and Phansidewa 5 p.c. Matigara and Naxalbari together account for a little more than three percent of cultivators. Khoribari again has 12 p.c. and Phansidewa 8p.c. of agricultural laboures. Other two blocks have less than 3 p.c. of agricultural laboures.

As most of the agricultural farms are small in size and peasants are poor, subsistence farming is still prevailing in hill areas of Darjeeling. The average size of holding is less than 2 hectares in plain areas. Majority of the cultivators belong to the category of marginal farmers. Large farms are very few in the district. After independence the land area has a tendency to get smaller and smaller, per cultivating household. It may be mentioned that per capita income of the hill people is low and lower than the plain people of Darjeeling district.

Due to certain physical and economic constraints, the development of irrigation is not possible in hill areas of Darjeeling. Fields are irrigated by spring water. With the onset of monsoon the availability of spring water increases and decreases gradually. The water from spring collected into 'kholas'; the water of this 'kholas' are taken into channel and used for irrigation, only if they are flowing at higher level than the area to be irrigated. Well-defined irrigated channels exist only in paddy fields. Irrigation in vegetables and other crops are done carefully. Cardamom, an important spice of the hill is grown undershade. This spice requires moist climate. Water from khola is allowed to flow from top to the field and spread mostly by itself. Though recently,



SUKHIPOKHRI JOREBUNGLOW
2001 - 2002

Fig. 11.4.

the number of deeps tubewell is less and area irrigated is proportionately less. In 2002, 231 hectares of land was cultivated by deep tube well. 17 number of deep tubewells are operating in the hills area.

The plain areas of the district, river lift irrigation are the most popular means of irrigation. There are 61 'river lift irrigation projects', which are used by the farmers. In this area 3240 hectares of land is irrigated by this source.

Table 14.08

Roads in the Blocks of Darjeeling for the year 2001-02

(in km.)

Name of Block	P.W.D.		Zilla Parishad	
	Surfaced	Un-surfaced	Surfaced	Un-surfaced
Darjeeling/Pulbazar	68	-	307	641
Jorebunglow/ Sukhiapokhri	53	-	25	77
Rangli Rangliot	46	-	30	60
Kalimpong-I	65	-	18	131
Kalimpong-II		-	26	90
Gorubathan	41	-	13	100
Kurseong	59	-	66	4
Mirik	24	-	24	67
Matigara	31	-	35	176
Naxalbari	29	-	40	125
Khoribari	40	-	10	94
Phansidewa	30	-	8	113

Roads of Gram Panchayat and Panchayat Samity included in Zilla Parishad.

Sources: 1) Ex. Engg., P.W.D. (Roads).
2) Ex. Engg., Zilla Parishad.
3) Local Bodies (D.G.H.C.)
4) Dist. Panchayat Officxer, Darjeeling

Khoribari has 135 shallow tubewells and Phansidewa 47. Total area irrigated by these wells are 454 hectares.

Hill areas of Darjeeling has both surfaced and unsurfaced road maintained by the P.W.D. and Zilla Parishad. There are 356 kms. of surfaced roads and 1170 km. of unsurfaced roads.

In plain areas of the district 130 kms. are surfaced roads and 508 are unsurfaced roads.

There remains wide interblock variations in cropping pattern and cropping intensity in the district of Darjeeling. It is to be however, noticed that the possibility of increasing the cropping intensity is limited both in hills and plain areas owing to the scarcity of land rugged terrain and restricted scope of irrigation. Yield rate of principal crops vary from place to place within the hill areas. Potato and maize are dominant crops of the hill area and give highest yield rate because of introduction of high yielding varieties of seeds. The rise in production, thus is evident basically due to the rise in yield rates rather than the increase in areas. Though as compared to 1994 the area for potatoes has gone down by 8 hundred hectares. It is not possible to compare the yield of maize and its production due to non-availability of data. The total cropped area for rice in 1994 was 53 hundred hectares in 2002 the area under rice has gone down to 37 hundred hectares. But due to improved varieties of seeds and development in the irrigational facilities, use of fertilizer the production has substantially increased from 9845 kg. to 14568 kg./per hectare.

In the plain areas of Darjeeling production of aman and aus rice has increased but area has been decreasing. This may be due to pressure of population, demand for foodgrains, mechanization of agriculture. During the last eight years the area has been decreasing for potatoes but production is showing upward trend. During the 1993-94 7.7 hundred hectares of land produced 24995 kg. of potatoes per hectare. The study

period of 2002 shows the production of potatoes has gone up to 56103 kg. per hectare in 2002. simultaneously widespread availability and use of chemical fertilizers and improved irrigational facilities have gone a long way in enhancing the productivity of some food crops such as rice in the plain areas of Darjeeling. Jute is an important crops of the plain area. The data indicates a general decreasing trend in jute cultivated area but the production is showing an increasing trend. It is not possible to compare the production of tea and orange due to lack of data.

In the hilly areas of Darjeeling the primary concern of the peasants to produce their own food crops in their own household farm. Only a few peasants can afford to divert their land to cash crops because the cost of food items in the hill area is high, supply is uncertain and prices fluctuate. Accordingly, only relative big farmers after producing their annual requirements of food, put the remaining part of the land to the production of other crops. A remarkable change took place in case of orange and some temperate fruit crops. Increase in areas under fruits in the hill areas of Darjeeling district has far reaching effects, as it will generate some employment and more income for the people.

CHAPTER – FIFTEEN

15.0 Agriculture Practises in National Economy, Plan Period analysis and its Future Prospects Through agro-geomorphological Regions.

The role of agriculture is very important in Indian Economy. So it is high time that the Government should look into the matter for the development of agricultural practices in hills and plains of Darjeeling district from the data it is clear that agricultural development in hill areas is abnormally low due to its terrain constraints. It has been said in tenth five-year plan (2002-07) the 8% of national income will increase every year. To make it practical, it is necessary to increase agricultural products by 4% annually. It may be noted that it does not mean only the agricultural but the agricultural and allied activities i.e., agriculture and related areas that indicate the increase of overall field. It is clear that India is proceeding towards self-sufficiency but disparities are plenty in case of uniform developmental scenario in every administrative units or geographical units of the district. It has been observed that all the peasants are not uniformly well established and development of different agricultural products is different. Lastly task of infrastructural facilities and financial potentiality, various types of control, bring down the development of this primary sectoral activity. From the gist of the report of the M.S. Swaminathan Committee or steering group on agriculture and allied sectors submitted in January, 2002 it is seen that 11 different task forces have been formed for different problems in agricultural sectors. Over and above in 2000 special task force had been designed for agriculture under the Chairmanship of Sharod Joshi. So there is no controversy regarding the problems in agriculture (as revealed from different reports) but what is the solution ? How can it be renovated ? The following problems have been identified so solutions also may be designed later on. The problems are as follows : (1) It has been observed that 25% of national income comes from the agriculture and 69% of the people of the

district depend on this national income, (2) Production and productionability have been increased at the end of sixties due to high quality seeds, pesticides, and precision instruments have been used irrigation facilities, supply or electricity, communication facilities, market facilities have been added with this. But it is not the over all picture. These facilities did not reach everywhere of the district. Only about 45% of the land of the district comes under the purview of irrigation facilities particularly in the plains. It can be well estimated about the precarious condition of the hill areas of the district. Even in hill areas of Darjeeling district, *rabi crop* can not be produced smoothly. (3) Agricultural loan is not available readly.Bank has been directed that 18% of the loan year marked for the priority section should be directed to agriculture but in practice it is only 12% or less. Kisan credit card has been issued to the peasants but it is very difficult to say, how far the poor peasants will be benefited by this. (4) The constraints of fund have become the menace for agricultural development of the district. The Government Fund of the D.G.H.C. in case of irrigation, transport, research, development and application of technology has been reduced to a great extent.

(5) Control or embargo has been imposed on production, storage and marketing in terms or technology and exchange of agricultural products too.

(6) The development of agriculture or primary sector does not come only from the production of food and other crops only. So diversification in agriculture is necessary e.g., cultivation of fruits, flower, poultery, fishing is encouraged inspite of many constraints. It has been observed that a sizeable amount of produced crop is lost due to non-availability of timely cold storage and processing practices. Ultimately frustration among the peasants has become acute thereby restricting the growth in this sector.

Diversification and rate of increase production, particularly food grain and other crops have been reduced during ninetees. More water has been used in agriculture without thinking about its proper utilization. Rainwater has been misused without making any arrangement for rainwater harvesting. Due to unwise and excess use of fertaliser some

land has been declared degraded for agricultural use. The income of the peasants has reduced due to these factors.

The government's financial help in agriculture in Darjeeling district is a matter of discussion in this context. Subsides have been given in electricity, water and fertilizer. Minimum support price has been introduced in the tenth five-year plan and the rich peasant have benefited a lot out of this practice. So there is enourmous inequality in applying the principle for agricultural development.

Some fruitful suggestions may be placed for solving the problems in the near future considering the miserable condition of agricultural practices and productions, particularly in hill areas.

(1) Subsidies should be given to the needy peasants only (BPL).

(2) Non-Government organizations along with FCI have been empowered to collect food grains.

(3) Instead of subsidy the Govt. should help financially for the development of infrastructure in the villages.

(4) Tax should be imposed on agricultural income.

(5) Restriction should not be imposed on the production, storage, marketing and use of technology to check the entry of multinational entrepreneurship.

(6) Decision should be taken about the contract cultivation or corporate cultivation.

(7) Land market should not be opened completely.

(8) The gene-transplantation system may be introduced to cater the needs of the present demand and thereby bringing about new dimension in agro diversity in North Bengal particularly in the Darjeeling district in the age of globalisation

to save extinct seeds as mentioned in a statistical account of Bengal, 1864 by William Wilson Hunter.

(9) There is enough of scope for crop diversification in the soil of this region that may strengthen the economy of North Bengal as a whole and Darjeeling in particular (as expressed by Mrs. Joke Mayabik, the ex-ambassador of Netherlands in a Seminar, organized by center for the Development initiatives in 31.01.2004.

(10) For ascertaining the crop diversification Bhatia (1965)[1] formula

(Icd = %THAc/Nc) should be taken into consideration.

Where Icd = Index of crop diversification

THAc = Total harvested areas of crops Nc = Number of crops.

(11) For the measurement of the level of production, the crop yield and concentration indices ranking co-efficient may taken into consideration. The procedure may be expressed as follows :-

$$Yi = \frac{Ya_c}{Ya_r} \times 100 \text{ and } Ci = \frac{Pa_c}{Pa_r} \times 100$$

Where Yi	=	Crop yield index
Yac	=	av. Yield / hectare of crop 'a'
Ci	=	Crop concentration index
Pac	=	% strength of the crop 'a' in the unit
Par	=	% strength of the crop 'a' in the region

$$\text{Crop yield and concentration Indices ranking coefficient For crop 'a' (RC)} = \frac{\text{Crop yield Index ranking of crop 'a'} + \text{Crop concentration Index ranking of crop 'a'}}{2}$$

[1] Singh, Jasbir (1976) : An agricultural Geography of Haryana, pp. 309-319, Vishal Publication, University Campus

The results thus derived will give us an idea of the level of agricultural production. $Rc = \frac{1}{Pr\,oduction}$; it means that the ranking co-efficient is lower, then the higher will be level of agricultural production.

(12) For measuring the level of agricultural production a new technique comprising, nine broad approaches should be considered :

a. Value of agricultural production/unit area

b. Production / unit of farm labour

c. Input-output ratio and profitability of farming.

d. Production in terms of grain equivalent / head of population.

e. Output / unit area (ha).

f. Ranking order of land in terms of population.

g. Index of productivity.

h. Index number of agricultural efficiency per unit area.

(13) 'Ayacut Development' and Management should be practised for high yield production. 'Ayacut development' – means water utilization and management in areas that may be brought under irrigation and also cover such areas that are reclaimed by flood control, drainage and soil conservation measure for planned development of agricultural production of these areas as a composite operation involving improved agricultural practices, land shaping, construction of channels, supply of input and introduction of new cropping patterns[2].

[2] Mamoria, C.B. (1982) : Agricultural Geography, p. 690-719. Shivlal Agarwala & Co., Delhi.

(14) Agriculture in broad sense involves cultivating an extensive area including forestry, plantation including medicinal crop production, animal husbandry and fisheries. Thus agro-geomorphological map should be prepared for the use of all farmers, and agricultural planners. Agro-geomorphological maps show the rational arrangement of crops based on geomorphological characteristics of the area under cultivation (excluding the high inaccessible terrain in Darjeeling mountainous areas. Based on the needs of demand for agricultural products the following four important criteria may be identified :

a. Agro-geomorphological map for showing the impact of terrain on agricultural development in Darjeeling district in particular should be prepared (Relationship between geomorphology and agricultural production in the context of national economy of the country.

b. For showing the relationship between the climate and exogenous process assemblages.

c. Agro-geomorphological classification should be made on the basis of morphological types, exogenetic process assemblages and surface materials.

d. Field checks should be carried out with a view to studying the relationships of geomorphology with existing agricultural layout to put forward amendments for appraisal and recommendations for further agricultural developments.

(15) It may be pointed out that agro-geomorphological classification (CHW GUO-NAN, 1984) as established by the author should be made with some modifications. The classification for the Darjeeling district may be made which comprises both hills and plains. As assessment may be done for comparative study of the agricultural practices and recommendations may be made for its overall agricultural development. The relationships may be shown

between the terrain types and agricultural practices over the genetic types (depositional and erosional-structural) with morphological and clima-morphogenetic sub-types based on lithology (geology). So morphology and lithology is the only criterion that makes the present study successful for tackling the problems i.e., landsliding, gullies depressions, fault scrps, cuestas etc. in hill areas of Darjeeling district.

(16) The detail slope analyses may be undertaken depicting the relationship between the terrain and agricultural production. Fruitful suggestions may be put forward and attention of the concerned authorities may be drawn for agricultural development in the tune of national economy.

Chronological development of agricultural practices during the plan periods.

We have not yet been able to achieve self-sufficiency in food. The so-called green revolution is now out of question. The problems of hunger and malnutrition in our country are very serious. There are reports on starvation deaths in the tribal and backward areas. The problem of global hunger has been receiving worldwide attention. It is estimated that 700 million people out of one billion people in the world are suffering from hunger and malnutrition for which endemic poverty is responsible for this. The Darjeeling district is no exception. The international food policy research institute in Washington has warned that the developing countries will face a food crisis in future, because the trend in investment in agriculture is declining gradually.

In the *First Plan period (1951-56)* there were two fold objectives viz. to correct the diequilibrium in the economy and to initiate simultaneous process of all round balanced development for raising national income and living standards. *The Second Plan period (1956-61)* tried to meet the increasing demand for food and raw materials due to growing population and expanding industries. *The Third Plan peiod (1961-66)* gave the priority to agricultural development because agricultural production the main factor for the progress of national economy. This plan sets two specific goals that it has reached (1) to produce enough of food grains for self-sufficiency and (2) to

produce enough of commercial crops for meeting the needs of exports and industry. The plan period was readjusted due to hostilities in 1962 and 1965 that brings down the agricultural production for two successive years 1965-66 and 1966-67 and the devaluation of the rupee in 1966. As a matter of fact the *Fourth Plan* was abandoned and three yearly plans were implemented (1966-69). *The Fourth Plan* (1969-74) more or less fulfilled its two main objectives (1) growth of about 5% per annum and (2) remedy of imbalances. The *Fifth Plan* (1974-78) aimed at fulfilling two goals (1) removal of poverty and (2) attainments of economic self-reliance. The *Sixth Five Year Plan* (1979-80 – 1984-95) tried to take into account for immediate and long term needs of agricultural commodities both for domestic consumption and export. After these periods new agricultural strategies were introduced with a view to reaching its goals. After these programmes many recommendations came into being for intensive agricultural production. The recommendations were based on selective approaches like IADP (Intensive Agricultural District Programme) and IAAP (Intensive Agricultural Area Programme) for intensive agricultural production. And it was necessary till Xth Five Year Plan to launch new strategy for agricultural development. The keynote of this strategy is the application of science and technology for increasing yield per hectare. This strategy, known as New Agricultural Strategy or Green Revolution (as it created greener looking field) is based on high yielding varieties responsive to heavy doses of fertilizers and the package of improved practices in selected areas with assured rainfall or irrigation facilities. The programmes are (1) High Yielding Varieties Programmes (HYVP) (2) Multiple Cropping Programme (MCP) (3) Integrated Development of Dry areas (IDDP) (4) Plant Protection Measures (PPM) (5) Increased Use of Fertilizers (IUF) through new irrigation concept and water management.

From the analyses it is clear that we have not yet achieved self-sufficiency during *Eighth Five year Plan* where our production was 190 MT. in 95-96. The so called green revolution has now reached a dead end. With the passage of time the high yield variety and multicrop practices were encouraged. Boro rice cultivation practices have

been introduced between November and May i.e., the influence of summer and winter is beneficial to this production. Basin and hill-valley systems have been introduced during this plan period. On 27th May 1998 Mr. Swapan Sinha stated that there is enough of scope for development in agriculture in Terai on the basis of the cultivated crops in the remaining parts of North Bengal except the mountaineous part of Darjeeling district. It was observed that cultivable land in Darjeeling district is very low (30,000 ha) in comparison with Jalpaiguri and Cooch Behar (2,30,000 ha). It is obvious that national economic development comes through industrial development and industrial development is complementary to agricultural development and it is important to note that raw materials can fulfill this requirement.

Tista irrigation project has become the new hope to the people of North Bengal because with the completion of the project the agricultural scenario may be changed with the advent of Green Revolution. Out of 9 lakh 23 thousand hectares only 22,800 hectares of land have been brought under irrigation for the cultivation of Kharif crop. The peasants are now cultivating two crops a year. This multipurpose project will be completed in three phases. Only 15% of the total work is not completed. The project in the village stage has developed three hydel projects and each of these projects will produce 22.5 MW of electricity. Besides, there is scope for establishment of agro-industry in North Bengal for enrichment of national economy.

'Contract Farming' has become a new agricultural policy introduced in West Bengal. This policy was formulated by 'Mackinsey and was known as 'Mackinsey Report'. The 'Contract Farming' may be explained as follows : One company, foreign or inland, will make contract with the peasants. On the basis of the contract the company will purchase the crop from the peasants at a predetermined cost and amount. The benefit of this new agricultural policy is that the peasants will know their amount before hand and at the same time the company will know his share of payment to the peasants before hand. Abrupt rise and fall of market price will be abolished and 'uncertainty' will be replaced by 'certainty'. The national economy will be stable (Das Gupta, 2002).

The present new agricultural policy was introduced in August 2002. It was said in the policy that an alternative way should be established for agricultural development keeping in mind the national crisis and imperialists attack. China has adopted both the policies, we should not follow that principle for increasing our national economy.

Centre and state should consider seriously about the speedy completion of Tista project for overall development of North Bengal.

Just before the WTO conference at CANCUN, three organizations IMF, WB and OECD unitedly demanded the withdrawal of subsidy on agricultural products. The bad effect is the fall of crop price in world market. As a result of it the poor peasants will be bound to go far away from the market.

Now question arises whether the new agricultural policy will be fruitful in reality ? It is quite relevant that unless the easily available organic manure will be sufficient as per demand, the agricultural development will not be satisfactory. This policy has been introduced with a view to elevate the economy of the states inspite of many constraints. It is a matter of satisfaction that in Cuncun (Sept. 2003) twenty developing countries have demanded the withdrawal of export subsidies in agriculture that ultimately will bring stability in national economy of the country as a whole and North Bengal or specifically Darjeeling District in particular.

In this context of agricultural status the fact raised by Mr. Dipak Basu on Friday the 19th September 2003 in the Statesman may be quoted here for some implications in agricultural development in Darjeeling district. It would allow foreign investors to control eventually all natural resources including agricultural land. That would take away the sovereignty of the government making the country a dependent economy. It would not allow the government of India to direct investment to the socially descrable sectors or to the economically backward regions. It would also create extreme inequality between regions and between social classes, which can undermine the stability of the country.

In the context of the above, Government should think seriously about the fate of agricultural development in North Bengal and in Darjeeling district in particular. In the interest of North Bengal agriculture one should think afresh. As everybody knows that Egypt is called the gift of the Nile. So it is obvious that North Bengal could be called as the gift of the 'Tista-Torsa'. Both government and NGOs can only save the agriculturists of North Bengal and they may undertake the following programmes forthwith. (Report on 26.06.2004).

(a) Budget must be increased for agricultural development.

(b) The maximum agricultural areas are to be brought under the irrigation scheme in Cooch Behar and Jalpaiguri district through the construction of the canals.

(c) The waters of the small canals and water bodies of North Bengal are to be brought under the irrigation scheme.

(d) Irrigation waters may be arranged by deep tubewell where there is no small canals and water bodies.

(e) Even a square inch of land should not be left outside the irrigation scheme.

(f) Agricultural training and workshops should be arranged for the agriculturists instead of well to do people free of cost.

(g) Agro-industry should be encouraged to strengthen the economy of North Bengal districts.

(h) Special attention should be given for Darjeeling District in developing agriculture in the context of terrain constrains particularly in hilly areas.

(i) The hill areas are to be brought under Agri-Export Zone (AEZ) immediately which have got green signal from center in September 2004 (as announced by Murasoli Maran, Union Commerce and Industry Minister in March 2001.)

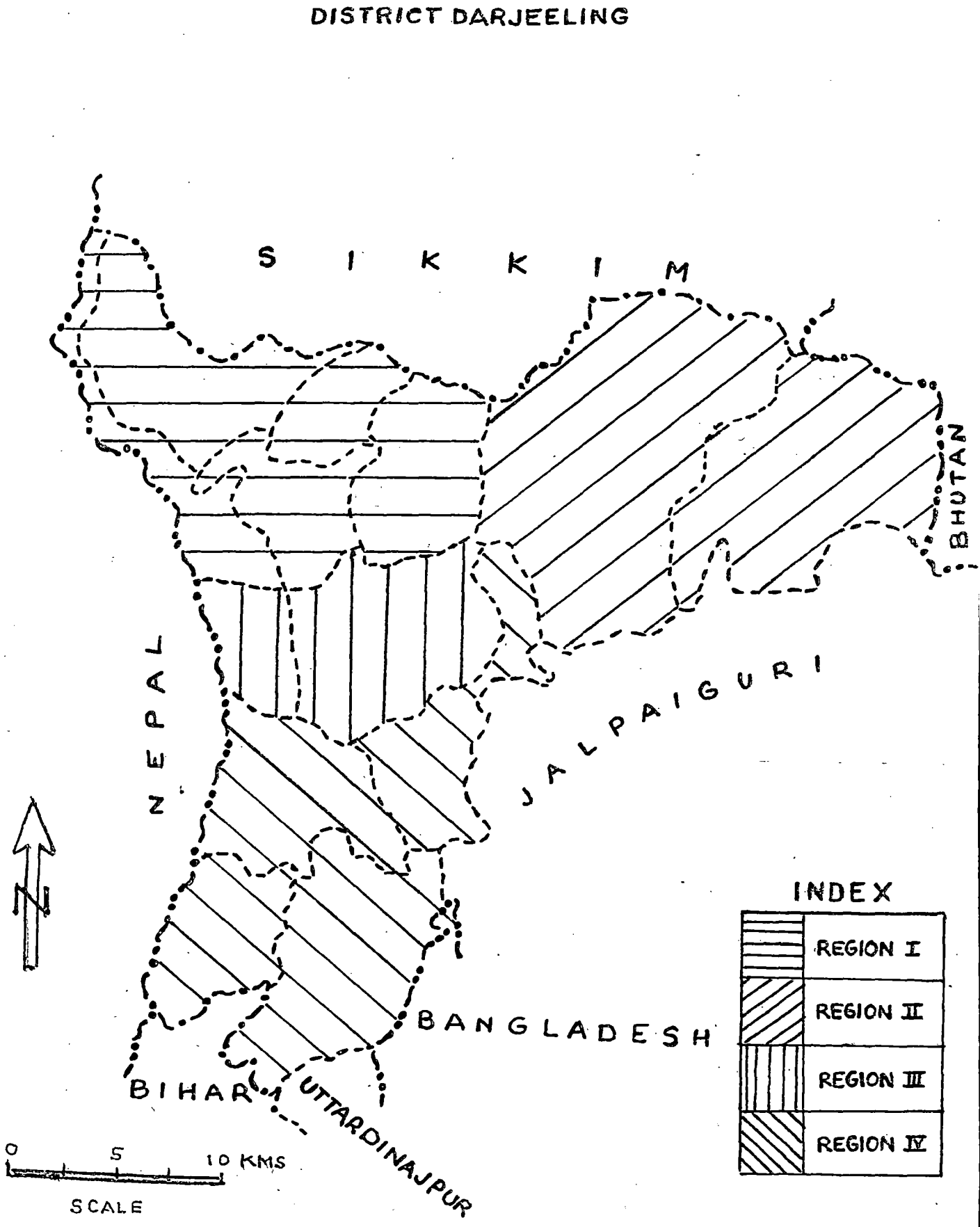


Fig. 15.1 SHOWING FOUR AGRICULTURAL REGIONS. (ON THE BASIS OF ADMINISTRATIVE BOUNDARIES)

Planning Commissions (1964) divided the agricultural regions on the basis of topography, soil, climate, geology, land use, irrigation and cropping pattern Dr. Randhawa divided the country into agricultural and animal husbandry region on the basis of rainfall, temperature, altitude, latitude, natural vegetation, soils, crops and stock animals. NSS classified on the basis of similar population density and crop pattern and having similar altitude above sea level, and also having good transport and communication facilities. ICAR classified agricultural regions in collaboration with DES (Directorate of Economics and statistics 1968) into four broad zones for each of the crops of rice, wheat, cotton, sugarcane, jowar, bajra, maize, gram, groundnut, jute, pulses, soyabeans, potato and other plantation crops. K. William Easter (1972) classified on the basis of percentage contribution of a district to the total national production of crops and the percentage of the district's gross cropped area under the crop. Sengupta and Sdasyuk's classification was based on physical features and climatic conditions. I have divided the agricultural regions of Darjeeling district (2006) on the basis of administrative boundary of the block (fig. 15.1). It has followed the physical features (relief and geology) that corroborates with the crop pattern and terrain.

SUMMARISED CONCLUSION SUGGESTIONS AND PROGNOSIS

The impact of terrain on agricultural development of North Bengal with particular reference to Darjeeling District has given us a clear idea about the agricultural situation in this region. The study includes the interpretation and analysis of the fifteen chapters, which will be summerised below.

A brief relevant works in this subject is written in order to have background knowledge of the problem. The data were collected for each chapter from Government Offices, library sources and filed investigation to complete this research work. The researcher also has read and collected various relevant books, journals and published material to understand the topic well and got thereby some general information about the situation of agriculture in North Bengal. Data thus collected were analysed and with the help of cartographic and statistical methods maps and diagrams were drawn. Introduction deals with the geographical setting of the area, the problem, scope of the study and its objectives, hypothesis, methods, and its significance.

North Bengal lies between 27°13′ - 24°40′20′′ North Latitude and 89°5′35′ east longitudes North is bounded by the river Ganga in the south the state of Bihar in the west Nepal and Sikkim and Bhutan in the North and Assam and Bangladesh in the east.

The northern most region of the state of West Bengal is known as North Bengal. The six districts that comprise North Bengal are Darjeeling, Jalpaiguri, Cooch Behar, Uttar Dinajpur, Dakshin Dinajpur and Malda. The total area of North Bengal is 21845 sq.km which is 24.62 percent of the total area of the state of West Bengal. The northern most part of the Darjeeling district is a mountainous region situated on the Himalayan chains. The southern districts of North Bengal viz., Uttar Dinajpur,

Dakshin Dinajpur and Malda are completely riverine plains, other plain areas comprise southern parts of Cooch Behar, Jalpaiguri and Darjeeling District.

Historical background of each six districts has been discussed in brief. The study area North Bengal with particular reference to Darjeeling district in the state of West Bengal is acknowledged agriculturally and economically backward region according to the indicators prescribed by different institutions to determine agricultural development of a region. It is an area of great physical enequalities with varied topographical features. The physical constraints are : (i) variations in topography (ii) variations of soil fertility (iii) problems due to drainage and floods (iv) uncertainty and uneven rainfall and temperature (v) soil erosion and landslides and (vi) problems due to irrigation. All these factors directly or indirectly wholly or partly stood in way of development of agriculture in North Bengal in general and Darjeeling district in particular.

Chapter one deals with the geology of North Bengal, which is covered by diverse rock types ranging from oldest Archaean metamorphis to sub recent and recent alluvium. The region lies partly in the extra peninsular region and partly in the plain. The various rock formations of North Bengal are (a) Daling Darjeeling series – the mountainous tract is characterized by folding thrusting and metamorphism with resultant inversion in straightgraphy (B) Buxa formation comprises predominantly by dolostone, phyllite and quartzite etc. occupying the northern part of Jalpaiguri district, around Buxa and Jainti Hills Buxas are an admixture of argillaceous, are nacreous and calcareous facies. Besides, the presence of hematite schist and banded hematite as per in the Buxas are also (C) Gondwana formation occurs in the ditrict of Jalpaiguri and Darjeeling (D) Gondwana rocks consist of pebbles boulders slates, quartzites quarzilts slates and carbonaceous slates and coal seams (a) Tertiary rock formation is notice in the Terai region of Darjeeling district and northern part of Jalpaiguri district. These rocks consist of detritus material of coarse hard red sandstone, silstones shale and pseudo conglomerate, belonging to the Siwaliks. (e) older and newer alluvium. The older alluvium generally occupies high grounds forming raised terraces and mostly

covers the southern portions of foot hills and forms part of the gangetic alluvium in the area known asterai. The newer alluvium is of recent origin. It occupies the northern and western part of Uttar Dinajpur Dakshin Dinajpur and western part of Malda.

Chapter two deals with physical setting of the North Bengal. On the basis of elevation morphological features and slopes of terrain North Bengal may be divided into four physiographic units (a) northern hills (b) the terai (c) transitional plain and (d) the plains of uttar Dinajpur, Dakshin Dinajpur and Malda. The northern hills corresponds with the three northern sub-divisions of Darjeeling district. The hilly potion consists of complicated relief features with ridges and narrow deep gorges most of the ridges stretch from north to south. The hilly portion of Jalpaiguri district comprises the part of Bhutan hills. The area extending from the foot hills of Darjeeling and Jalpaiguri districts is divided into Terai and Duars by the Tista river. The area lying west of Tista river is known as Terai and area lying east of the river is known as Duars. The transitional zone between the terai and Duars is a triangular shaped plain area. This area is intersected by numerous rivers and streams flouring southward. The plains of Uttar Dinajpur, Dakshin Dinajpur and Malda. Composed of old and recent allivium, sandy loams drained by many large and small rivers and characterized by recent floods. The altitude is varying from 300 meters to 100 meters from North to South.

North Bengal is drained by many large rivers with their numerious tributaries and distributors. The varied physical and geological characteristics of the region have profoundly influenced the drainage pattern of the area. In the district of Darjeeling rectangular drainage is observed. In other plain areas of North Bengal dendritic drainage patter is noticed.

The large rivers of North Bengal are the Tista, the Torsa, the Jaldhaka, the Sankosh, Balason, the Atrai, the Punarbhaba, the Kulik, only the Ganga, the Tista and some other tributaries have their origin in glaciers other rivers rise from the drain outs of the precipitation in the different parts of the Himalayan range and these rivers become dry

in the dry seans. The soils of North Bengal are generally poor in organic matter and as well as in nitrogent content. The depth of the soil is rather low and soil is principally derived from tertiary rocks. The texture of the soil is mainly from sandy loam to loam and the colour of the soil is yellowish. The soils are mainly porous and have faced acute erosion. These are not very fertile but responsive to fertilizers is noticeable. The soils of the hilly areas are immature than the soils of the plain areas, moreover hill soils are constantly disturbed by the process like soil creep. Four broad classification of soils in North Bengal area (a) hill soils (b) terai soil (c) Alluvial soils and (d) red soils. Acidic character of soils in the districts of North Bengal varies between pH 5.0 and 6.5. Though in some areas like Darjeeling it is even less than 5.0. the acidic character of the soils makes them less suitable for agriculture as most of the plant nutrients do not get the major nutrients, nitrogen and phosphorous tend to become available in lesser amounts below pH 6.0

The North Bengal has two district tracts – the hills and the plains. The mountainous portion of the northeast and the area bordering the Himalayas in the north experience lower temperature mainly due to the effects of elevation. The west extension of the Himalayas effectively bars the influence of cold polar winds, on the other hand annual range of temperature does not show continental character due to the influence of the Bay of Bengal. The average maximum and minimum temperature in hill area is 20° Celsius and 3° Celsius respectively. In remaining parts of North Bengal the average annual temperature is almost uniform and ranges between 23° to 43° Celsius. Minimum temperature ranges between 7° to 9° Celsius. The highest amount of rainfall is restricted to the northern most part of the region at higher altitude and decreases southward.

The rainfall in this area ranges between 2500 to 4000 mm in a year. It has been observed that the yield of crops usually increases with an increase in rainfall. Heavy rainfall is favourable for the cultivation of jute and rice in plain areas. Productivity of crops also depends very much on the total amount of temperature which plant receives in varying degree with seasons.

North Bengal is gifted with a large forest area in its mountainous terrain and adjacent valleys. These forests are covered with valuable trees. There also exists a wide variation of different types of forests. The variation is mainly due to the variation in altitude and climate. In the districts of Darjeeling and Jalpaiguri 38.27 p.c. and 28.74 p.c. of the area to total area of the respective districts are under forest cover. Other districts of North Bengal has less than one p.c. of forest area.

The agricultural landuse in North Bengal is not uniform because of the differences in soil fertility, relief and climatic conditions etc. The great regional variation in agriculture is primarily due to varying physical and ecological conditions, level of socio-economic development, demographic and cultural pattern. It has been observed that the pattern of landuse is governed by the relief morphometries and morphological characteristics of the area. It is generally found that most of the hilly terrain, ridges, domes, rocks are either under forest or pasture according to climatic condition of the area. Landscape recognized as alluvial fans, valleys some hilly terrain, flood plains, out wash plains and loess plains are under intensive agriculture because of low climatic and physical constraints.

Particular study area Darjeeling district has been discussed in chapter eleven. In the landuse of other five districts of North Bengal gives clear idea about the agricultural pattern, practices and development of the area.

The district of Jalpaiguri extends over an area of 6227 sq.km. in the shape of an irregular rectangle lying length wise east to west. The district of Jalpaiguri is known as western Duars, which is submontane and covered almost by forest and dry sandy river beds. The northern part of the district is undulated high and low deep plain small hillocks can be found in plently in northeastern part of the district. The major part of the district is formed with riverine plain. The majority of the people in the district are engaged in agriculture. There are 241026 hectares of agricultural land where intensive forming is practiced. The economy of the district is dependent on agriculture and plantation. Tea orange are important plantation crops of the district. Net cropped areas

is 59 p.c. In Jalpaiguri paddy, jute, potato are produced in large quality. Pulses sugarcane tobacco are other important crops of the district. During the period 1997 to 2002 agricultural the yield rate of various crops has undergone major changes owing to expansion irrigational facilities. Moreover the area in majority of the cases reveals the mounting pressure on land or the increasing intensity of cropping. Some other factors such as use of fertilizer, application of improved varieties of seeds and change in technical inputs are collectively responsible for the improvement in the productivity level of some important crops. A plain geomorphology also ensures continuity of cultivation. Successful agriculture is possible only on reasonably level ground if climatic conditions and some other related factors such as soil labour capital, marketing and institutional facilities are favourable for the agricultural development in the district. Cooch Behar district is located in east-west direction. Cooch Behar is situated in the sub-Himalayan, territory, which is commonly known as 'terai' in West Bengal. The total area of the district is 3387 sq.km., and it is more or less a plain district with a slight slope from north-west towards south-east direction. There is a small forest in the north-eastern region of the district. Net cropped area in the district is 81 p.c. soil of the district is fertile and alluvial in nature. The district has witnessed a total increase of land area during study period. The period 1997 to 2002 shows the upward trend in the production of all the crops such as rice and potato with exception of pulses. The total area of irrigation also increased from 46 thousand hectares in 1997-98 to 75 thousand hectares in 2001-20. The average consumption of fertilizer also shows increasing trend. Majority of the farmers in the district have less than one p.c. of cultivated area and are practising subsistence agriculture. Moreover infrastructural development in the rural area is very low or in the process of development. Uttar Dinajpur is completely a riverine plain land. The altitude is insignificant here. The region has a monotonous landscape characterized by agrarian fields with scattered homestead leaving some barren land here and there. The total geographical area of the district is 312467 hectares and only 0.579 hectares area is covered by forest. Net cropped area is a little more than 84 p.c. Total cereals, which includes rice, wheat jute and other crops occupy the highest percentage of area. Yield

rate of rice, wheat, potato shows increased production. The application of chemical fertilizer and better irrigational facilities boosted the production of cereals crops. The agricultural holdings are very small and fragmented. It may be concluded that the plain topography, soil, Climate, irrigation and communication have collectively influenced the spatial pattern of agriculture in Uttar Dinajpur. But farmers are still in the level of subsistence agriculture.

Dakshin Dinajpur is a low lying plain area. The total area of the district is 221908 hectares. More than 86 p.c. of the land area is under cultivation. The percentage of net cropped area is increasing every year since 1999. Food grains production is showing increasing trend. Though some crops are also showing decreased yield rate. Irrigational facilities, consumption of fertilizer, network of communication are other factors influenced the district to become important in the cultivation of rice jute and potato.

The district of Malda is a low-lying area without any hill. The land is sloping towards south. The district has 1.68 thousand hectare of land of which 60 p.c. is net-cropped area. The yield rate of rice is very high; potato and wheat also give high yield rate. Other food crops and jute are showing increasing yield rate. The farmers of Malda are using different sources of irrigation and move land are being covered by the well-developed system of irrigation. The data suggests increased use of fertilizer and, therefore, bumper crops are grown. Like other districts of North Bengal average size of holding is below one hectare but net of communication does not show much improvement.

Chapter eight deals with the influence of geology and soil on agriculture in Darjeeling district. The physical configuration of Darjeeling varies from a wide range of alluvial plain, terai Duars to the mountainous areas of the Darjeeling Himalaya or the lower Himalayan range. In terms of geological era this region is the product of very recent times. The greatest difference in relief has brought about difference in climate, natural vegetation, and drainage and soil character. All these factors together influence the

agricultural practices in Darjeeling district. All these factors together influence the agricultural practises in the District of Darjeeling. The hilly areas of the Darjeeling consist of a landscape with rugged terrain full of ridges. The mountains are made of folded rocks piled one over another by a series of north south horizontal compressions. The Darjeeling district may be divided into four tracts viz. the hard rocks area, the Bhabar belt, the terai belt and the alluvial plains. The soil of Darjeeling is characterized by brown podzolic variety. It may be mentioned here that mountains cover about 66 p.c. of Darjeeling district. The nature of soil changes with altitude. For example, it is black and alluvial in Siliguri but higher up it is rather reddish or white in colours. On the whole agricultural practices and cropping pattern shows considerable variations due to influence of geology and soil formation. There is no flattened land or valley at the relatively high altitude and therefore, limited area is available for cultivation. In high altitudes the productivity per unit area is very low, since crops are subject to various physical and other constraints. Soil in the plain areas of Siliguri sub-division is fertile and dark in colour. Paddy jute and other crops grows well in this area. Climate is one of the most important factors affecting the cultivation practises of an area. The mountainous portion of the Darjeeling bordering. Himalayas experience lower temperature mainly due to the effect of elevation. In the remaining part of the district average annual maximum and minimum temperature ranges between 30° to 38° and 12° to 8° Celsius respectively. In hill areas average maximum temperature is 20° Celsius in May and minimum temperature is 3° Celsius in January. Darjeeling receives fairly high rainfall on account of hilly terrain and there are sharp contrast in the amount of rainfall even between nearby stations. Rainfall in general heavier in the southern terai region and slopes near the plain rice, maize, millets along with other minor crops such as ginger, oilseeds, pulses, buckwheat etc are cultivated as summer crops. In hill regions principal cold weather crops are barley, mustard, buck wheat and vegetables. In lower elevation rice, oil seeds, cereals, jute, wheat, potato are grown as summer crops. Rabi crops includes rice pulses maize, potato and vegetables, From the study of the climate of Darjeeling district, it has been found that

there is wide diversities in the cropping pattern, which is closely associated with the climatic regions of the district.

The hill areas consist of a landscape with rugged terrain full of ridges and spurs of sharp incline and deep riverine valleys. The northern most point of the district is characterized by very hard types of rock and is not cultivated, southern stretch of the area lying along the base of the outlying hills. This belt is fertile and cultivation is practiced here. In plain areas agriculture is practiced throughout the year because of flat nature of land. In Darjeeling slopes have been fully used for tea cultivation. Hill slopes determines terracing and its characteristics. The greater the slope, the smaller the width of the terraced fields.

There is an extensive network of drainage system of rivers, rivulets and streams, which flow down below the valleys. Flood does not occur due to natural slope of hill areas. Generally heavy rainfall is favourable for agriculture but excessive rain causes flood, and water logging in plain areas. In Darjeeling delay in the on set of summer monsoon may be disastrous as Kharif sowing may be delayed in rain fed areas. In hill area the only available source of irrigation is the spring. Irrigation is common in terai areas. In plains area of Darjeeling revierlift irrigation is practiced. Landslide is another common feature in Darjeeling hills where landform is far from stable. Heavy rainfall, light soil, hailstorms are the main causes of landslips. The occurrence of landslips is a serious threat to life, agriculture and property in the district. Effective control measurers include, afforestation, terrace, cultivation, introduction of suitable cropping pattern and treatment of gullies and jhoras.

The data regarding landuse pattern shows that the growth and development of agriculture during few years was not encouraging due to some physical and socio-economic constraints in the district of Darjeeling. The pattern of agriculture within the district changes from one place to another. As a result there is a wide variation in the patterns of agriculture within the hill and plain areas of the district. The effect of terrain can be observed significantly in the mountainous region of higher altitudes.

The differences in topography and elevation make agricultural conditions extremely diverse. The two distinct division of the district are mountainous region in north forming the greater part and the alluvial plains to the south. There is also poor sandy tract, which cannot be brought under cultivation. Altitudes vary from 74m above the sea level in the plains to about 3500 m in the hills. Most of the area in the district is under forest. Cultivation is suitable between 300 m and 600 m in the hill areas.

The agricultural cropping pattern, which dominates in the hills of Darjeeling comprise of maize, mille and maize, rice crop cycle both of which lead to considerable soil loss through rainwater run off. In plain areas of Darjeeling rice and jute dominates the cropping pattern.

The low intensity of cultivation i.e., Gorubathan is characterized by rugged terrain and devoid of fertile soils for crop cultivation. The cultivated land is confined to valleys and low lands. The medium intensity group includes Darjeeling, Jorebunglow, Sukhiapokhri, Kalimpong-I, Kalimpong-II. The last two blocks where altitude is less than 600 m some crops usually gives good yield rate. Matigara, Naxalbari, Phansidewa has high percentages of net sown area.

The study shows the very slow rate of increase in net sown area and less percentage of net sown area in some block are due to several factor such as rugged terrain which is responsible for less area under cultivation, poor accessibility, fertile and poor quality of soil, lack of extensive irrigational facilities, high altitudes, high variability of rainfall, lack of modern mechanized cultivation, major part of the some blocks are either covered by forest or by tea cultivation.

Intensity of cultivation also shows that in plains blocks of the district such as Matigara (previously Siliguri) Naxalbari, Khoribari-Phansidewa cultivation is practised though out year. This is possible because of better irrigational facilities, availability of fertilizer, better communication network made it possible to grow crops through out the year. Rangli-Rangliot and Garubathan blocks of hill area has high percentage of

cropping intensity because of the presence of river valleys and soil is fertile in some region.

The output of rice low in hill soil and land suitable for rice cultivation is limited. The productivity of different crops shows regional variation due to rapid change in micro-climatic and terrain factors. In plain areas yield rate of rice is much higher.

At the beginning of fifth five year plan high yielding varieties of seeds were introduced in entire paddy, wheat and maize growing areas of the district. It was found that the average yield rate of maize was only 3.5 to 4 quintals per acre, prior to this programme while H.Y.V. varities gave an average yield of 10 quintals to 14 quintals per acre from the same field. The programme covered entire wheat growing area and the yield rate increased substantially. But in case of paddy H.Y.V. programme could not make any success in hill areas of Darjeeling. In this context it is to be noticed that H.Y.V. responses well only if water fertilizers are supplied in prescribed quantities along with measures to protect crops from diseases and pests.

Agro-forestry landuses fulfill both productive and service functions in Darjeeling. The main productive outputs are food grains, fuels wood and fodder but most important service function is soil conservation.

The forest of Darjeeling can be divided into four classes viz. hill forest, middle hill forest, upper hill forest and plain forest. Medicinal plants are found both in hill as well as plain forests. It has been found in the Darjeeling district that during first two year of laying out a forest plantation, many food crops such as paddy maize and mustard combine with the forest trees such as sal. Medicinal plants like Chirata amlesho, market, ginger have also been successfully introduced as inter crops.

The density of population per square kilometer in 1991 was 413 but in 2001 the density has gone up to 510 persons per sq./km. The plain blocks of the district have more farmers and agricultural labourers and agriculture is practiced throughout the year. Less number of agricultural labourers and small farmers indicate that agriculture

is not practised extensively. Terrain altitude drainage pattern, soil fertility and socio-economic factors have influenced the distribution of settlement pattern in Darjeeling. It has been observed that rural settlements are found scattered and in great isolation. The rugged topography of the district is a handicapped for the development of larger settlements. The northern hilly tract of the region has sparsely-spaced settlements due to uneven surface, the presence of large forest areas and prevailing climatic conditions of the region. No general pattern of settlement is found in villages of hill areas. Settlements have also grown in a dotted fashion following the national highway and district roads. However concentration of settlement is also observed in market areas. Different types of settlement includes forest settlement khasmahal settlement etc.

The plain area of the district is density populated and cultivation is practised through out the year except in urban areas. Agricultural settlements are surrounded by the agricultural land in the villages. The progress and expansion of agriculture in hill and plain areas of Darjeeling has been discussed in chapter fourteen. The interpretation and analysis of the data shows that there remains a wide interblock variations in cropping pattern and cropping intensity in the district of Darjeeling. The possibility of increasing the area under cultivation is limited in hill areas owing to the scarcity of cultivated land, rugged terrain. Moreover major part of the hill area is either covered by forest or tea plantation. The statistical data of 1993-94 and 2001-02 reveals that potato and maize are dominate crops of the hill area. In 1993-94 the area under potato cultivation was 37.7 hundred hectares total yield was 94428 kg. In 2001-02 the area of the crop decreased to 29.3 hundred hectares and it shows a total yield of 124123 kg.

Area under Aman and Aus variety of rice shows decreasing trend and not showing substantial increase. Total yield area of wheat cultivations has decreased like other crops. The quality of rice in hill area is very poor.

In the plain areas of Darjeeling, during the period 1993-94, 83 and 289.86 hundred hectares of land was under Aus and Aman variety of rice cultivation. But 2001-02 shows area under both varieties of rice decreased. The total yield of both varieties of

rice increased from 3222.12 kg. and 2781.01 kg. to 8935 kg. and 999 kg. for the above mentioned periods. Boro variety of rice is also cultivated in the plain area and area as well as production increased in 2001-02. The area of wheat cultivation decreased from 49.5 in 1993-94 to 29.8 hundred hectares the total yield increased from 3971 kg. to 5619 kg. in 2001-02. Potato was grown in 07.7 hundred hectares and total yield was 24995.68 kg. in 1963-94 but the data shows the area and yield increased from 19.3 hundred hectare and 56103 kg. respectively in the year 2001-02.

The widespread availability and application of fertilizer and also improved irrigational facilities have gone a long way in enhancing the yield rate of some food crops in the plain areas. The data suggests decreasing trend of area in jute cultivation but the production is showing increasing trend. In hill areas of Darjeeling the primary concern of the peasants is to produce their own food crops in their own household in their own household farm. Only relatively big farmers after producing their annual requirements of foods put the remaining part of the land to the production of other crops. In plain areas of the district the agriculture is in the state of developing development is developed stage. Chapter fifteen deals with agriculture in national economy and various plan periods and future prospect through agricultural regions.

For the development of agricultural practices in hill and plain area the government should pay proper attention in every geographical units of the district. Diversification in agriculture is necessary e.g., cultivation of fruits, flower poultry fishing should be encouraged because development of primary sector does not only come from the production of food crop and other crops. Some fruitful suggestions may be placed in solving the problems in near future considering the miserable condition of agricultural practices and production in hill areas. These include subsidies should be given to peasant only FCI should be given power to collect grains and restriction should not be imposed on the production, storage, marketing and use of technology to check the entry of multinational company. The gene transplantation system may be introduced to cater the needs of the present demand, which will bring new dimension in agro diversity in North Bengal particularly in Darjeeling district. There is enough scope for

crop diversification in the soil of North Bengal. For ascertaining crop diversification, Bhatia's formula should be taken into consideration.

For the measurement of the level of production the crop yield and concentration indices ranking co-efficient may also be taken into consideration. The result thus derived will give us an idea of the level of agricultural production

$$RC = \frac{1}{\text{Production}}$$

It means that the ranking co-efficient is lower then the higher will be level of production.

For measuring the level of agricultural production a new technique comprising nine broad approaches should be considered.

(a) Value of agricultural production per unit area

(b) Production per unit of farm labourer

(c) Out put per unitarea in hect.

(d) Index of productivity

(e) Index number of agricultural efficiency per unit area.

(f) Input output ratio and profitability in farming

(g) Ranking order of land in term of population

(h) Production in terms of grain equivalent per head of population.

A yacut development and management should be practiced for high yield production. Agro-geomorphological map should be prepared for showing map should be prepared for showing the impact of terrain on agricultural development in Darjeeling district. Thus, the map will help all the farmers and agricultural planners. An assessment may be done on the basis of comparative study of the agricultural practices in plain and hill

areas and recommendation made for the over all development of the region. Chronological development of agricultural practises during the plan periods reveals that the trend in investment in agriculture is declining gradually and Darjeeling district is no exception. In the first plan period (1951-56) two fold objectives were to bring an equilibrium in economy and to bring about an all round development in raising national income. Second plan period (1956-61) and Third plan period tried to meet the food requirements of the country and priority was given to agricultural development respectively.

Fourth plan period fulfilled two objectives growth of 5% per annum and to eradicate regional unbalances. Fifth plan period fulfilled two goals i.e., removal of poverty and economic self-sufficiency Sixth Five Year Plan (1979-80 1984-95) tried to take into account for immediate and long term needs of agricultural commodities both for domestic consumption and export.

During Eight Five Year Plan it was noticed that there is enough scope for development in agriculture in Terai basin and in hill valleys.

With the completion of Tista irrigation project the agricultural scenario may be changed in North Bengal. Besides, there is enough scope of agro-based industry in North Bengal, which will strength national economy. Contract farming has become a new policy in West Bengal. The benefit of this agricultural policy is that the peasants will know their profit before hand.

To improve the agricultural situation in North Bengal the following programme can be taken into consideration. Budget must be increased in agricultural sector and maximum area of North Bengal is to be brought under irrigation. Trrain constraint must be taken into consideration while for proper attention should be paid to agricultural development. The hill areas are to be brought under Agri Export Zone (AEZ) and agro-based industry should be encouraged which with strengthen economy of North Bengal. Dr. Randhawa divided the country on into agricultural and animal husbandry region on the basis of rainfall temperature, altitude latitude, soils, natural

vegetation, crops, and stock animals, planning commission (1964) also divided the country on the basis of topography geology, soil, climate, landuse, irrigation and cropping pattern. Different scientist ICAR, have also classified the agricultural regions into different zones on the on the basis of natural resources, climatic factors and cropping pattern. I have divided the agricultural regions of Darjeeling on the basis of administrative boundary and it has followed the physical features of geology and relief.

14.02 Suggestions and Prognosis

Agriculture plays a vital role in changing economic development of the nation. At low levels per capita income in the agricultural sector often accounts for half or more of national income and 60 to 80 per cent employment. Successful development of agriculture is essential for national economic growth. Agricultural development contributes to national economic growth by (a) supplying raw material to agro-based industries (b) food to feed urban people (c) contributing substantially to government revenue and capital for human resource development and industrialization and (d) to earn foreign money by exporting surplus agricultural products.

The development of agriculture in the district of Darjeeling does not necessarily involve expensive changes in the morphological features of land nor does it mean full scale change in the existing pattern of crop cultivation what is essential is the better understanding of the different aspects of the terrain, the physical potential of the land and how different types of land react to the external pressure.

Agricultural scientist plays a very important role in determining agricultural development and it is more so in the hill areas of Darjeeling, which is handicapped with natural calamities.

The topographical condition of the district does not permit much economic activities. Deforestation and natural calamities have also influenced agricultural practices of the

region. For all these above-mentioned factors the method of agriculture cannot be converted into mechanized and intensive one.

Some suggestions, which can improve agricultural condition in North Bengal, are —

1. Conservation and development of resources must be given attention.

2. The objective is to develop more intensive, socially responsive, ecologically sustainable and economically efficient pattern of landuse for the hill as well as plain areas of the Darjeeling and North Bengal in general.

3. Modern methods of farm technology have to be identified in order to make efficient use of advance knowledge in the process of planned agricultural development of the study area.

4. For any agrarian development the net cultivated area pastures and grazing ground should increase and it must be given due importance

Prognoses

Our present Government has chalked out several plans for agricultural development in North Bengal in general and Darjeeling District is particular. Gene transplantation is going to be introduced in our state. Shubhendu Dev Chatterjee, the Additional Agricultural Director has cited many examples in support of it. The State Government has formed the agricultural commission to bring co-ordination between agriculture and industry in the interest of national economy of the country. Dr. M.S. Swaminathan the eminent agricultural scientist will help in every respect to the commission. He has suggested contract farming for the benefit of the farmers of the country. The Government in the near future will be able to convert single cropped land to double cropped land in future converting 177% crop production. It is a matter of great satisfaction that India has touched 8.4% for its all round development due to large scale agriculture in the financial year 2005-06. During the current year (2006-

2007) the Government will examine its agricultural problems and try to solve these through the commission for the state's agricultural development.

I believe the agricultural development in North Bengal specially Darjeeling district will be possible if administration takes keen interest. Terrain constrain must be taken into consideration while planning for agriculture.

It is a matter of great pleasure that agricultural development of North Bengal and of Darjeeling district in particular will be having a new vista of national income through the approval of six-year, $ 250 in National Agricultural Innovation Project (NAIP) by the Union Cabinet on 29.06.2006. This will oversee transformation of the country's agricultural research system and as a matter of fact this will help a lot for agricultural development in hill areas of Darjeeling district. It will be implemented by the Indian Council of Agricultural Research (ICAR) from 01.07.2006 with the World Bank credit of $ 200 million. It may be mentioned here that for strengthening and development of agricultural education the ICAR has been sanctioned the additional funding of Rs. 200 crore during the remaining period of the Tenth Plan (2002-07) in addition to the existing allocation of Rs. 720 crore for the purpose. The research on 'sustainable rural livelihood security' will be implemented by a network of public research institutions, public sectors and Non Government Organizations (NGOs) of the country.

BIBLIOGRAPHY

Agarwal, A.N.,	1980	:	Indian Agriculture, (Problems, progress and prospects) Vikash Publishing House Pvt. Ltd., New Delhi, pp. 231-251, 267-68.
_____	1974	:	Agriculture and environment, Vol. I, No. 1
_____	1998	:	Agricultural Situation in India, Vol. LIV
_____	1997	:	Annals of Arid Zone – The Arid. Research, Vol. 36, No. 3
Banerjee, B.,	1954	:	Tea Soils of West Bengla. Geographical Review of India. The Geographical Society of India, Vol. XVI, No. 3, pp. 4-5.
_____	1974	:	"Green Revolution in India : A Geographical Analysis" Science and Culture, Vol. 40, p. 347.
_____	1982	:	Resource Utilization of Darjeeling Himalayas and Conservation of Ecology, Geological Review of India, Vol. 44, No. 3, pp. 1-15.
Basu, A.K.,	1970	:	Agriculture of West Bengal, Edited by A.B. Chatterjee and others Presidency College, Calcutta.
Basu, Dipak	2003	:	Imbalance between Rights and Responsibilities in Question at Cancun-II on Fridary 19th Sept. 203 Statesman.
Bhagabati, A.,	1984	:	Levels of Agricultural Productivity in the Brahmaputra Valley : A regional analysis in The North Eastern Geographer, Vol. 15, No. 1, 2, pp. 34-36.
Bhatia, S.S.,	1965	:	A New Measure of Agricultural Efficiency in U.P., Economic Geography, XLII, pp. 244-60.

Bhatia, B.M.,	1977	:	Poverty Agriculture and Economic Growth, Vikas Publishing House, New Delhi, pp. 112, 158.
Bhattacharjee, J.P.	1976	:	Reflections on Aspects of Population and Agriculture in Selected Countries in Dams, T., Kunt, K.E., and Tyler, G.J. (Eds.) Foods and Population : Priorities in Decision Making.
Blache, P. Vidal Dela,	1952	:	Principles in Human Geography, Constable Publishing Co. Ltd., London.
Bhattacharjee, R.	1987	:	Temporal and Spatial Changes in the Cultivated Area of W.B. Geographical Review of India, Vol. 49, No. 4, pp. 56-58.
Carucci, R.,	2000	:	Trees Outside Forests : an Essential Tool For Desertification Control in the Sahel, Unasylva, Vol. 51, No. 2000, pp. 18-24.
Census of India	1981	:	office of the Superintendent, Govt. Printing, India.
Census of India	1991	:	Ibid, p. 140
Census of India	2001	:	Ibid, pp. 20-90
Chakraborty, S.,	1981	:	Crop Combination Regions of Eastern India, Geographical Review of India, Vol. 43, No. 2, pp. 138-40.
Clark, C.,	1969	:	The value of Agricultural land Journal of Agricultural Economics Vol. 20, pp. 1-23.
Das, K.N.,	1968	:	Westward Shift in the Course of the Kosi The National Geographical, Journal of India, Vol. XIV(1), pp. 28-30.
Das, M.M.,	1979	:	Population Pressure and Intensity of Cropping in Assam India Geographical Review of India, Vol. 4, No. 2, pp. 104-111.

Das, P.,	1976	:	Dependence of paddy yield on physico-economic factors – a case study of multiple correlation analysis. Geographical Review of India, Vol., 34, pp. 344-352.
Das, P. and Bhattacharyya, R.,	1978	:	Criteria for land Capability Classification, Geographical Review of India, Vol.40, pp.340-344.
Demko, G.J.,	1970	:	Population Geography – A Reader, Mac Graw Hill Co., New York, pp. 1-15
Desai, M., Rudolph, S.H., Rudra, A.,	1984	:	Agrarian Power and Agricultural Productivity in South Asia Oxford University Press, Oxford, p. 51, p. 250-53
_____	1998	:	The Deccan Geographer, Vol. 36, No. 2.
_____	1997	:	The Deccan Geographer, Vol. 35, No. 2
Desai, A.	1998	:	Rural Sustainability : A GIS Study in Backward Regions of Gujarat. Geo al Review of India, Vol. 60, No. 4, pp. 497-499.
_____			District Statistical Handbooks of Darjeeling, Jalpaiguri, Cooch Behar, Uttar Dinajpur, Dakshin Dinajpur and Malda, Govt. of West Bengal, 2002.
_____	1999	:	Economic Geography, Vol. 75, No. 2
_____	1975-76	:	Darjeeling Marches Ahead, A Review of Development Programme Darjeeling : Development and Planning Dept. Hill Branch Section, p. 3
_____	1975-77	:	Geographical Abstracts, Climatelogy Hydeology - Part B.
Gupta, N.S., Singh, A.,	1979	:	Agricultural Development of States of India, Jammu and Kashmir, New Delhi, p. 86.

_____	1999	:	Himalayan Paryavaran The Journal of Environment Protection Society, Vol. 6
Hunday, A. and Banerjee, S.,	1967	:	Geology and Mineral Resources of West Bengal Geological Survey of India, Vol. 97.
Husain, M.,	1996	:	Systematic Agricultural Geography Rawat Publications, Jaipur, pp. 94-103
Jain, S.C.,	1964	:	Agricultural Planning in India.
Jana, M.M.,	1987	:	Cropping Patterns in West Bengal, Geographical Review of India, Vol. 49, 3, pp. 13-18.
_____	1998	:	Journal of Rural Development Geographic Information Systems (GSI) Application Micro Level Planning, Vol. 17, No. 3, p. 492.
Jones C.F. and Darkenwald G.G.	1982	:	Economic Geography, Surajit Publications, Delhi-7, pp. 1-19
Kadam, A and Saptaishi, P.	2000	:	Cost Benefit Analysis of Agro-Forestry Models in Satara and Sangli Districts in Western Mahaashtia, National Geographer, Vol. 35, No. 1 & 2, pp. 43-64
Kamnath, M.G.	1954	:	Rice Cultivation in India Indian Council of Agricultural Research, New Delhi, p. 19.
Karrar, E., Haider	1998	:	Agricultural Development in Uttarkhand published by A.M. Deokule, pp. 31-33
Khatu K.K.	1995	:	Advances in Kharland District in Gujarat and Maharashtra. The Deccan Geographer, Vol. 33, No. 2, pp. 83-93.
Kleinn, K.K.,	1995	:	Advances of Khar Land Development in Gujarat and Maharashtra, The Deccan Geographer, Vol. 33, No. 2, pp. 83-93.
Kothari, S., Kohli, A.,	1999	:	Development and Regional Disparities – A

Jain, H.,			Factor Analysis Study of Rajasthan – National Geographer, Vol. 34, No. 1
Kostrowicki, J.,	1964	:	'Agricultural Typology, Agricultural Regionalisation, Agricultural Development Geographia Polonica, Vol. IV, pp. 265-74.
Kostrowicki, J.,	1977	:	'Agricultural Typology, Concept and Method', Agricultural System 2, pp. 33-45, W. Stola, Essai ..... op.cit.
Lahiri, S.,	1957	:	Influence of Physiography on the location and landuse of the tea garden of the district of Darjeeling. The Indian Geographer, Vol. I and 2.
Malakar, B., and Basu, B.,	1996	:	Decline in Net Cropped area in West Bengal Geographical Review of India, Vol. 56, No. 4, pp. 43-46.
Mamoria, C.B.,	1975	:	Geography of India, 1st Edition, Shiva Lal Agarwala & Co., Agra-3, pp. 688-700.
Manil, G.,	1959	:	General Consideration of Soil Classification Journal of Soil Science, Vol. X, pp. 5-13.
Ministry of	1957	:	Indian Agriculture in Brief (3rd ed.) Food and Agriculture
Mitra, A.,	1978	:	India's Population Aspects of Quality and Control. Avinav Publication, New Delhi, pp. 500-504.
Mitra, S., and Roy, S.,	1982	:	Changing Pattern of Agricultural Landuse in Rangli-Rangliot (Darjeeling Himalaya) Geographical Review of India, Vol. 4, No. 1, pp. 45-77.
Mohammad, A.,	1978	:	Studies in Agricultural Geographer, Rajesh Publications, New Delhi-2, pp. 28, 102-25.
Mohammad, N.,	1978	:	Agricultural Landuse in India, pp. 173-192.

Moree, H.I.	1944	:	Scops and Cropping, London, p. 40.
Morgan, W.B. And Munton, R.J.C.	1971	:	Agricultural Geography Methuen & Co. Ltd., London.
Mukhopadhyay, M.,	1982	:	Impact of Rainfall on the Net sown Area of Purulia District, Geographical Review of India, Vol. 46, No. 2, pp. 77-79.
Mughal, A.H., Ara, T., Bhattacharjee, P.,	2000	:	Socio-Economic Aspects of Agro-forestry in Rural Sri Nagar of Kashmir Valley, The Indian Foreter, Vol. 126, No. 3, pp. 234-240.
Mukherjee, A.B.	1962	:	Agricultural Geography of Upper-Ganga Yamuna Doab' Indian Geographer, 11(2).
Murthy, R.S.	1979	:	'Modern Techniques of Evaluation of Natural Resources and their Development in Soils, Agriculture, Forestry and Landuse', A Keytone Address in Session V(II) : International Symposium of Resources Engineering and Technology, Bombay.
Nadkarni, M.V.,	1973	:	Agricultural prices and Development with Stability, National Publishing House, Delhi-6, p. 49.
Nath, V.,	1969	:	'The Growth of Indian Agriculture – A Regional Analysis', Geographical Review, Vol. 59, pp. 348-77.
_____	1976	:	National Commission on Agriculture, A bridged Report, Part-IV, Government of India and Ministry of Agriculture and Irrigation, New Delhi.
_____	1992	:	National Geographer, 1992, Vol. XXVII, No. 2

Narayan, N.S.S.,	1990	:	Agriculture, Growth and Redistribution of Income Policy Analysis with a General
Pathak, C.R.,	1986	:	Man, Environment and Settlements in Geography and Environment edited by Singh R.L., New Delhi, pp. 11-16.
_____	1967	:	Progress Report – Geological Survey of India, (unpublished).
Pathak, C.R.,	1986	:	Man, Environment and Settlements in Geography and Environment (ed.), pp. 11-16.
_____	1997	:	Regional Disparities in India, Geo al Review of India, Vol. 56, No. 4, pp. 330-35.
Pathak, H.G.,	1977	:	A study in methodology and crop association regions and their role in agricultural regionalisation. A study in Eastern Uttar Pradesh Himalayan, The National Geographical Journal of India March June, pp. 73-85.
Parikh, K.S.,	1990	:	Equilibrium Model of India, Co-publisher – Allied Publishers Ltd., New Delhi-2, pp. 257-265.
_____	1985	:	Plan for Darjeeling Hill Areas Mid Term Review and Annual Plan, Vol. 1.
Ramchandran, V.K. and Swaminathan, M.,	2002	:	Agrarian Studies, Essay on Agrarian Relations in Less Developed Countries. Published by Tulika books, New Delhi, pp. 329-340.
Randhawa, M.S.	1974	:	Green Revolution : A Case Study of Punjab, Delhi : Vikas Publishing House, p. 5.
_____	1998	:	Resource Based Development in the Russian Far East – Problems and Prospects, Vol. 29, No. 4.
Rhind, D., and Hudson, Ray	1980	:	Methvene & Col. Td. London EC4P, pp. 18-21, 4EE.

Roy Choudhury, C., Mondal, B.K.,	1989	:	Agro-Climatic Zones of West Bengal Geographical Review of India, Vol. 51, No. 2, pp. 13-16.
Riddell, B.,	1965	:	'Statistical Methods in Geographical Research', Geographical Review, Vol. 46, pp. 129-32.
Rind, David and Hudson Ray,	1980	:	Landuse, Methuen and Company, New York-17, pp. 13-15.
Safi, M.,	1967	:	Food, Production, Efficiency and Nutrition in India. The Geographer, Vol. XIV, Aligarh.
_____	1972	:	Measurement of Agricultural Productivity of the Great Indian Plains. The Geographers, Vol. XIX, pp. 4-13.
_____	1984	:	Concept Publishing Company, New Delhi-15, India, pp. 155-58.
Santra, S.,	1993	:	Factors Determining Present Agricultural Landuse of Haora, Vol. 55, No. 3, pp. 53-56.
Sengupta, Smita,	1987	:	problems of Changing Landuse Pattern in the Urban Fringe of Ahmedabad. Geographical Review of India, Vol. 5, No. 1, pp. 77-79.
Shafi, M.,	1967	:	'Food Production Efficiency and Nutrition in India', The Geographer, Vol. XIV, Aligarh.
Shafi, M.,	1972	:	'Measurement of Agricultural Productivity of the Guest Indian Plains.' The Geographer, Vol. XIX, pp. 4-13.
Shah, S.A.,	1999	:	Forests Management Objectives in The Twenty First Century, The Indian Forester, Vol. 26, No. 2, pp. 111-118.
Sharma, N.K., Singh, H.P. and Dadhawal, K.S.	2000	:	Nutrient Returns through little Fall in Populus Deltoids Based Agro Forestry System, The Indian Forester, Vol. 126, No. 3, pp. 295-299.

Shelton, H.M.	2000	:	Tropical Forage Tree Legumes in Agroforestry Systems, Unasylva, Vol. 51, No. 200, pp. 25-32.
Singh, Jarnail	2000	:	Evaluation of System Approach ? and its relevance in present day Forest Management An Introspective View, The Indian Forester, Vol. 126, No. 3, pp. 213-233.
Singh, Jasbir.,	1974	:	An Agricultural Attas of India : A Geographical Analysis – Vishal Publication, Kurukshetra, pp. XXVIT
Singh, Jhujar.,	1994	:	Tube well irrigation and spatial organization of Agriculture, Geographical Review of India, Vol. 56, No. 4, pp. 43-46.
Singh, R.P.	1967	:	Concept of Land Use, Patna University Journal, Vol. 23, No. 1, pp. 52-62.
Singh R.B. and Sen Roy, S.,	2002	:	Crop responses to climatic variability in Mountaneous areas : A case study of Western Himalaya India. National Geographical Journal of India, Vol. 48, pp. 97-106.
Singh, S.B. and Verman Mukesh	2002	:	Modernization of Agricultural Development – A Case Study National Geographical Journal of India, Vol. 48, 2002, pp. 107-116.
Singh, S.,	1994	:	Agricultural Development in India – A Regional Analysis. Kaushal Publications, Shillong-14, pp. 102-108.
Sundaram, K.V.,	1985	:	Geography and Planning, Essays in Honour of Prof. V.I.S., Prakash Rao, Concept Publishing, New Delhi-15, pp. 154-55.
Symons, L.,	1968	:	Agricultural Geography, London, p. 15
_____	1967	:	Ibid.

_____	1993	:	The Indian Geographical Journal Cultural Practices as Determinates of Agricultural Efficiency, Vol. 68, No.2.
Taufique, M.,	2004	:	Inter Regional Variations in Agricultural Productivity in North Bihar, Geographical Review of India, Vol. 66, No. 3.
Thirumalai, S.,	1954	:	Post War Agricultural Problems and Policies in India.
Vaidya, B.C.,	1997	:	Agricultural Land Use in India, First Published by Manak Publications (P) Ltd., New Delhi, p. 79.
Wal Ford, Nigel	2005	:	Agricultural Reconstructing During the Closing Decade of the Twentieth Century : Evidence of Farmsize in South East England, Geography, An International Journal, Vol. 90(3), pp. 238-239.
_____	1964	:	West Bengal Forests, Forests Directorate, Environment of West Bengal, Centenary Commemoration.
Whittlessey, D.,	1936	:	'Major Agricultural Regions of The Earth' Annals of the Association of American Geographers, Vol. 26, pp. 199-240.
Whyte, R.O.	1982	:	The Spatial Geography of Rural Economies, Oxford University Press, Delhi-2, pp. 78-81.
Wang Yu-Tal, Jian Bing	1984	:	The Study of Agricultural Geomorphological Conditions as the Foundation of Agricultural regionalisation – Science Press China.
Wills, J.b.	1962	:	Agriculture and Landuse in Ghana, p. 177.
Yadav, N.P.,	1990	:	Land Reforms and Agricultural Development Commonwealth, Publishers, Delhi-2, pp. 60-85.

Appendix –I

Intensity of Cropping $\frac{\text{Gross Cropped Area}}{\text{Net Cropped Area}} \times 100$

Crop diversification Bhatia (1965)

Icd = % THAC/NC

Icd = Index of crop diversification

THAC = Total harvested of crops

NC = Number of Crops

Measurement of level of production

$$Yi = \frac{Yac}{Yar} \times 100 \text{ and } Ci = \frac{Pac}{Par} \times 100$$

Where Yi = Crop Yield Index

Yac = Average Yield hectare of crop 'a'

Ci = Crop concentration index

Pac = % strength of the crop 'a' in the unit.

Par = % strength of the crop 'a' in the region.

Crop yield and concentration indices coefficient for crop 'a' (RC)

$$Rc = \frac{\dfrac{\text{Crop yield index ranking of crop} + \text{Crop concentration Index ranking of crop}}{2}}{\text{Production}}$$

NORTH BENGAL
DRAINAGE AND IRRIGATION

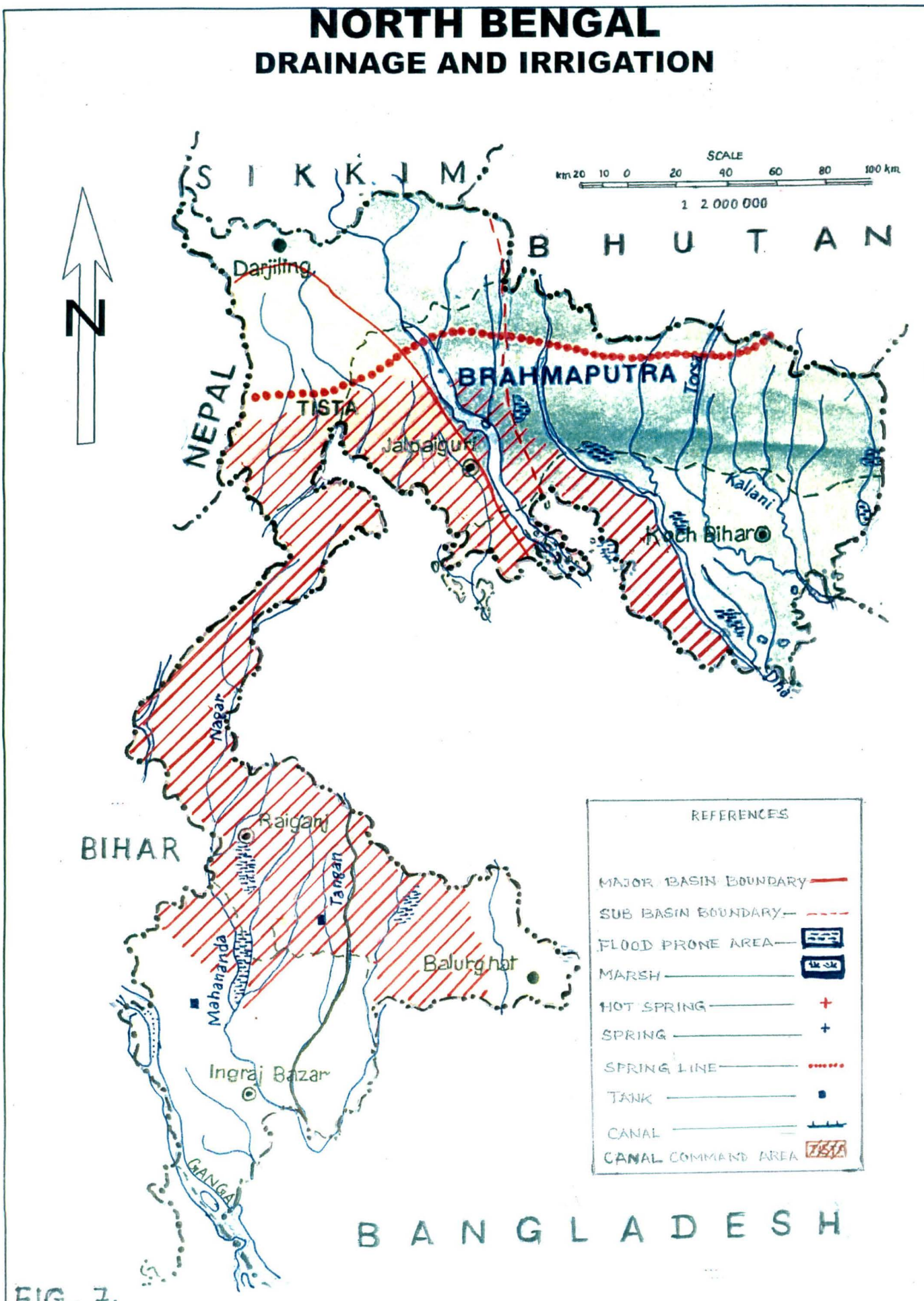


FIG. 7.

Source- NATMO, Kolkata

DISTRICTS OF NORTH BENGAL

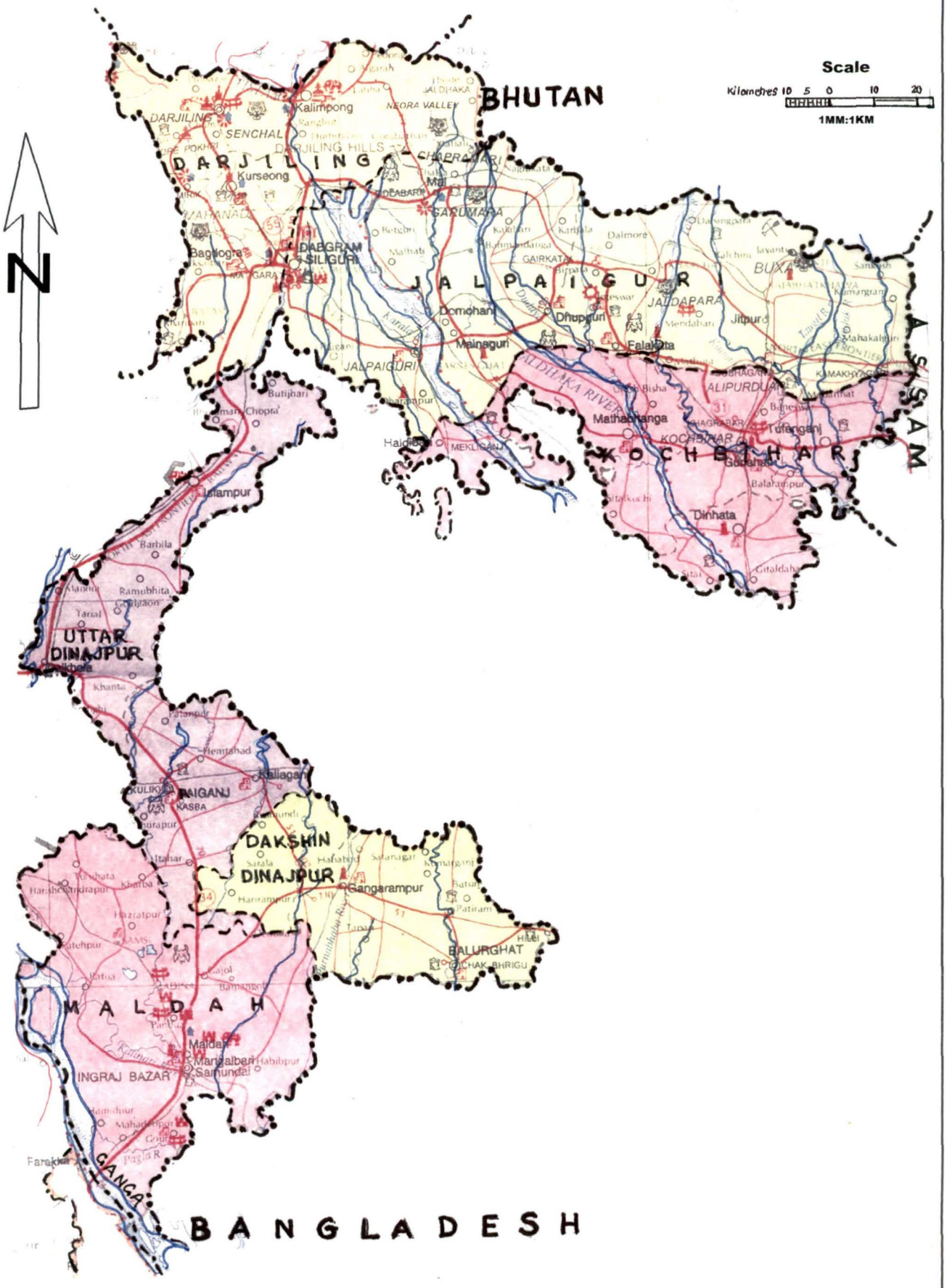
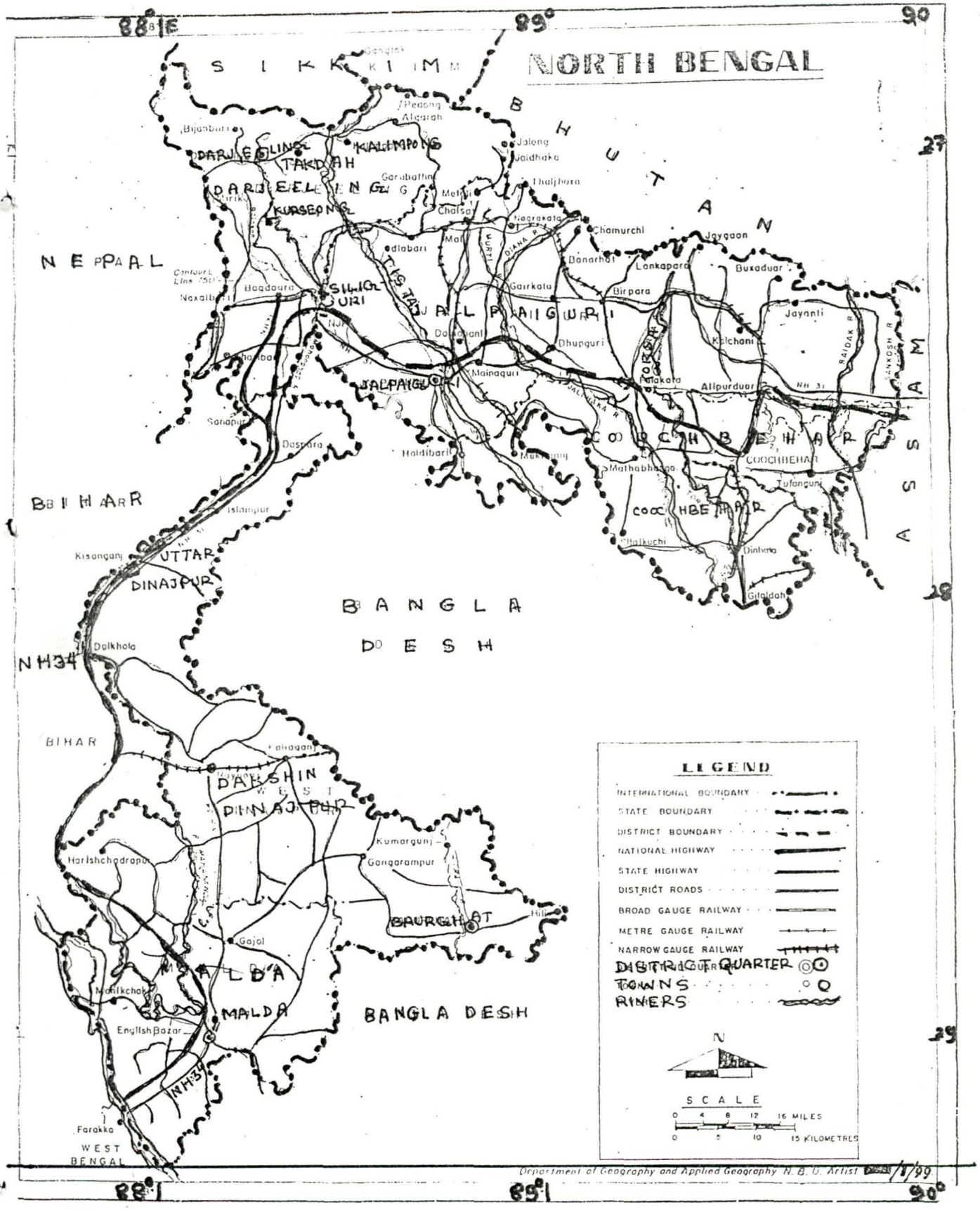


FIG. 0.1

Source- NATMO, Kolkata


NORTH BENGAL
88°E
89°
90
27
28
29
SIKKIM
BHUTAN
NEPAL
BIHAR
BANGLA DESH
ASSAM
DARJEELING
KALIMPONG
TAKDAH
KURSEONG
SILIGURI
JALPAIGURI
JALPAIGURI
COOCHBEHAR
COOCHBEHAR
COOCHBEHAR
UTTAR DINAJPUR
DAKSHIN DINAJPUR
MALDA
MALDA
BANGLA DESH
NH34
NH31
Bijanbari
Pedong
Algarah
Jalong
Jaldhaka
Garubathan
Thaljhora
Chalsa
Chamurchi
Jaygaon
Dalabari
Danarhat
Lankapara
Buxaduar
Naxalbari
Bagdogra
Gairkata
Birpara
Jayanti
Dhupguri
Kalchani
Mainaguri
Falakata
Alipurduar
Sonapur
Dastara
Haldibari
Mathabhanga
Tufanganj
Islampur
Kisanganj
Dalkhola
Halkuchi
Dinhata
Gitaldah
Raiganj
Harishchandrapur
Kumarganj
Gangarampur
BALURGHAT
Gajol
Malkchak
English Bazar
Farakka
WEST BENGAL
LEGEND
INTERNATIONAL BOUNDARY
STATE BOUNDARY
DISTRICT BOUNDARY
NATIONAL HIGHWAY
STATE HIGHWAY
DISTRICT ROADS
BROAD GAUGE RAILWAY
METRE GAUGE RAILWAY
NARROW GAUGE RAILWAY
DISTRICT QUARTER
TOWNS
RIVERS
N
SCALE
0 4 8 12 16 MILES
0 5 10 15 KILOMETRES
Department of Geography and Applied Geography N. B. U. Artist 1/99

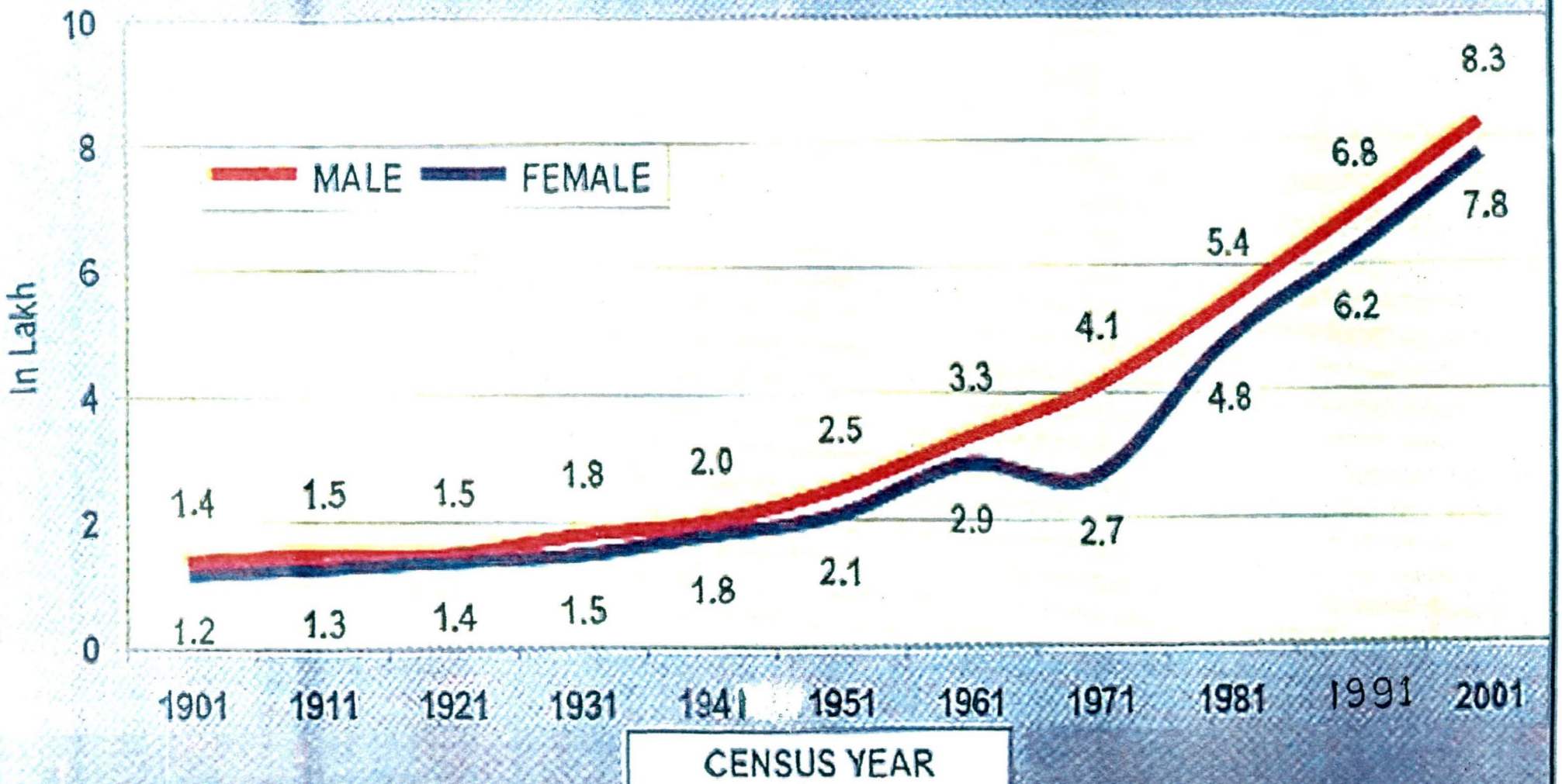


Fig- Line Chart showing population by sex of the district of Darjeeling in Census years 1901 to 2001

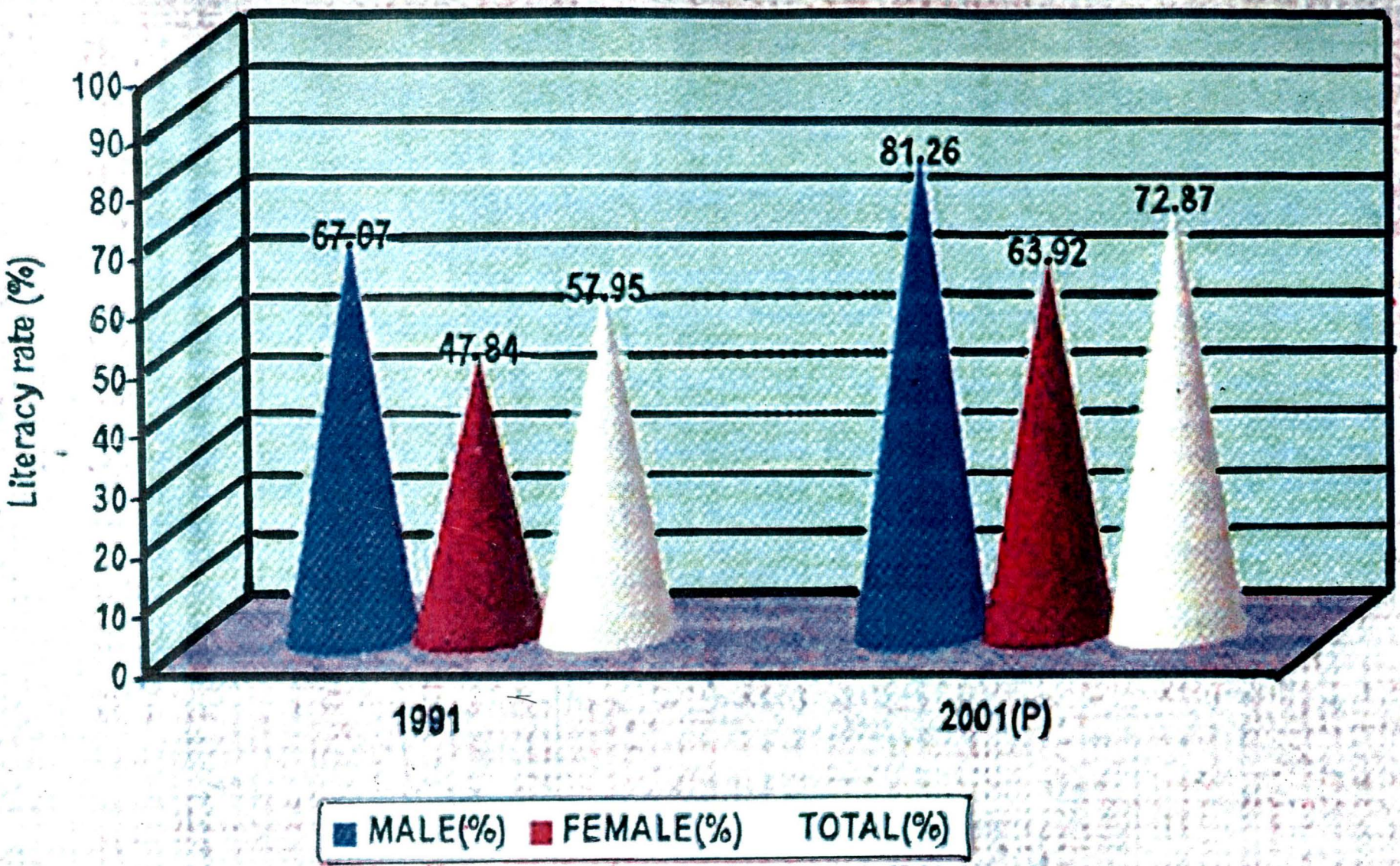


Fig- Literacy rate (percentage) by sex in Darjeeling District as per Census of India, 1991 & 2001