PATTERN OF LAND USE IN EASTERN INDIA
A CARTOGRAPHIC ANALYSIS

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the award of the Degree of

MASTER OF PHILOSOPHY

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CERTIFICATE

This is to certify that the dissertation entitled **"PATTERN OF LAND USE IN EASTERN INDIA: A CARTOGRAPHIC ANALYSIS"** submitted by **Kakali Majumdar**, in partial fulfilment of the requirements for the degree of award of Master of Philosophy of the University, is to the best of my knowledge, a bonafide work and may be placed before the examiners for evaluation.

19/7/96

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Dedicated to

Ma O Baba

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CHAPTER I

INTRODUCTION

Land is a very basic natural resource. A large segment of population depends directly on land for their sustenance. The pattern of landuse is the result of continuous interplay of physical elements like topography, soil, climate and human efforts guided by socio-economic conditions. Landuse shows a reciprocal relationship between prevailing ecological conditions and the cultural attainments of people living in a region. Hence, it has been changing over time in response to numerous demographic, scientific, technological, social and institutional changes. The degree and direction of these changes have made the problem of landuse more complex and increasingly important.

In regional geography there are two leading questions to be answered: to what use is the area in question being put and what are its possibilities?[1] If these primary objectives have to be taken into account in the present study, it is necessary to study the present utilization of land first, and then ascertaining its possibilities temporarily.

The term landuse can be defined as 'The surface utilization of all developed and vacant land of a specific

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[1] C.O. Sauer (1921) "The Problem of Land Classification" Annals of the Association of American Geographers, vol.xi, No.1, p.3.

place at a given time and space'.[2] The primary uses of land are for agriculture, forest, pasture, mining, residential, transport, recreational, industrial, commercial, culturable waste, barren lands etc. In rural areas large proportion of land is put to agricultural uses. But in urban areas much of the land remains under non-agricultural uses such as residential, commercial, industrial, recreational and others. Two major concepts which have attracted wide attention in landuse studies, are: a) optimum landuse, b) multiple landuse. Optimum landuse refers to the two characteristics of land, i.e. its type and intensity of use. It accentuates the utilization of land according to its suitability and capability without disturbing the ecological balance. Landuse is also related to the shifts of land within multiple uses. In other words, landuse is also related to conversion of land from one major use to another general use.[3]

STATEMENT OF THE PROBLEM

Landuse pattern is generally changed to meet the variable demand for land by the society. The demand for new uses of land may be inspired by technological innovation or by a change in the size, composition and requirements of the

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[2] J. Kumar (1986); Land Use Analysis: A Case Study of Nalanda District, Bihar, Inter India Publication, New Delhi, p.1.

[3] M.B. Nanavati (1957), Readings in Land Utilization, The Indian Society of Agricultural Economics, Bombay, p.2.

people. Some changes are short lived whereas other represents more constant demand.[4]

In the historical past there was enough land to support the limited population, but today the growth of population and their resultant needs make the problem of landuse more intricate. The demand for food and other requirements of increasing population cannot be fulfilled by limited available land. In the Asian countries till 1950s, the areas of higher population growth had been characterised by an equally rapid increase in cultivated area.[5] The area under crops increased by 19.78 percent while population grew by 24.78% in India during the decade 1971-81. One of the strategies to meet the increasing food demand may be by extension of net sown area. But land is limited, therefore, the pressure of population compels to ignore the natural limits and farming is extended to physically unsuitable lands. It is creating environmental crisis. As estimated by Planning Commission a vast area in the country is facing the problem of water logging, salinity and alkalinity due to faulty land utilization. Sometimes it results in intensive use of cultivated land and extensive destruction of forest and non-forest public lands like pastures and other grazing lands.

In eastern India, the rapid growth of population,

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[4] J.N. Jackson (1963) Survey for Town and Country Planning. Hutchianson University Library, London, p.109.

[5] Ishikawa (1974), Economic Development in Asian Perspective, Tokyo, Kinokuniya Book Centre, p.64.

urbanisation and industrialization and the introduction of scientific methods of cultivation have brought a large change in landuse pattern. The study is an attempt to look into the competition between landusing activities more particularly the struggle between agricultural and non-agricultural land uses.

OVERVIEW OF LITERATURE

The economic status and the progress of the country may to a great extent be measured by the way in which land is used and maintained. From the earlier periods, numerous studies have been conducted on landuse. The study of landuse not only includes the land classification, use and misuse of land but it also deals with several socio-economic aspects like man land ratio, changing pressure of man on land, landuse change due to scientific innovations.

Mapping of use or nonuse of land has got more attention in earlier studies on landuse. With the publication of Sauer's "Mapping the Utilization of Land" and Jones and Finch's "Detailed Field Mapping of an Agricultural Area" around the 1920s, the era of systematic landuse studies had started. Stamp[6] pioneered the studies related to landuse in Britain. He prepared the landuse map of Britain before the outbreak of First World War.

In the United States several studies on landuse have been

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[6] L.D. Stamp (1962), The Land of Britain: Its Use and Misuse, Longmans Ltd., London.

made. The credit of such studies goes to Baker (1937) who has depicted the trends of landuse in his article entitled "Land Utilization in the USA: Geographical Aspects of the Problem". USA Government also encouraged the landuse study in the country. Although the programme of landuse survey was launched in the year 1935, it was properly executed only after 1938. Nearly one thousand communities were organised and 140,000 individuals mostly layman took part in the work.[7] The organisation undertook the studies of landuse analysis. Special attention was laid on kind of farming, area under forestry wild life, recreation, settlement etc.

The impact of population on landuse has been examined in several studies. Mather[8] (1986) in his book 'Landuse' explained that the principles of landuse are associated with economics and ecology. But it is the product of human decision operating with social and political framework, i.e. individual and groups decide how to use and manage land. According to him, 'one potential landuser may seek to utilize its ecological potential by raising crop or growing animals.'

With regards to landuse studies in India attention has been paid to different aspects of landuse studies. Most of such studies followed the guidelines provided by Stamp. First

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[7] A. Hillman (1957), Community Organisation and Planning, New York; Macmillan, pp.44-48.

[8] A.S. Mather (1986), Landuse, Longman, London.

of all the land utilization survey of 24 Parganas (1945)[9] and Howrah district (1952)[10] were conducted by Chatterjee. He emphasized that landuse survey should be carried out combined with survey of land capability which would help in determining the best use of land.

In 1954, Ahmad[11] analyzed the land use types in relation to physical elements. He considered the natural factors as the determinants of changing landuse. He concluded that the slope of the land should be considered in preparing the development scheme of an Indian village.

Shafi[12] (1961) attempted to study the land utilization in selected villages in eastern Uttar Pradesh. He examined the carrying capacity of agricultural land on the basis of landuse map and population data. He suggested that the scope for the extension of cultivated land in eastern Uttar Pradesh lies mainly in the reclamation of existing wastelands. He also suggested that the improvement of drainage would lead to a better utilization of existing cultivated land. Shafi has considered the physical factors like soil, drainage, climate as major determinants of landuse.

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[9] S.P. Chatterjee (1945), Land Utilisation in the district of 24 Parganas, Bengal, B.C. Law.

[10] _____ (1952), "Land Utilisation Survey of Howrah district", Geographical Review of India, vol.14, no.3.

[11] E. Ahmad (1954), Geographical Essays of India, Patna.

[12] M. Shafi (1961), Land Utilization in Eastern Uttar Pradesh, Aligarh Muslim University, Aligarh.

Similarly, Chauhan (1966) analysed the changing pattern of landuse in Chhalesar village in Agra district. He reported the reduction in cultivated area of the village mainly due to soil erosion. Chauhan[13] also discussed different problems associated with utilization of agricultural land indicating the complimentary character of physical inputs and the relevance of nonphysical cultural inputs in implementing improved agricultural production process. He compared the landuse pattern of India with the world view.

In the study of landuse in Khadar and ravines of Lower Middle Gomati Valley, Mishra (1969)[14] has attempted a planning of landuse for better adjustment of agriculture to the physical environment for optimum exploitation and conservation of natural resources. In 1973, B.K.Roy[15] made an attempt to bring out the determinants of landuse changes in West Bengal. The study clearly pointed out that there are enough scope and possibilities for adjustment in landuse in future. He also studied that the spatial variation in landuse development is found in arable lands due to misuse by unconscious farmers who have tried to maximise arable areas

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[13] D.S. Chauhan (1966), Studies in Utilization of Agricultural Land, Educational Publisher, Agra.

[14] S.N. Mishra (1969) "Landuse in Khadar and Ravine Tract of Lower Middle Gomati Valley", National Geographical Journal of India, vol.XXXI, no.1, pp.4-5.

[15] B.K. Roy (1973) "Determination of Landuse Changes Arable Potential and Land Development in West Bengal", National Geographical Journal of India, vol.xiv, March 1973, pp.15-29.

without assured means of irrigation or fertilisation. In another study on changing landuse in a village of West Champaran district, Bihar M. Prasad (1976)[16] compared the changing use of agricultural land between 1914-15 and 1974-77. He reported 16.7 percent increase in area under cultivation during six decades. But with simultaneous increase in population the availability of cultivated land per capita had decreased.

The natural factors are taken as determinant of agriculture efficiency and landuse pattern in the study of Mandal.[17]

He considered that the variation in agricultural efficiency is due to the various topographic factors, fertility of the soil, intensity of rainfall and irrigation facilities in Bihar. According to him, the nature of land is a vital issue in landuse analysis.

The relationship between increasing population and growing needs of the people was emphasized by Dr. Kumar in 1986.[18] Kumar in his study of Nalanda district of Bihar analysed the various aspects of agricultural landuse which are related to the geographical factors more particularly soil and

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[16] M. Prasad (1976), "Changing use of land in village Serikahia (West Champaran)", Indian Geographical Studies, Research Bulletin, no.-7, September 1976, pp.23-30.

[17] R.B. Mandal (1982), Land Utilization, Theory and Practice, Concept Publishing Company, New Delhi.

[18] J. Kumar (1986), op.cit.

climate coupled with the long period of human occupance and high density of population. He observed that landuse changes have taken place due to socio-economic transformation. There is a tendency of increasing population to maximise the use of land and also the construction of settlement in the fertile land. Chatterjee and Bagchi in their study on delta region of West Bengal brings out the facts that agricultural landuse is changing for the needs of growing population within the region.[19] They reported that the correlation between cropping intensity and population density in this region is very insignificant in 1975-76. According to them, the density is large enough to accommodate in agriculture due to the influx of people from outside.

In 1970, Goswami[20] made a comparison between agro-landuse and population pressure on the basis of 1981 census data. His overall analysis reveals that the increasing density of population forces to take pasture and forest land under cultivation. He also analysed that the increasing man-land ratio creates a great challenge for use of land resources

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[19] S. Chatterjee and K. Bagchi (1984), "Changing Character of Agricultural Landuse in Littoral Tract of West Bengal", The National Geographical Journal of India, Vol.30, no.3, pp.151-163.

[20] D.B. Goswami (1990) "Changing Agro-Landuse and Growth of Population in India", Geographical Review of India, vol.52, no.4, pp.16-26.

for different purposes. Chatterjee[21] in 1995 examined the impact of irrigation on landuse in West Bengal. According to her, irrigation has a direct bearing on cropping intensity which was enhanced further by the presence of favourable ecological setting. She finds that irrigation has led to slight extension of net sown area in the plateau tract of West Bengal.

The overview of existing literatures thus indicate that the study on land utilization have been initiated and well progressed at different levels and at different periods in India. But most of such studies are micro-regional in character being confined to a particular village or district or a small region. The north western part of India has witnessed a substantial development in agricultural land after 1970s. But eastern India has displayed very dismal performance. Nevertheless, this part continued to experience tremendous growth of population which has badly affected the existing landuse pattern of the region. Therefore, the present study aims at exploring the changes in landuse pattern and their different aspects at a broad regional level including three states of eastern India.

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[21] N. Chatterjee (1995) Irrigated Agriculture, A Case Study of West Bengal, Rawat Publications, Jaipur and New Delhi, pp.149-182.

OBJECTIVES OF THE STUDY

The main objectives of the study are as follows:

i) to present the spatio-temporal pattern of landuse in eastern India and to examine the trends in each category of landuse,

ii) to analyse the impact of some of the natural and technological factors on the patterns and trends of land utilization,

iii) to study the nature of relationship between land and man at different time periods.

HYPOTHESES

To analyse the above mentioned objectives the following hypotheses have been formulated.

i) population growth and growth in cultivated area are positively related.

ii) The areas with higher pressure on land has been marked by an equally greater intensity of cropping.

iii) The cropping intensity and the application of technological inputs are directly related.

DATA BASE

The present study is based on the secondary sources of data. The main sources are as follows:

i) Indian Agricultural Statistics, volume II, 1961-64, 1974-77 and 1986-89

Table 1.1 Districts Affected by Changes in Administrative Boundary

Sl. No.	As in 1971	As in 1981	As in 1991
1.	Patna	Patna, Nalanda	Patna, Nalanda
2.	Gaya	Gaya, Nawada, Aurangabad	Gaya, Nawada, Aurangabad, Jahanabad
3.	Sahabad	Rohtas, Bhojpur	Rohtas, Bhojpur
4.	Saran	Saran, Siwan, Gopalganj	Saran, Siwan, Gopalganj
5.	Champaran	Pashchim Champaran Purba Champagan	Pashchim Champaran Purba Champagan
6.	Muzaffarpur	Sitamarhi, Vaishali Muzaffarpur	Sitamarhi, Vaishali,, Muzaffarpur
7.	Darbhanga	Samastipur, Darbhanga, Madhubani	Samastipur, Darbhanga, Madhubani
8.	Munger	Begusarai, Munger	Begusarai, Munger Khagaria
9.	Saharsha	Saharsha	Saharsha, Madhepura
10.	Purnea	Purnea, Katihar	Purnea, Katihar Araria, Krishanganj
11.	Santhal Pargana	Santhal Pargana	Dumka, Godda, Deoghar, Sahebganj
12.	Hazaribag	Hazaribag, Giridih	Hazaribag, Giridih
13.	Ranchi	Ranchi	Ranchi, Lohardaga Gumla

Source: Census of India, 1981 Series I, Part-2-A(i) Appendix-1 [Census of India (1991), Bihar, Series-5, Paper 1].

ii) Orissa Agricultural Statistics, 1986-89

iii) Statistical Data of Bihar, 1991

iv) Bihar Statistical Handbook, 1978

v) Statistical Abstract of Orissa 1974-77

vi) Statistics on Fertilizer and Agriculture in Eastern India, FAI (various volumes from 1975 to 1990)

vii) Effective Demand for Fertilizer in India, May 10, 1970

viii) Census of India, Series I, Part IIA General Population Tables, 1961, 1971, 1981, 1991.

METHODOLOGY:

As aforementioned, the study attempts to examine the trends in landuse pattern. Thus, three time periods have been selected to study the landuse pattern, i.e. early 1960s which represents the triennium averages from 1961 to 1964; mid 1970s which is the average of 1974 to 1977 and late 1980s, the triennium averages of 1986 to 1989.

The eastern India experienced several changes in administrative divisions between 1971 and 1991. West Bengal had recorded a little change. According to 1991 census there are 17 districts in West Bengal which were 16 in 1961. Only one district, 24 Parganas was divided into two parts, North 24 Parganas and South 24 Parganas after 1981. The creation of many new districts in Bihar during the intervening period raised the total number of districts from 17 in 1961 to 42 in 1991. Main changes had taken place after 1971. Table 1.1

gives the list of the districts affected by such changes.

In order to maintain the comparability of analysis, those new districts are clubbed together following the method given by Census of India, Bihar, 1991.

Besides, the following statistical and cartographic techniques have been used in the present study:

i) Proportion of each category of landuse have been calculated for each district in percentage. The formula is

$$= \frac{\text{the area under each landuse type of a district}}{\text{total reporting area of the district}} \times 100$$

ii) The compound growth rate has been calculated to measure the temporal changes of landuse pattern with the help of the following formula:

$$P_1 = P_o\ (1 + r)^n$$

where P_1 = area in the terminal year

P_o = area in the base year

r = compound growth rate

n = number of years in the time period

iii) The data related to population is available for 1961, 1971, 1981 and 1991 in Census of India. Therefore, the mid year population of the period of study has been calculated to show the comparison between population and landuse. It is projected with the help of the formula of exponential growth rate, i.e.

$$P_1 = P_o.e^{rt}$$

where r = exponential growth rate

e = exponential constant

t = time between two periods

P_1 = population of the terminal year

P_o = population of the base year

iv) The intensity of cropping and irrigation have been calculated by the following method:

$$\text{Cropping intensity} = \frac{\text{Gross cropped area}}{\text{Net sown area}} \times 100$$

$$\text{Irrigation intensity} = \frac{\text{Gross irrigated area}}{\text{Net irrigated area}} \times 100$$

v) Agricultural density has been calculated by the method provided by Trewartha in 1953. This is as follows:

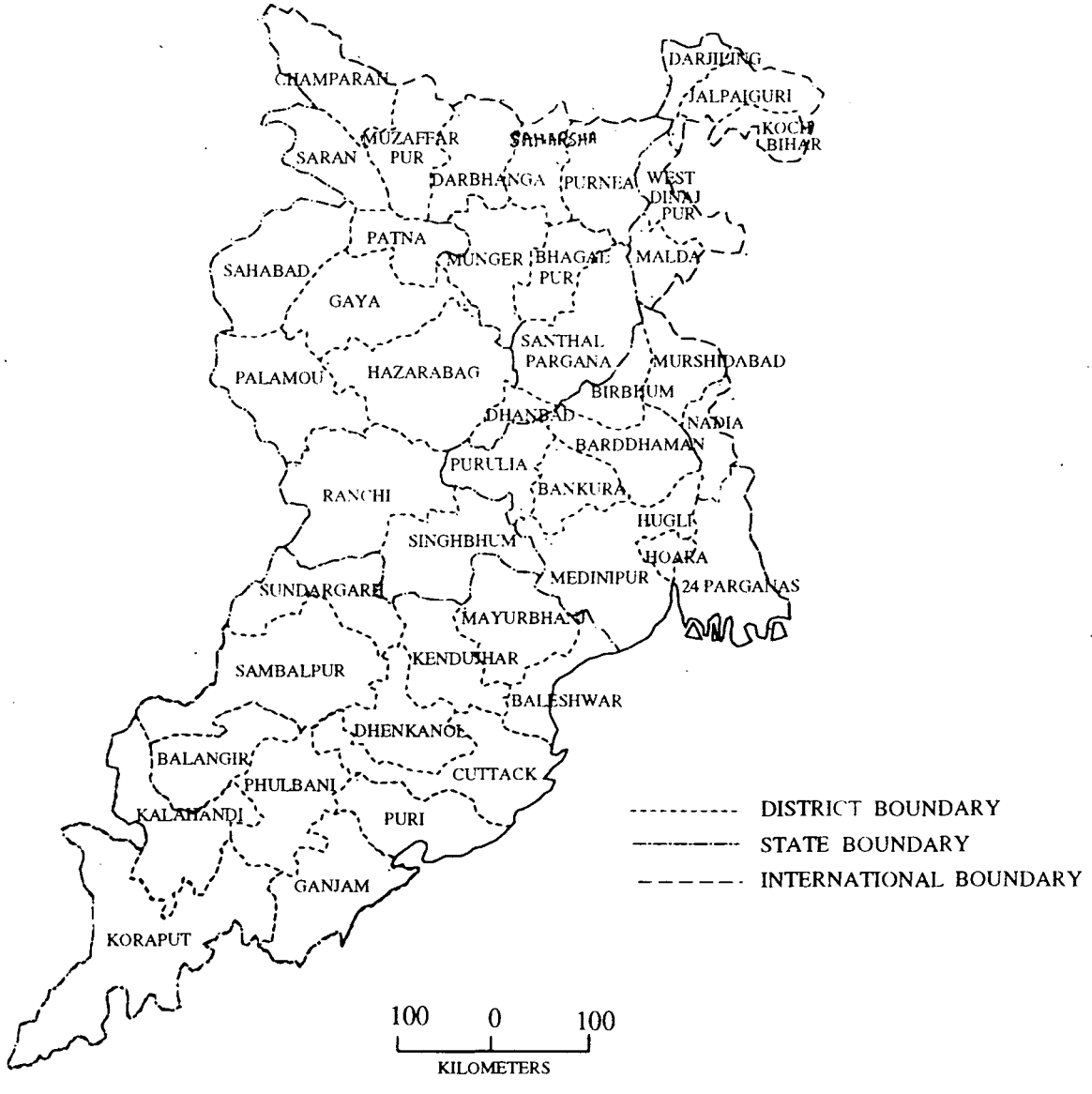
$$\text{Agricultural density} = \frac{\text{Total agricultural population of a district}}{\text{Total cultivated area of the district}}$$

vi) Similarly, land-man ratio is calculated by

$$\text{Land-Man ratio} = \frac{\text{Net sown area}}{\text{Total population}}$$

EASTERN INDIA

STUDY AREA



DISTRICT BOUNDARIES ACCORDING TO 1961 CENSUS

Fig .1.1

vii) Choropleth and Chorochromatic maps have been drawn to show the pattern of landuse, rainfall, fertilizer and distribution of population.

viii) An attempt has been made in the present research to ascertain if any relationship exists between the following variables. It has done with the help of simple correlation techniques. The variables are:

X_1 = Annual rainfall (mm)

X_2 = Percentage of forest land to total reporting area

X_3 = Percentage of fallow land to total reporting area

X_4 = Percentage of net sown area to total reporting area

X_5 = Cropping intensity

X_6 = Fertilizer consumption (kg/hectare)

X_7 = Irrigation intensity

X_8 = Percentage of net irrigated area to net sown area

ix) The relationship between different variables have also been analysed by bivariate mapping.

AREA OF THE STUDY

The study area covers Bihar, Orissa and West Bengal States of India. It extends from 17°48'N to 27°31'N latitudes and 81°24'E to 89°50'E longitudes, (Fig.1.1) and covers an area of 417,511 sq.kms, is one of the most thickly populated parts of India. Whereon nearly 12.73% of the total

geographical area, as much as 22.02% of the population of the union resides, exhibiting an average density of 360 persons per sq.kms against the nation's average of 208 persons per sq.km. Situated in the eastern part of Indian cub-continent, this region is bounded by the states namely Uttar Pradesh and Madhya Pradesh on the west and Andhra Pradesh on the southwest. The Bay of Bengal washes the southern and south eastern parts of eastern India. The boundary of the region touches Bangladesh in the east and Nepal, Bhutan and Sikkim in the north.

It comprises several natural regions such as, middle Ganga plain, lower Ganga plains, Chotanagpur plateau, Orissa uplands, northern part of east coastal plan and a part of eastern Himalayas. The part of middle Ganga plains usually termed as Bihar plain constitute two units, the north Bihar plain and the south Bihar plain. The north Bihar plain is absolutely monotonous and flat whereas, in the south Bihar plain, isolated hills could be seen which are basically the outliers of Chotanagpur plateau. The lower Ganga plain, stretching from Jalpaiguri and Siliguri to Sundarban creeks of West Bengal, is a flat featureless alluvial plain. The Chotanagpur plateau is basically a series of plateaus seperated from each other by intermediate valleys while Orissa uplands with complex denuded hills, plateaus, sharp ridges and mature valleys presents a complicated physical set up. The coastal plain is spread over the part of Puri, Cuttack,

Baleshwar and Ganjam districts of Orissa and in the north eastern extreme Darjiling and parts of Jalpaiguri districts attached to the world's loftiest mountain range.

The Ganga river system drains almost the whole of Bihar and Bengal. It receives water from a large number of tributaries like Ghaghra, Gandak, Kosi from the north and Son from the south. The Chotanagpur plateau is drained by Damodar, Subarnarekha, Kiol rivers wheras Orissa uplands are drained by Mahanadi, Brahmani and Baitarani rivers. On an average, the region displays all characteristics of a tropical monsoon type of climate although it represents a remarkable variation owing to its size, position and diversities in relief. The alluvial soils cover major parts of eastern India, particularly the plains of Bihar, West Bengal and coastal plain of Orissa. On the other side, laterite and red soils are found in Chotanagpur plateau and Orissa uplands.

ORGANIZATION OF THE STUDY

The introductory chapter is dealing with the statement of the problem, overview of literature, objectives, hypotheses, database, methodology and the study area.

The second chapter has been devoted to analyse the spatial pattern of landuse in terms of the proportion of area under different categories. The temporal changes in landuse pattern in terms of growth rates have also been examined in this chapter. This has been done at the district level for

three different time periods, i.e., 1961-64, 1974-77 and 1986-89.

In the third chapter the impact of some selected natural and technological determinants on landuse pattern have been examined.

The fourth chapter presents the analysis of the relationship between man and land. It has been studied with the help of agricultural density, man land ratio and growth rate of population during three time periods.

Lastly, the fifth chapter has brought out the summary and conclusion of the analysis of the study.

CHAPTER II

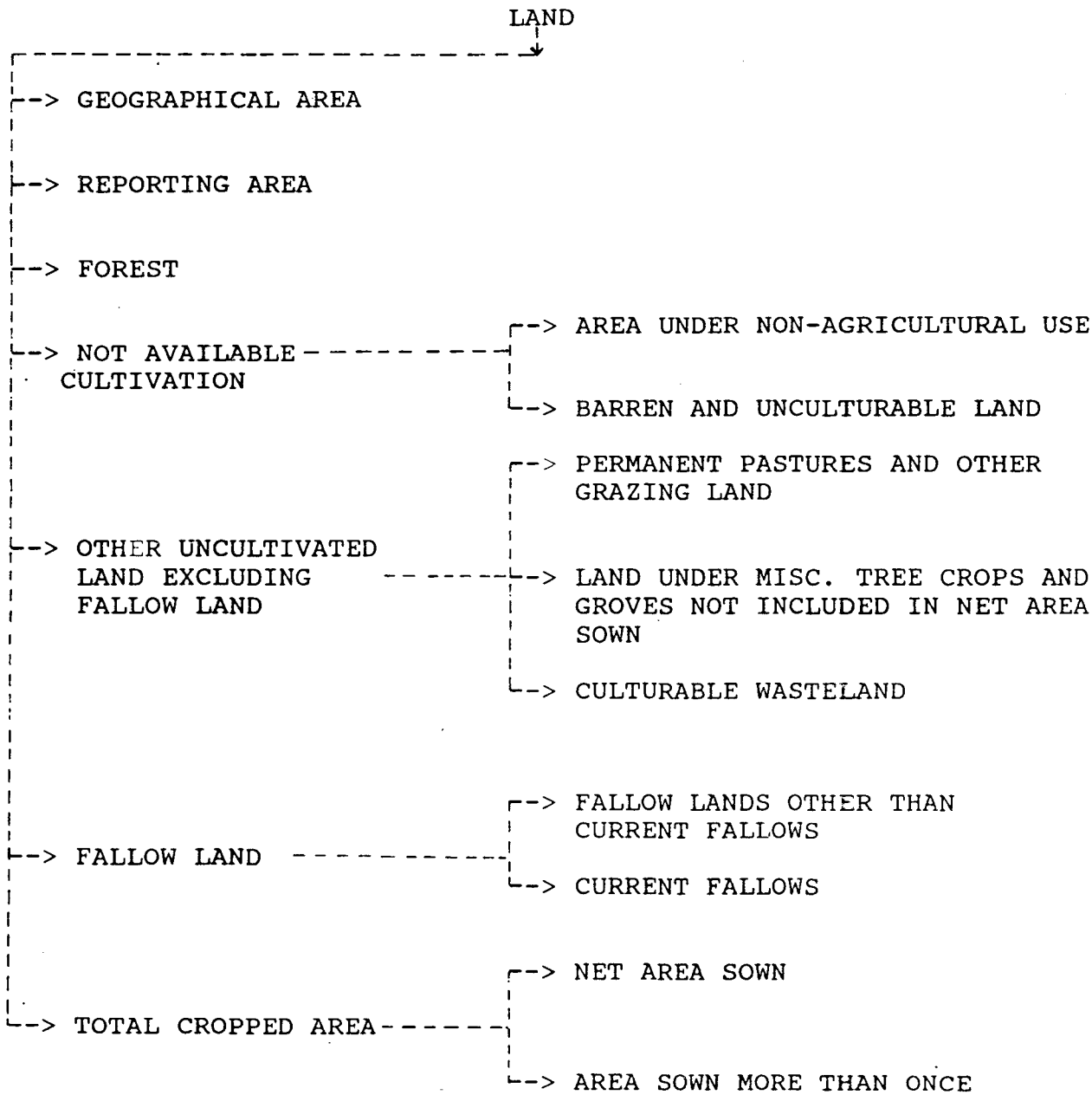
SPATIO TEMPORAL ANALYSIS OF LAND USE PATTERN

The land use patterns in eastern India have been changing over time and space. The main factors responsible for these changes are climatic parameters, soil characteristics, slope of the land, degree of erosion and other social and cultural factors. Landuse categorization depends upon the scheme of land classification. It refers to division of land into different categories according to the factors taken for classification. Stamp[1] classified the use of land into six categories, viz. the need of work, home, food, transportation, communication, defence and recreation. In India, the National Atlas Organisation in 1957 adopted a ninefold classification identified by the Revenue Department. According to the Ministry of Agriculture, land has been classified into the categories given in table 2.1.

An attempt has been made, in this chapter, to analyses the landuse categories in eastern India during three selected time periods, i.e., 1961-64, 1974-77 and 1986-89. The triennium averages of the values have been calculated for each period. To discuss the spatial and temporal variations in each category of landuse, two parameters have been taken into account:

[1] L.D. Stamp (1948) The Land of Britain and How it is used, London, Longman.

Table 2.1 Landuse Classification in India



Source: Ministry of Agriculture, India

Table 2.2 Land Utilization Pattern in Eastern India

Area in '000 hectares

Status	West Bengal			Bihar			Orissa		
Year	1961-64	74-77	86-89	1961-64	74-77	86-89	1961-64	74-77	86-89
Total reporting area	8588	8821	8846	17338	17328	17329	15532	15536	15540
Forest (%)	1106 (12.49)	1188 (13.47)	1123 (12.69)	3710 (21.39)	2806 (16.19)	2923 (16.86)	3573 (23.00)	6367 (40.98)	5580 (35.90)
Area not available for cultivation (%)	1291 (14.57)	1329 (15.06)	1761 (19.91)	2264 (13.06)	2676 (15.44)	3047 (17.58)	2556 (16.45)	862 (5.55)	1173 (7.54)
Culturable waste land (%)	NAS	383 (4.34)	113 (1.28)	NAS	479 (2.76)	395 (2.28)	NAS	354 (2.28)	456 (2.93)
Fallow land (%)	349 (3.94)	161 (1.82)	432 (4.88)	1996 (11.51)	2602 (15.01)	2977 (17.18)	994 (6.40)	973 (6.26)	728 (4.69)
Net sown area (%)	5481 (61.87)	5591 (63.38)	5358 (60.56)	8417 (48.54)	8389 (48.41)	7587 (43.78)	5881 (37.86)	5907 (38.02)	6166 (39.68)

% = percentage to total reporting area

NAS = not available separately

Source: Agricultural Statistics, vol.2, Table 1, 1961-64, 1974-77, 1986-89

i) percentage of each landuse category to total reporting area,

ii) compound growth rate of each landuse type.

This chapter has been divided into two sections. The first section deals with the utilization of non-arable land. whereas the second section deals with utilisation of arable land.

SECTION I

II.1 Utilisation of Non-Arable Land

Forest

Forest areas differ from plains to mountains with different altitudes. In eastern India, forests are largely concentrated in south western hills and northern plateaus of Orissa, Chotanagpur plateau of Bihar and northern hilly districts of West Bengal. But the area under forests is comparatively less in north and south Bihar plains, coastal districts of Orissa and alluvial plains of West Bengal. It is evident that physiography plays an important role in spatial distribution of forest. To examine the spatial variation, area under forests has been divided into five categories. The districts having more than 40 percent of the total reporting area under forest have been considered as 'very high' category. 'High category' includes the districts having 30 to 40 percent area under forest whereas 'medium category' includes 20 to 30 percent area under forest. Similarly, the

EASTERN INDIA

AREA UNDER FOREST

(TRIENNIUM AVERAGE 1961-1964)

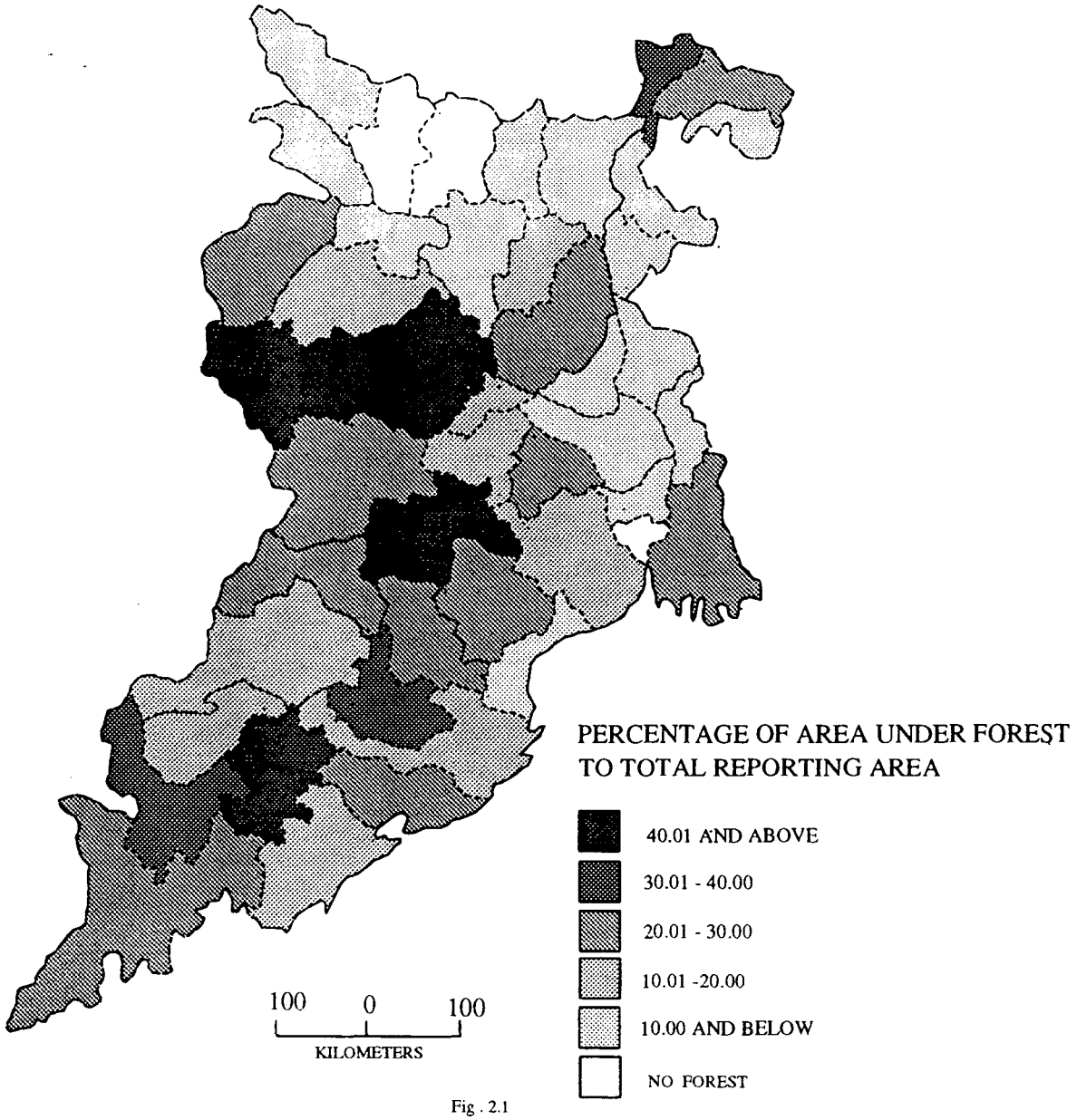


Fig . 2.1

districts having 10 to 20 percent forest area have been put under 'low category' while 'very low category' includes areas with below 10 percent forest cover. The figures 2.1, 2.2 and 2.3 show the proportions of area under forest during 1961-64, 1974-77 and 1986-89 respectively.

During the period 1961-64, about 20 percent of the total reporting area in eastern India was under forest. Area under forest was the lowest in West Bengal (12.49 percent) followed by Bihar (21 percent) and Orissa (23 percent). The proportion of area under forest was very high in Singhbhum, Palamau and Hazaribag districts of Bihar and Phulbani district of Orissa. A very high proportion of areas under forest was reported in Darjiling, Dhenkanal and Kalahandi districts, covering 30 to 40 percent of total reporting area whereas area under very low proportion of forest cover was recorded in northern and southern Bihar plains and the alluvial plains of West Bengal. In the remaining districts of eastern India, the forest covers ranged between medium to low proportion (Fig. 2.1).

In Orissa, the proportion of area under forest increased considerably from 1961-64 to 1974-77. The state's average forest land was above 40 percent in 1974-77 (table 2.2). The districts which reported a very high proportion of area under forests were Koraput, Phulbani, Dhenkanal, Kendujhar, Sundargarh, Mayurbhanj in Orissa; Palamau, Hazaribag in Bihar. Phulbani district accounted for more than 75 percent of its total reporting area under forests. High proportion of forest

EASTERN INDIA

AREA UNDER FOREST

(TRIENNIUM AVERAGE 1974-1977)

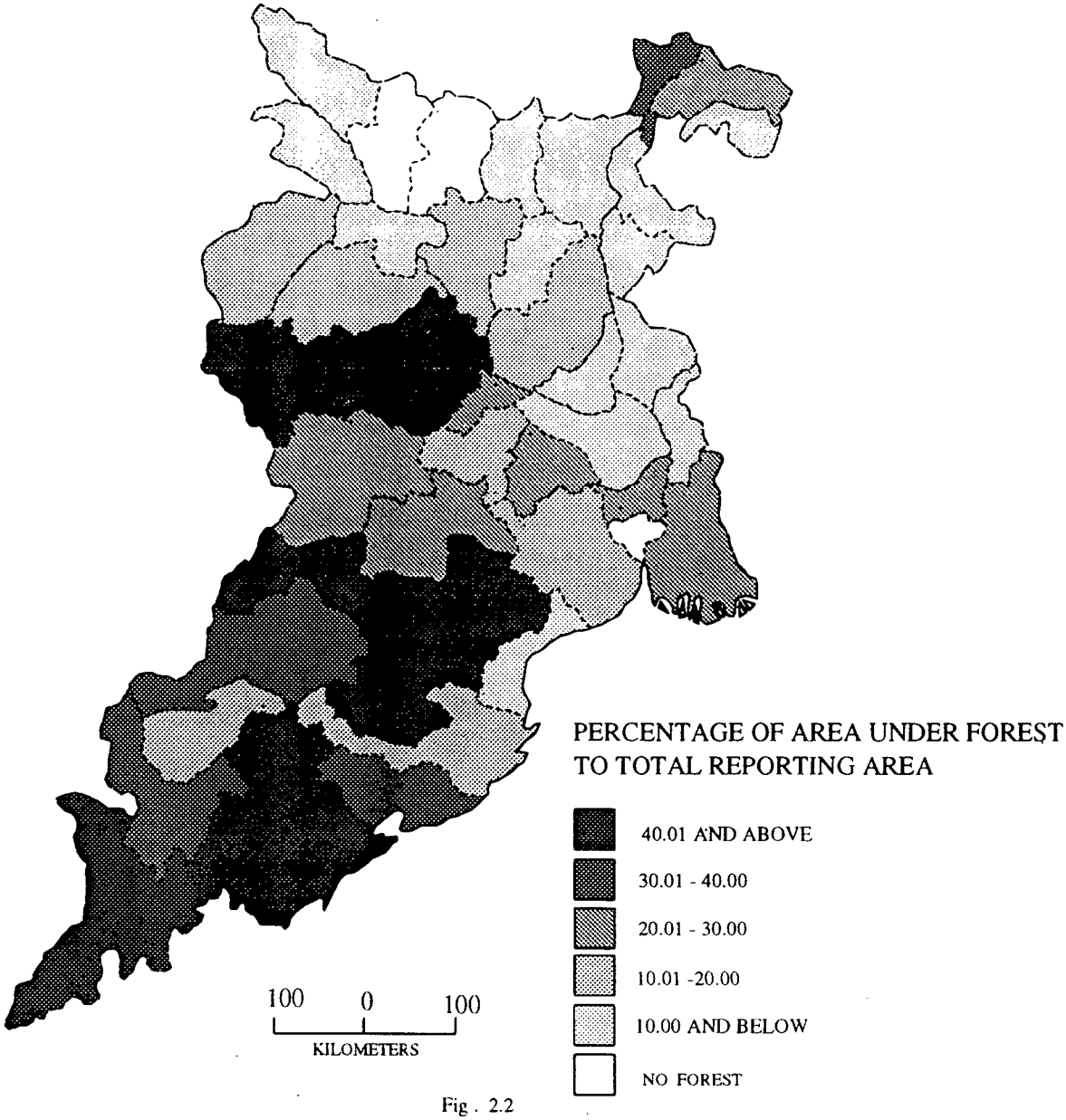


Fig . 2.2

EASTERN INDIA

AREA UNDER FOREST

(TRIENNIUM AVERAGE 1986-1989)

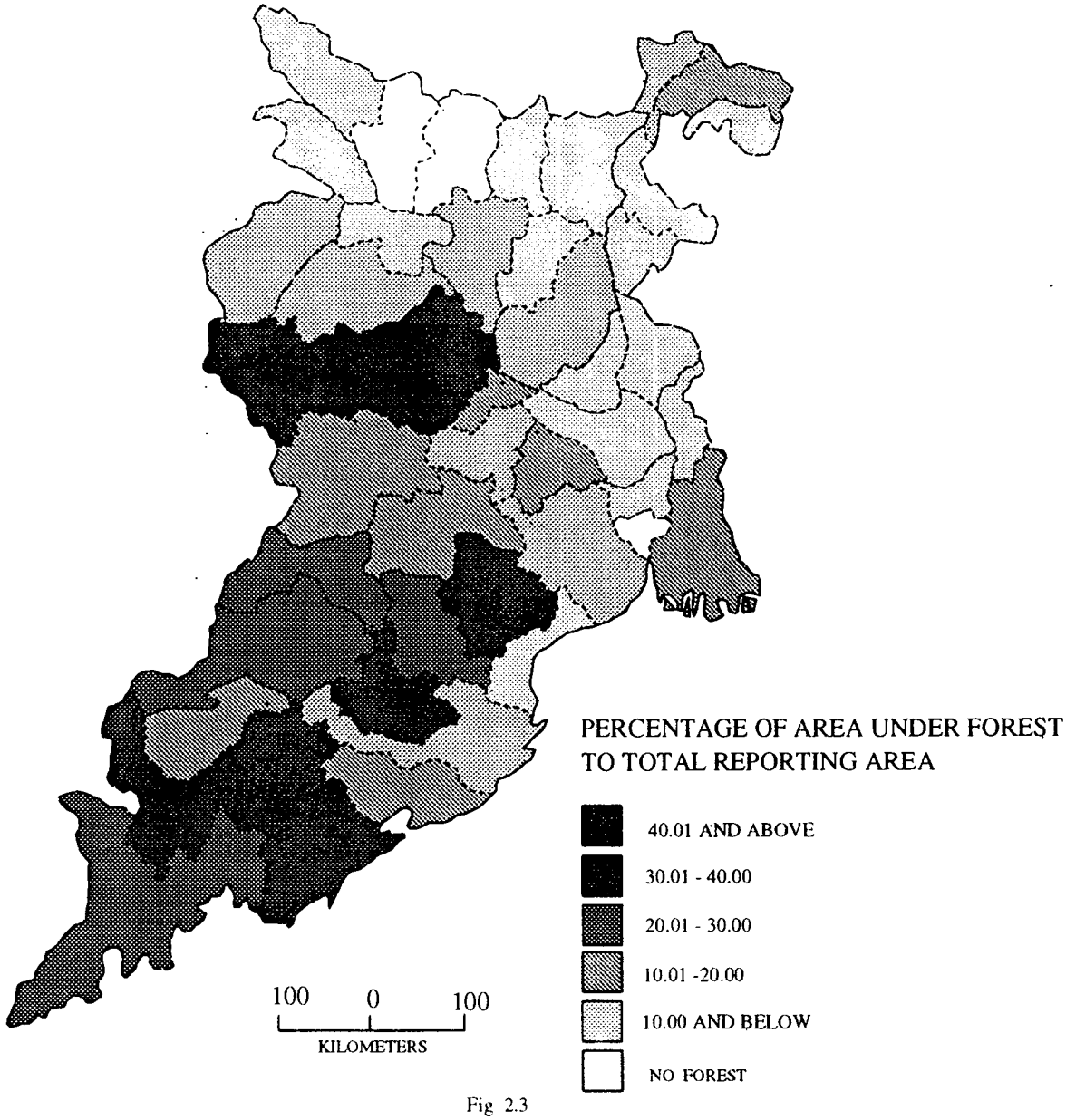


Fig 2.3

cover was found in Sambalpur, Kalahandi, Puri and Darjiling districts (Fig. 2.2) whereas Ranchi, Singhbhum, 24 Paraganas, Bankura, Hugli and Jalpaiguri districts had reported medium proportions and the remaining districts reported low proportion of forest area.

In Orissa the area under forest decreased to 35 percent in 1986-89 whereas in Bihar and West Bengal, it remained unchanged during this period. The decline in area under forest was profound in Kalahandi, Kendujhar and Sambalpur districts of Orissa. Low proportions of decrease have been registered in northern half of Bihar, alluvial plains in the northern and southern districts of West Bengal and coastal districts of Orissa. In Darjiling district of West Bengal a drastic decline in area under forest was observed in the same period (Fig. 2.3). The three districts namely Muzaffarpur, Darbhanga and Haora had no forest cover during three periods of study.

An examination of the annual growth rate of area under forest reveals that there has been an increase in forest area from 1961-64 to 1986-89 in the states of West Bengal and Orissa. Only three districts of Orissa, namely, Baleshwar, Cuttack and Purulia experienced low negative growth rate of forest area. The rate of growth was high (above 4 percent) in Mayurbhanj, Sundargarh, Sambalpur, Kendujhar, Koraput and Ganjam districts of Orissa; and Malda, Nadia, Birbhum districts of West Bengal. The southern coastal and alluvial plains, northern hilly districts of Orissa and West Bengal had

EASTERN INDIA

GROWTH RATE OF AREA UNDER FOREST

(1974-77 OVER 1961-64)

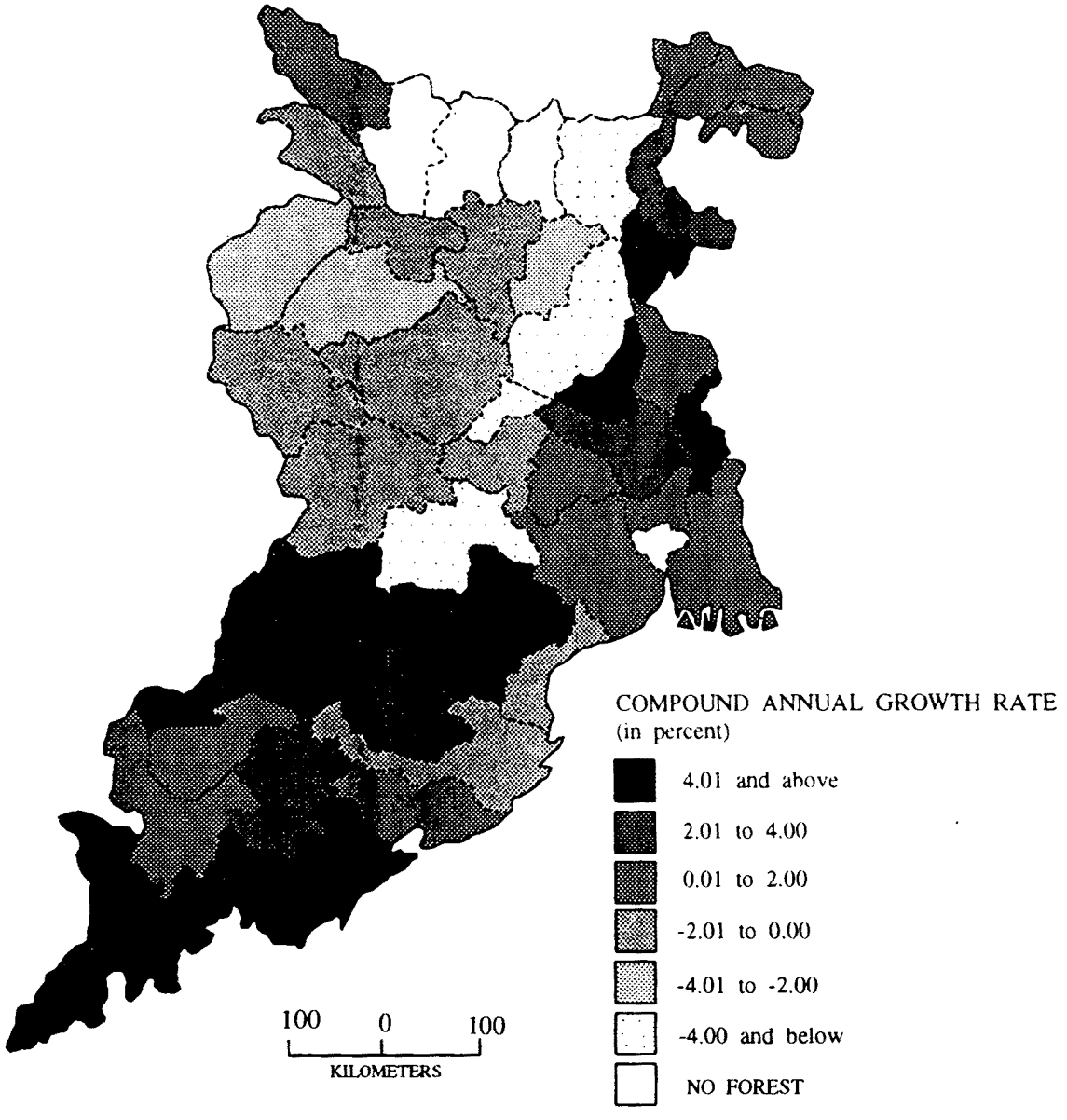


Fig . 2.4

EASTERN INDIA

GROWTH RATE OF AREA UNDER FOREST

(1986-89 OVER 1974-77)

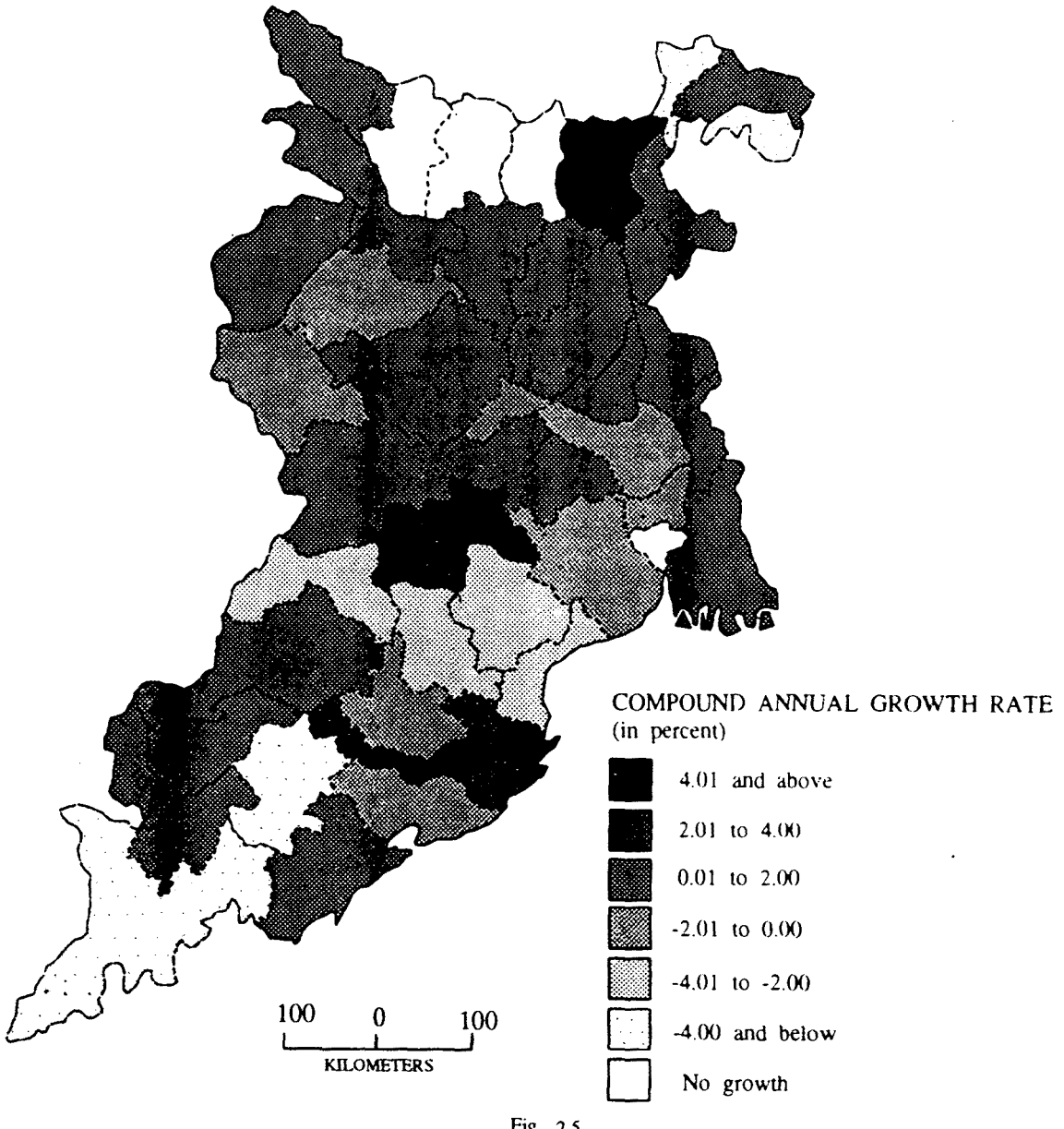


Fig . 2.5

experienced low rate of growth (0 to 2 percent) in area under this category (Fig. 2.4). Growth was negative in all districts of Bihar except Champaran which witnessed low growth rates. The negative rate of growth in area under forest was high (-4%) in Singhbhum, Dhanbad, Santhal Pargana, Saharsa and Purnea districts, medium (-2 percent to -4 percent) in Gaya and Sahabad districts and at a low rate of decrease (0 to -2 percent) in rest of the districts.

However, in comparison to the previous trends, the area under forest increased considerably from 1974-77 to 1986-89 in all the districts of eastern India except Palamau, Dhanbad and Gaya districts. Six districts out of 13 districts in Orissa and 10 out of 15 districts in West Bengal experienced positive trend in area under forest. In all these districts the rate of growth was low whereas Purnea and Cuttack recorded high growth rates (Fig. 2.5). Forest area declined at a higher rate in Koraput and Darjiling but at a medium rate in Phulbani, Kendujhar, Baleshwar and Sundargarh. Low rate of decline was registered in Puri, Dhenkanal, Hugli, Barddhaman, Gaya and Palamau districts.

The growth rate of area under forest over 25 years from 1961-64 to 1986-89 shows the positive in trends in major parts of eastern India comprising 12 districts of Orissa, 13 districts of West Bengal and 5 districts of Bihar. The area under forest had grown at a higher rate in Ganjam, Birbhum and Malda districts, at a medium rate in Sambalpur,

EASTERN INDIA

GROWTH RATE OF AREA UNDER FOREST

(1986-89 OVER 1961-64)

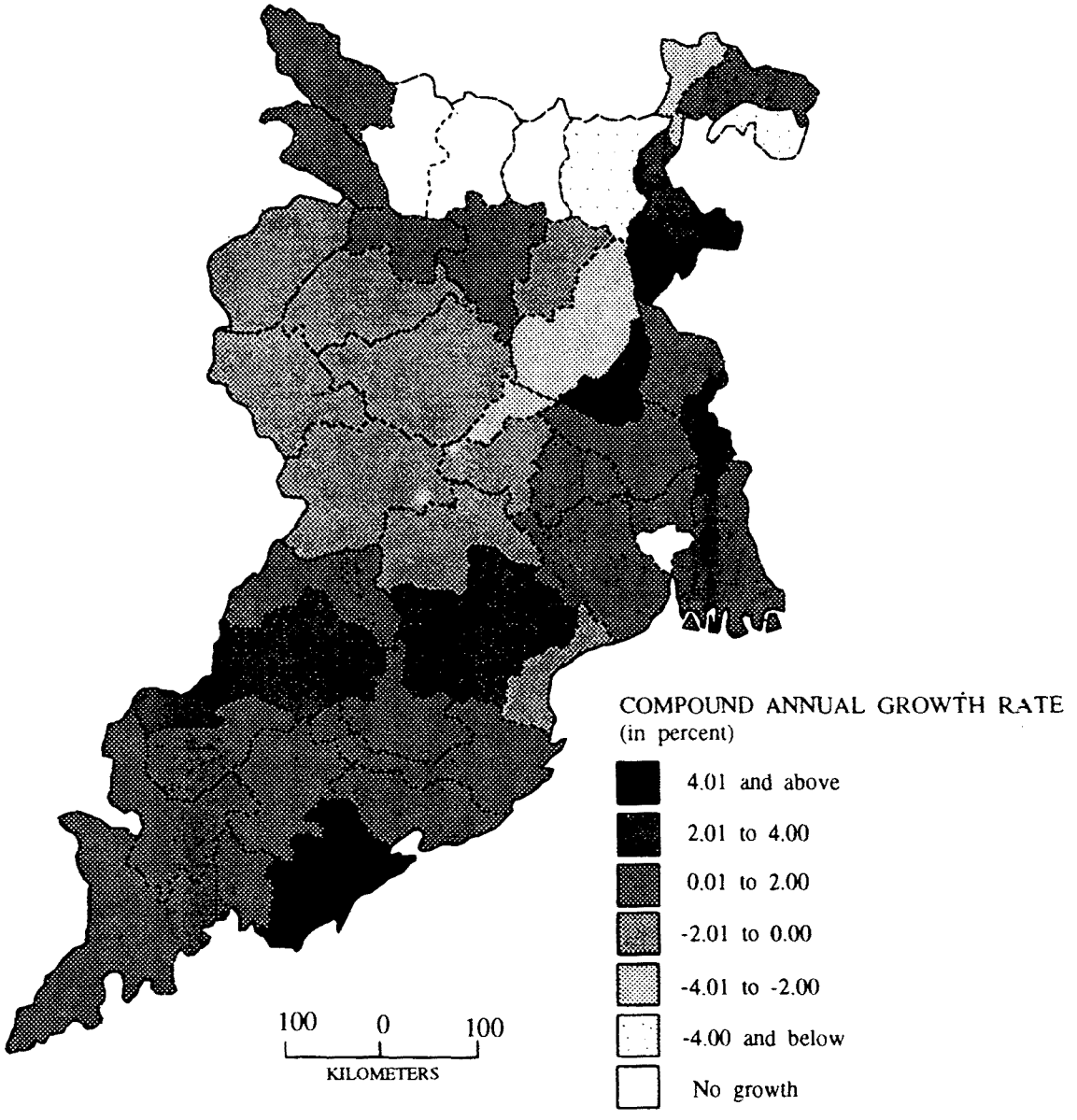


Fig . 2.6

Mayurbhanj, Kendujhar, Nadia, West Dinajpur districts and at a low rate in the remaining 22 districts. The trend was mainly negative in southern and central districts of Bihar, western and northern districts of West Bengal and coastal districts of Orissa. The rate of growth was highly negative in Purnea district while the remaining districts reported moderate to low negative growth rates.

Area Not Available For Cultivation

This category consists of two types of land: (i) land put to non-agricultural uses (ii) barren and unculturable land. In 1961-64, about 14 percent of the total reported area in eastern India was included in this category. It declined to 11 percent in 1974-77 whereas in 1986-89, it resumed the previous trend of 14 percent. In the present discussion, the districts are categorized according to the proportion of area not available for cultivation. The categories are as follows: 'very high category' having more than 20 percent area under this use, 'high category' accounting 15 to 20 percent area, 'medium category' with 10 to 15 percent area , 'low category' of 5-10 percent and 'very low category' with below 5 percent area not available for cultivation. The pattern of landuse under this category has been shown in Figures 2.7, 2.8 and 2.9.

In 1961-64, the proportion of area under this category was very high in Koraput, Sambalpur, Darjiling, Haora, Dhanbad

EASTERN INDIA

AREA NOT AVAILABLE FOR CULTIVATION

(TRIENNIUM AVERAGE 1961-1964)

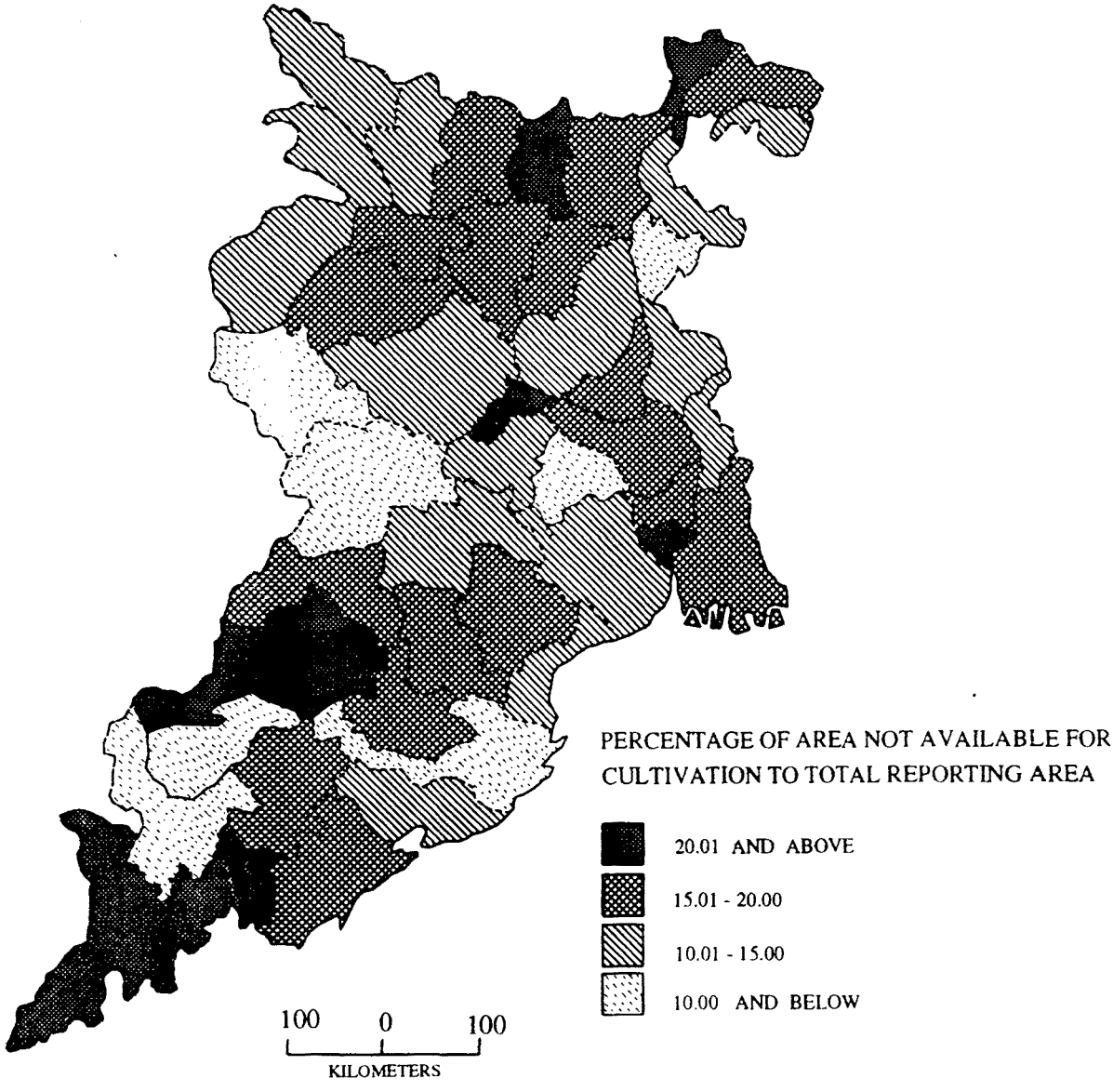


Fig . 2 .7

EASTERN INDIA

AREA NOT AVAILABLE FOR CULTIVATION

(TRIENNIUM AVERAGE 1974-1977)

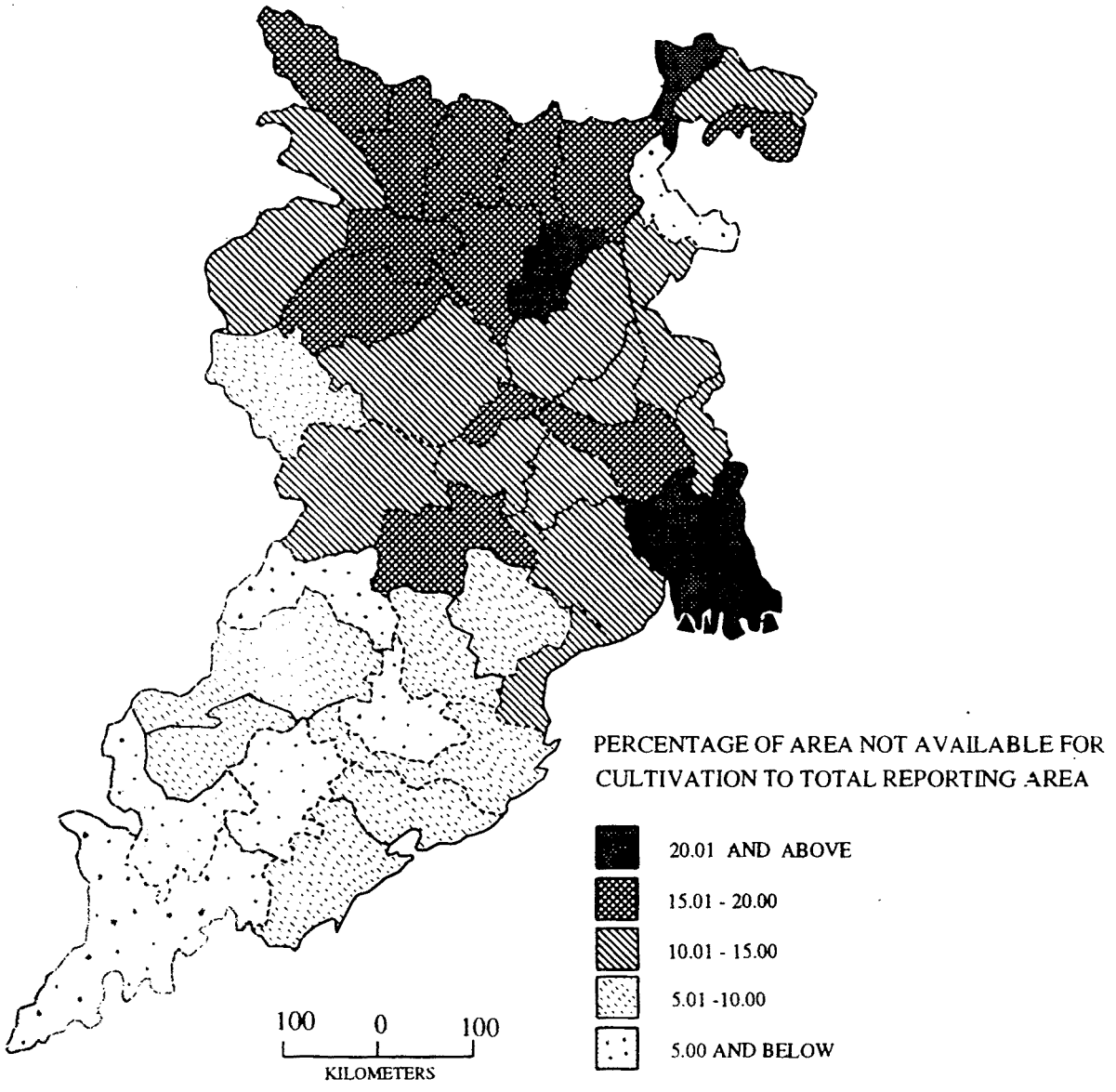


Fig . 2.8

and Saharsa districts. It was highest in Dhanbad accounting for 27.42 percent of the reporting area. The districts having high proportion of area not available for cultivation were scattered over south Bihar plain, northern hills and plateaus of Orissa, coastal and alluvial plains of West Bengal. But the proportions were low in a few districts viz. Ranchi, Bankura, Palamau, West Dinajpur, Cuttack, Kalahandi and Balangir districts (Fig.2.7).

During 1974-77 very high proportions of areas were registered as not available for cultivation in 24 Parganas, Haora, Hugli, Darjiling districts of West Bengal and Bhagalpur district of Bihar (Fig.2.8). Contrary to this, very low proportion was recorded in Koraput, Kalahandi, Phulbani, Dhenkanal, Sundargarh districts of Orissa. The state average was high in West Bengal (15.06%), Bihar (15.44%) as compared to Orissa (5%). The overall distribution showed that the area under this category highly dominated the land use pattern in north and south Bihar plains, alluvial plain and the Terai plain of West Bengal where forest cover was very low.

In 1986-89, the state average increased in all three states of eastern India. It was highest in West Bengal (19.91%) followed by Bihar (17.58%) and Orissa (7.54%). Very high proportions were reported by the districts of north and south Bihar plain, coastal and alluvial plain and northern districts of West Bengal (Fig.2.9). The proportion varied from high to medium in eastern plateau and Barind plain of

EASTERN INDIA

AREA NOT AVAILABLE FOR CULTIVATION

(TRIENNIUM AVERAGE 1986 - 1989)

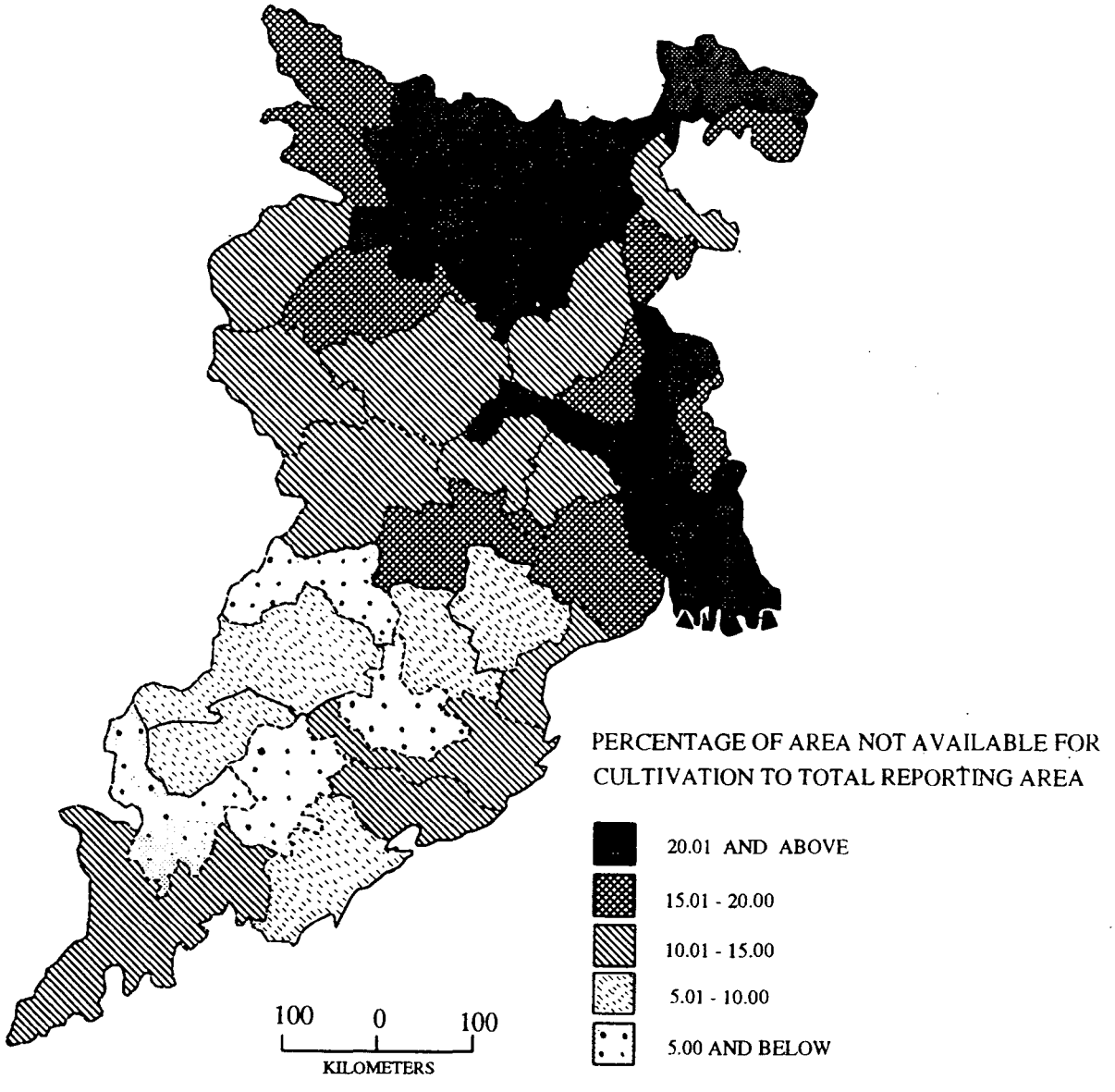


Fig . 2.9

EASTERN INDIA

GROWTH RATE OF AREA NOT AVAILABLE FOR CULTIVATION

(1974-77 OVER 1961-64)

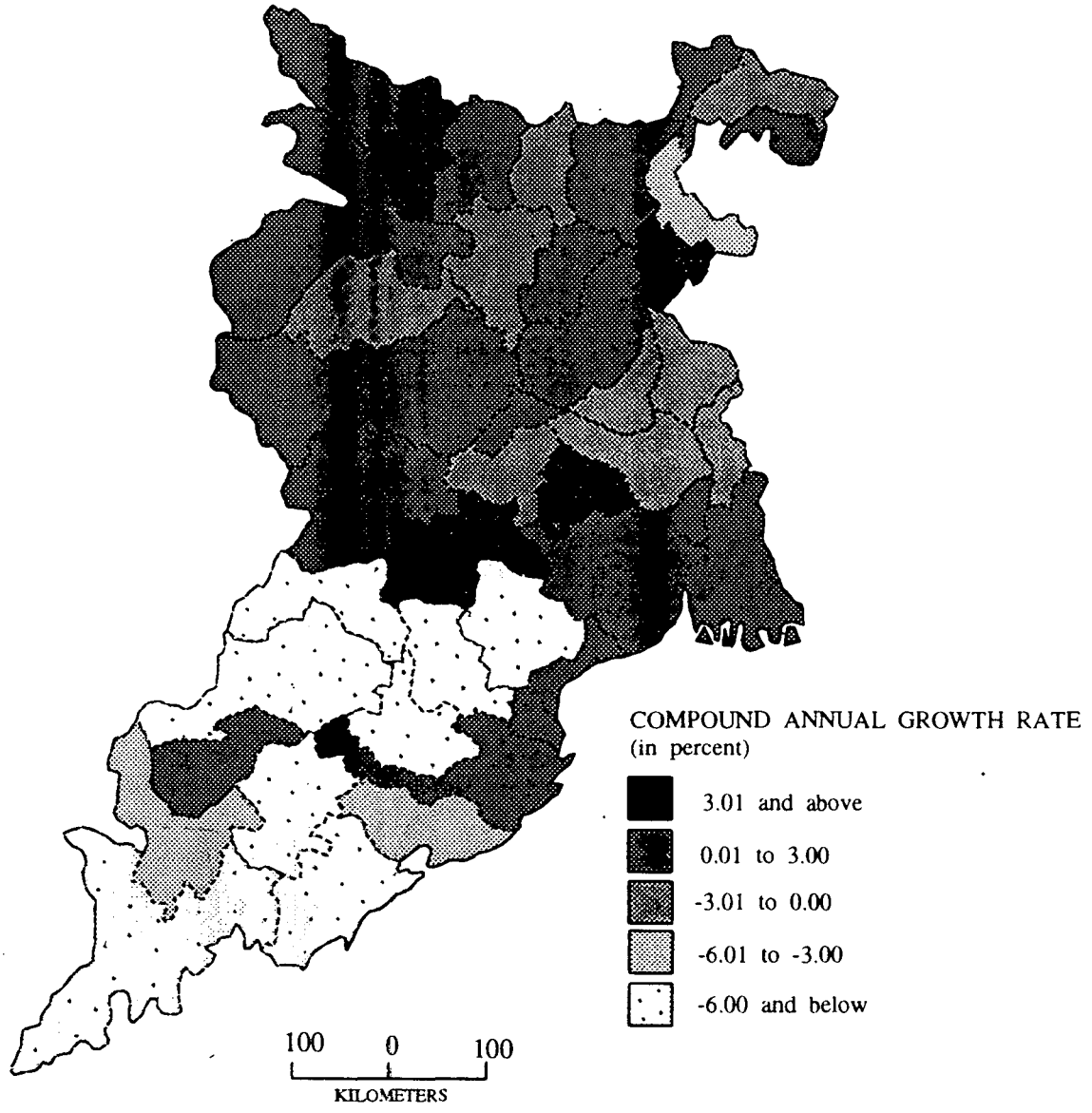


Fig. 2.10

West Bengal, Chotanagpur plateau of Bihar, coastal districts of Orissa. Major parts of Orissa were included in the low category. Very low proportions were reported in Kalahandi, Phulbani and Sundargarh districts during 1986-89. The figures 2.10, 2.11 and 2.12 represent the compound growth rate of area not available for cultivation. The figure 2.10 reveals that more than half of the districts in eastern India experienced positive trends in growth rates from 1961-64 to 1974-77. Most of such districts are concentrated in south Bengal plain, northern plain and hilly region of West Bengal, north Bihar plain, Chotanagpur plateau, parts of south Bihar plain and coastal belt of Orissa where the rate of growth was low (below 3%). In 10 districts out of 13 districts of Orissa, area under this category experienced a high negative growth rate (below -6 %). A low negative trend (-3%) has been registered in Gaya, Saharsa, Munger, Murshidabad, Nadia, Birbhum, Barddhaman, Purulia, Jalpaiguri, and a medium rate of growth (-3 to -6%) has been recorded in Kalahandi and West Dinajpur.

The trend in 1986-89 over 1974-77 was positive in 41 districts out of 45 districts in eastern India. The area not available for cultivation increased at a high rate in Koraput, at a medium rate in Phulbani, Kendujhar, Jalpaiguri, West Dinajpur, Murshidabad and Birbhum and at a low rate in the remaining 34 districts. Only four districts namely Kalahandi, Balangir, Ganjam and Mayurbhanj experienced low rates of

EASTERN INDIA

GROWTH RATE OF AREA NOT AVAILABLE FOR CULTIVATION

(1986-89 OVER 1974-77)

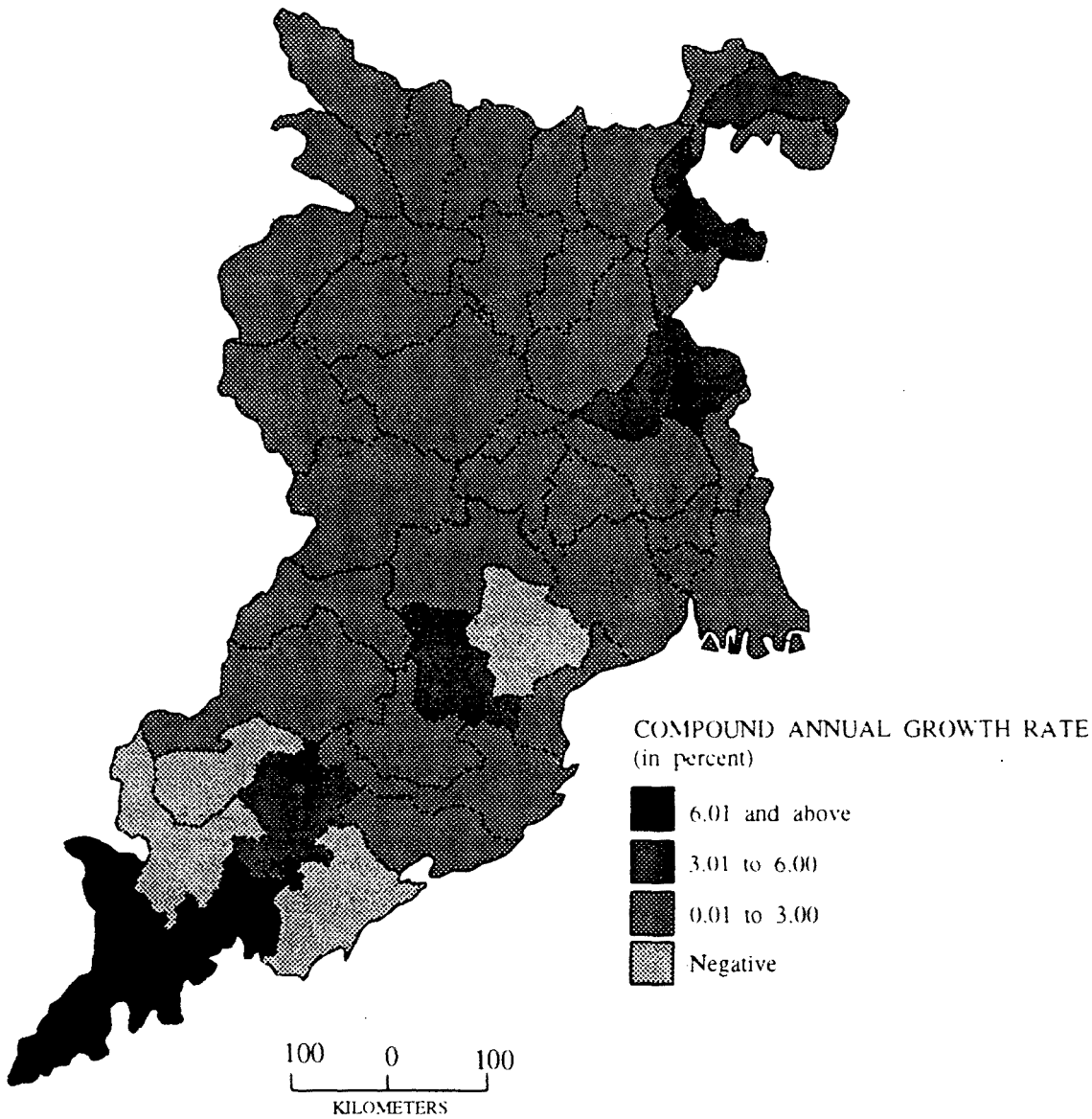


Fig. 2.11

EASTERN INDIA

GROWTH RATE OF AREA NOT AVAILABLE FOR CULTIVATION

(1986-89 OVER 1961-64)

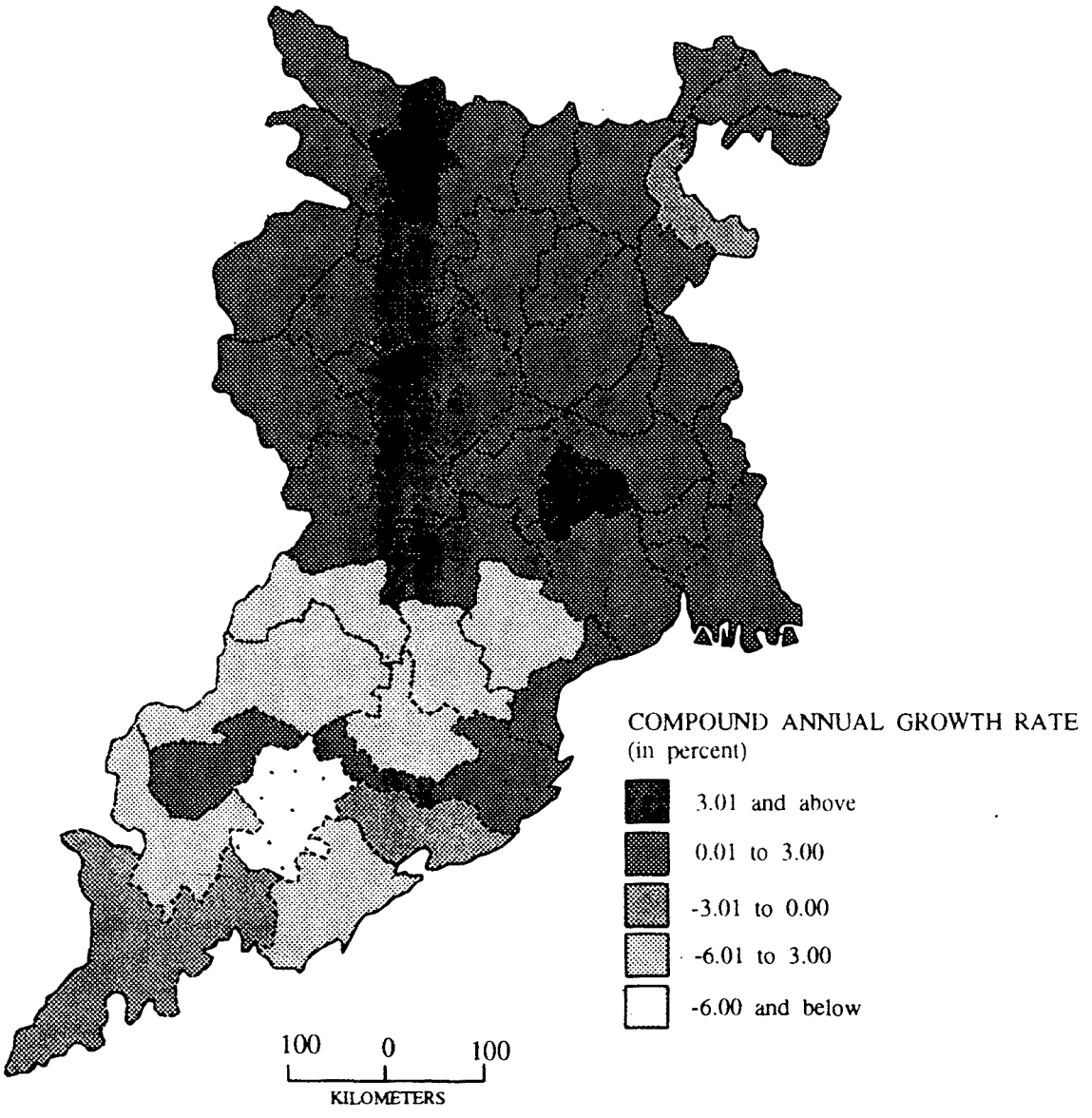


Fig. 2.12

decline in area not available for cultivation (fig.2.11).

The overall trend from 1961-64 to 1986-89 shows that area under this category increased slowly in most of the districts of West Bengal and Bihar, and three districts of Orissa. On the other hand, it declined at a high rate in Phulbani district, at a low rate in Puri and Koraput districts, and moderately in Sundargarh, Kendujhar, Sambalpur, Dhenkanal, Ganjam, Mayurbhanj and Kalahandi districts. The most striking feature that emerged out of the figure 2.12 was the negative trends in West Dinajpur despite the positive trend in remaining parts of West Bengal.

Culturable Waste Land

Culturable waste lands are defined as lands that are definitely cultivable but lying as waste for more than five years on account of number of limitations.[2] They can be enumerated under following heads: encroachment by wild weeds, floods, erosion, poor drainage, scarcity of water, distance from settlement site etc. The culturable waste land occupied very small proportion of study area which accounted for 2.91 percent in 1974-77 and 2.31 percent in 1986-89.

In 1974-77, about 4.34 percent of total reporting area in West Bengal belonged to this category whereas it accounted for 2.76 and 2.26 percent in Bihar and Orissa respectively.

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[2] J. Kumar (1986) Landuse Analysis: A Case Study of Nalanda District, Bihar. Inter India Publications, New Delhi, p.85.

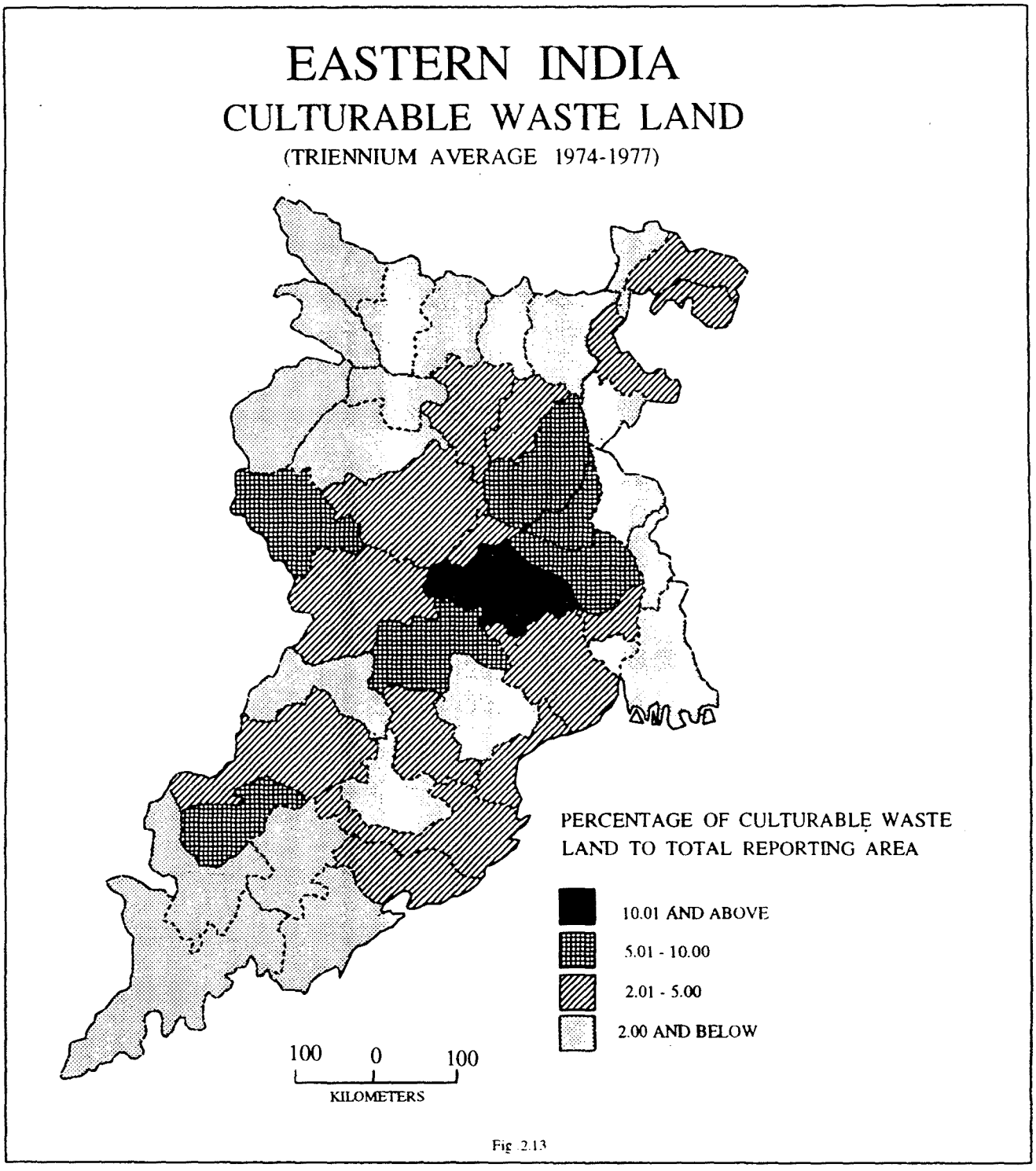
EASTERN INDIA
CULTURABLE WASTE LAND
(TRIENNIUM AVERAGE 1974-1977)
PERCENTAGE OF CULTURABLE WASTE LAND TO TOTAL REPORTING AREA
10.01 AND ABOVE
5.01 - 10.00
2.01 - 5.00
2.00 AND BELOW
100 0 100
KILOMETERS

Fig 2.13

Proportions under this category were very high, as compared to the regional average, in Bankura and Purulia districts occupying 10 percent of the total reporting area and high but below 10 percent in Palamau, Birbhum, Barddhaman, Singhbhum, Santhal Pargana and Baleshwar districts. The coastal districts of Orissa, northern and coastal districts of West Bengal and Chotanagpur plateau of Bihar were covered by medium proportion (2 to 5 percent) of area under culturable waste (Fig. 2.13) whereas the remaining parts of eastern India had a low proportion (below 2 percent) during 1974-77.

As compared to the picture in 1974-77, the area under culturable waste land showed a gradual decline during 1986-89. Change is remarkable in West Bengal where the state average had decreased to 1.28 percent in 1986-89. The proportions were high in only four districts of eastern India, viz. Singhbhum, Cuttack, Sambalpur and Santhal Parganas accounting for 5 to 10 percent (Fig. 2.14). Low proportions were recorded in north and south Bihar plain, coastal and interior parts of Orissa, coastal, northern and southern alluvial plains of West Bengal. Districts with plateaus and hill locations in the study area had recorded medium proportion (2 to 5 percent) of area under this category.

From mid 70s to late 80s, the growth of culturable waste land was negative in 32 out of 45 districts in eastern India. Most of these districts are located in West Bengal and Bihar. High rate of decline (below -8 percent) was recorded in

EASTERN INDIA

CULTURABLE WASTE LAND

(TRIENNIUM AVERAGE 1986 -1989)

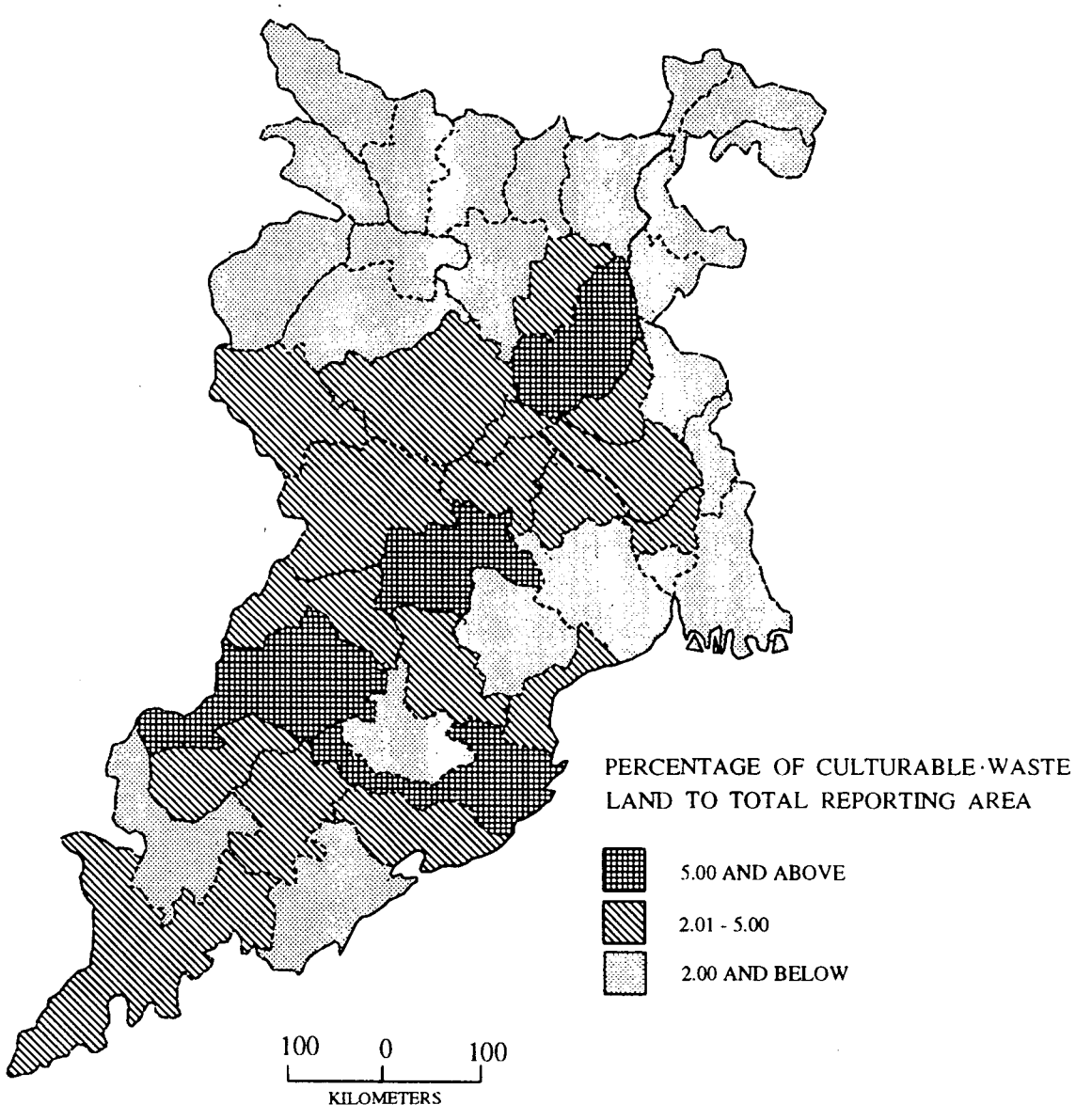

Fig .2.14

EASTERN INDIA

GROWTH RATE OF CULTURABLE WASTE LAND

(1986-89 OVER 1974-77)

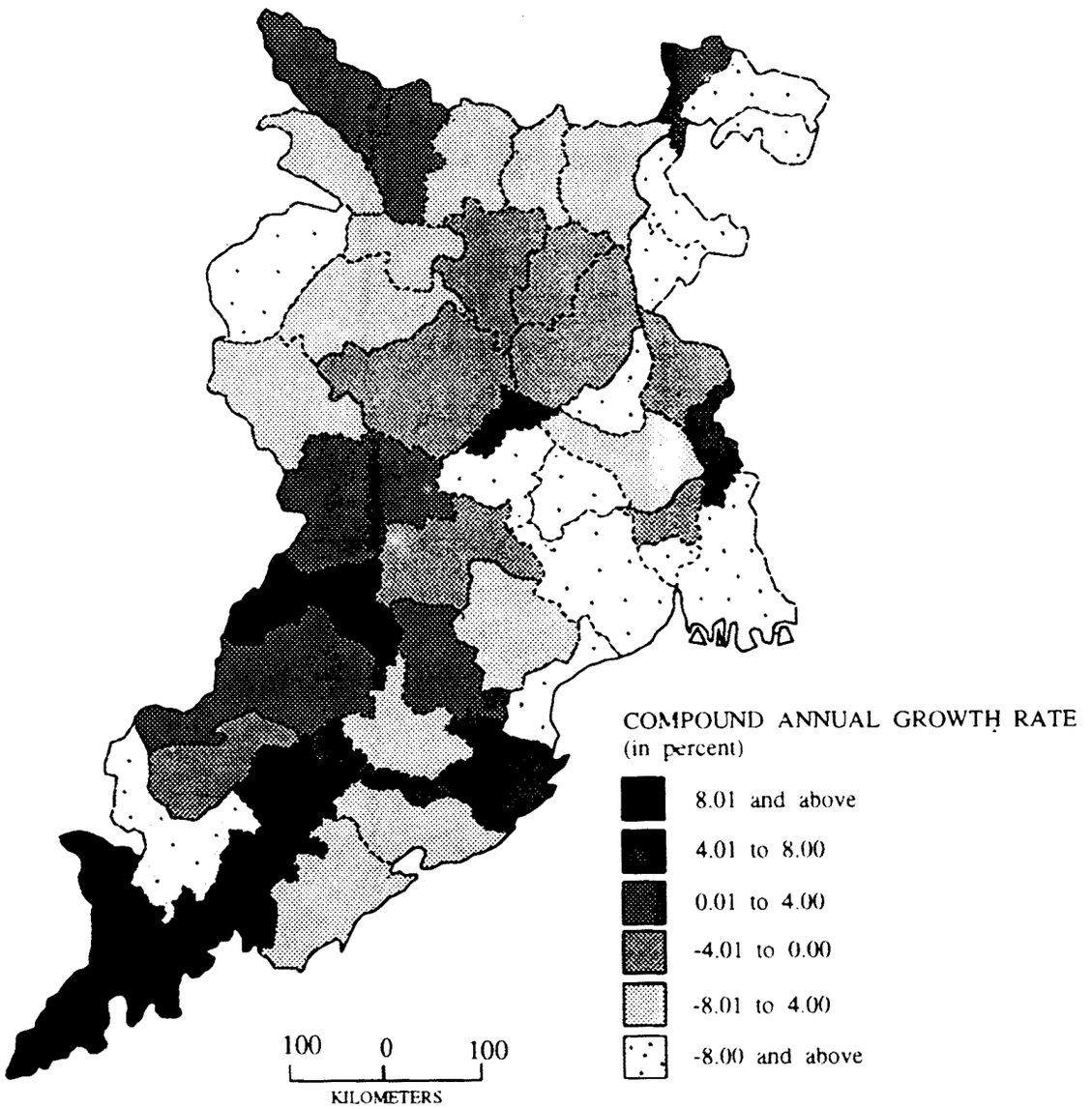

Fig. 2.15

western part of Bihar, western part of Orissa and a large belt of West Bengal, including coastal plain, north Bengal plain, Barind tract and eastern plateau region. Medium rate of growth was recorded in coastal Orissa, parts of north and south Bihar plain and alluvial plains of West Bengal (Fig. 2.15). In Orissa a sharp increase (above 8 percent) in culturable waste land was found in Koraput, Phulbani and Sundergarh districts while low rate of increase (below 4 percent) was more pronounced in Sambalpur, Ranchi, Darjiling, Champaran, Kendujhar and Muzaffarpur districts. Area under this category increased at a medium rate (4 to 8 percent) in Nadia, Dhanbad and Cuttack. Only Baleshwar district reported no change in area under culturable waste land.

SECTION II

II.2 Utilization of Arable Land

Fallow Land

This category includes two types of lands namely current fallows and fallows other than current fallow. The term current fallows is applied to all such lands which were not under crops at the time of reporting but which had been sown in the recent past. Thus, current fallows are parts of arable land. The other fallow land is actually arable but owing to the inherent infertility of the soil and other limiting factors, it can not be cultivated continuously. In this

practice, a cropping year is followed by 2 to 5 subsequent fallowing years.[3] In the present analysis the proportions of fallow land to total reporting area have been represented in figures 2.16, 2.17 and 2.18.

In 1961-64, about 8 percent of the total reporting area in eastern India was fallow. It increased to 9.91 percent during 1986-89. The districts have been divided into five categories according to their proportion of area under fallow. There is a large area under fallow in Bihar. In 1986-89 it accounted for 17.18 percent of the total reporting area as compared to 4.88 and 4.69 percent in West Bengal and Orissa during the same period respectively.

In 1961-64, high proportion of area was left fallow in Ranchi, Dhanbad, Santhal Pargana and Saharsa districts as it accounted for more than 15 percent of the reporting area (Fig. 2.16). The districts having moderate values, i.e. 10 to 15 percent of area were Saran, Purnea, Bhagalpur, Munger, Hazaribag, Palamau in Bihar, Purulia, Bankura in West Bengal and Sundargarh, Kendujhar districts in Orissa. The remaining districts in eastern India had lower than 5 percent area under fallow.

In 1974-77 the areas left fallow were very high in Ranchi, Singhbhum, Dhanbad and Santhal Pargana districts with more than 20 percent of the total reporting area (Fig. 2.17). The proportions were also high in Palamau, Hazaribag, Gaya,

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[3] J. Kumar, op. cit., pp. 76-81.

EASTERN INDIA

FALLOW LAND

(TRIENNIUM AVERAGE 1961 - 1964)

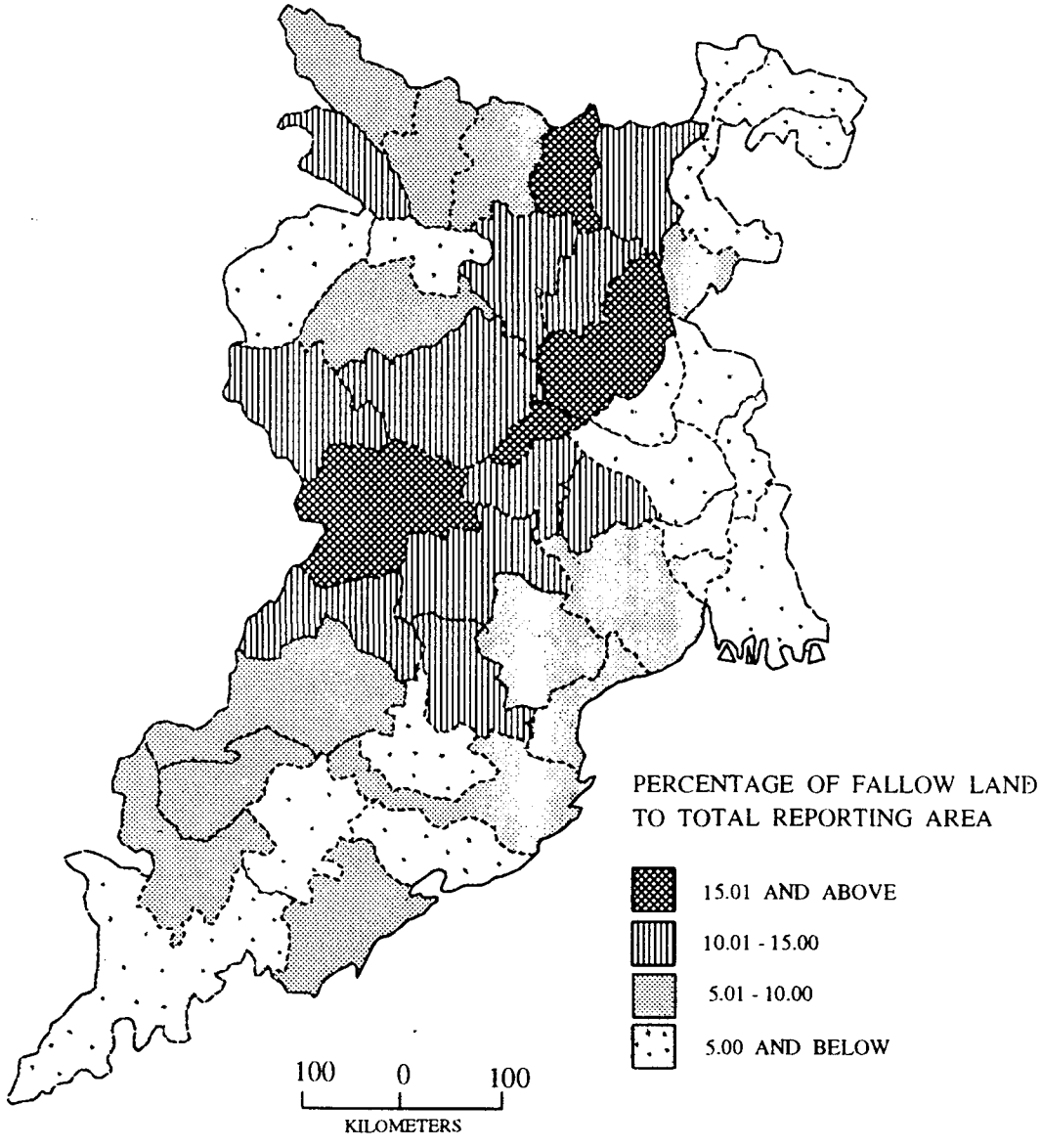

Fig . 2.16

EASTERN INDIA

FALLOW LAND

(TRIENNIUM AVERAGE 1974 - 1977)

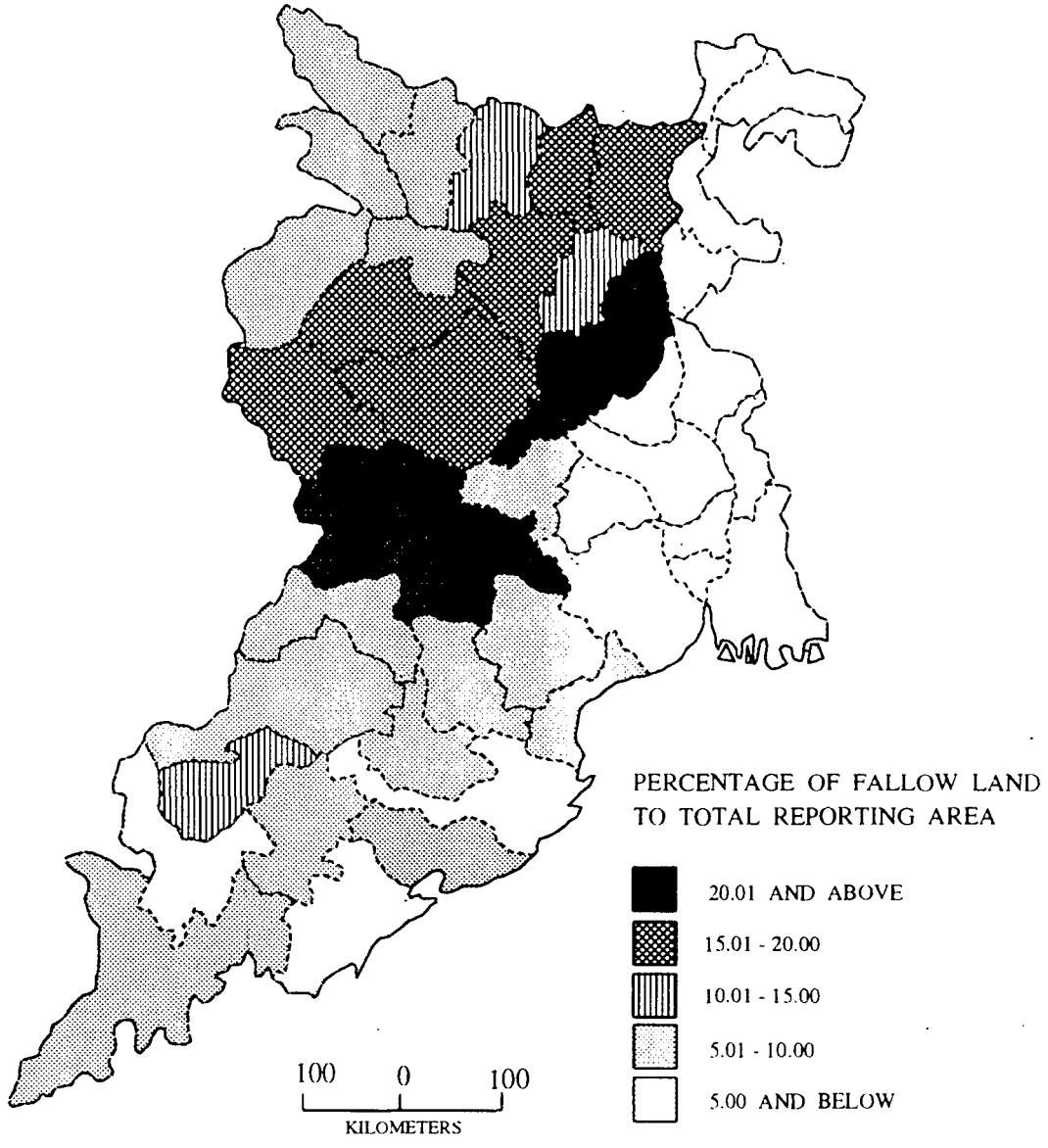

Fig . 2.17

Saharsa, Purnea, Munger districts of Bihar. Only three districts namely Darbhanga, Bhagalpur and Balangir were under medium category, whereas all the remaining districts i.e., 15 districts of West Bengal, 12 districts of Orissa and 5 districts of Bihar recorded very low proportion of area under fallows.

The spatial distribution of fallow lands changed from 1974-77 to 1986-89 with very few exceptions. Palamau district was included in very high category during 1986-89. The proportion changed in Purulia district from low to high. The north western districts of Bihar, south western and northern districts of Orissa, western plateau region and Rarh plain of West Bengal accounted for low proportion of fallows ranging from 5 to 10 percent, whereas very low proportions were found in central and coastal districts of Orissa, northern hills and Terai region and the southern alluvial plains of West Bengal (Fig. 2.18).

The compound growth rate of fallow land (Fig. 2.19) increased in entire state of Bihar, excluding three districts, viz. Saharsa, Saran and Muzaffarpur from 1961-64 to 1974-77. Trends were also positive in West Dinajpur, Barddhaman, Koraput, Balangir, Phulbani, Dhenkanal and Puri districts of Orissa, (Fig. 2.19). The rate of increase in area under fallow was high (above 8 percent) in Phulbani and Gaya districts, while it was medium (4 to 8 percent) in Koraput, Balangir, Puri, Patna and Sahabad districts. Contrary to this

EASTERN INDIA

FALLOW LAND

(TRIENNIUM AVERAGE 1986 - 1989)

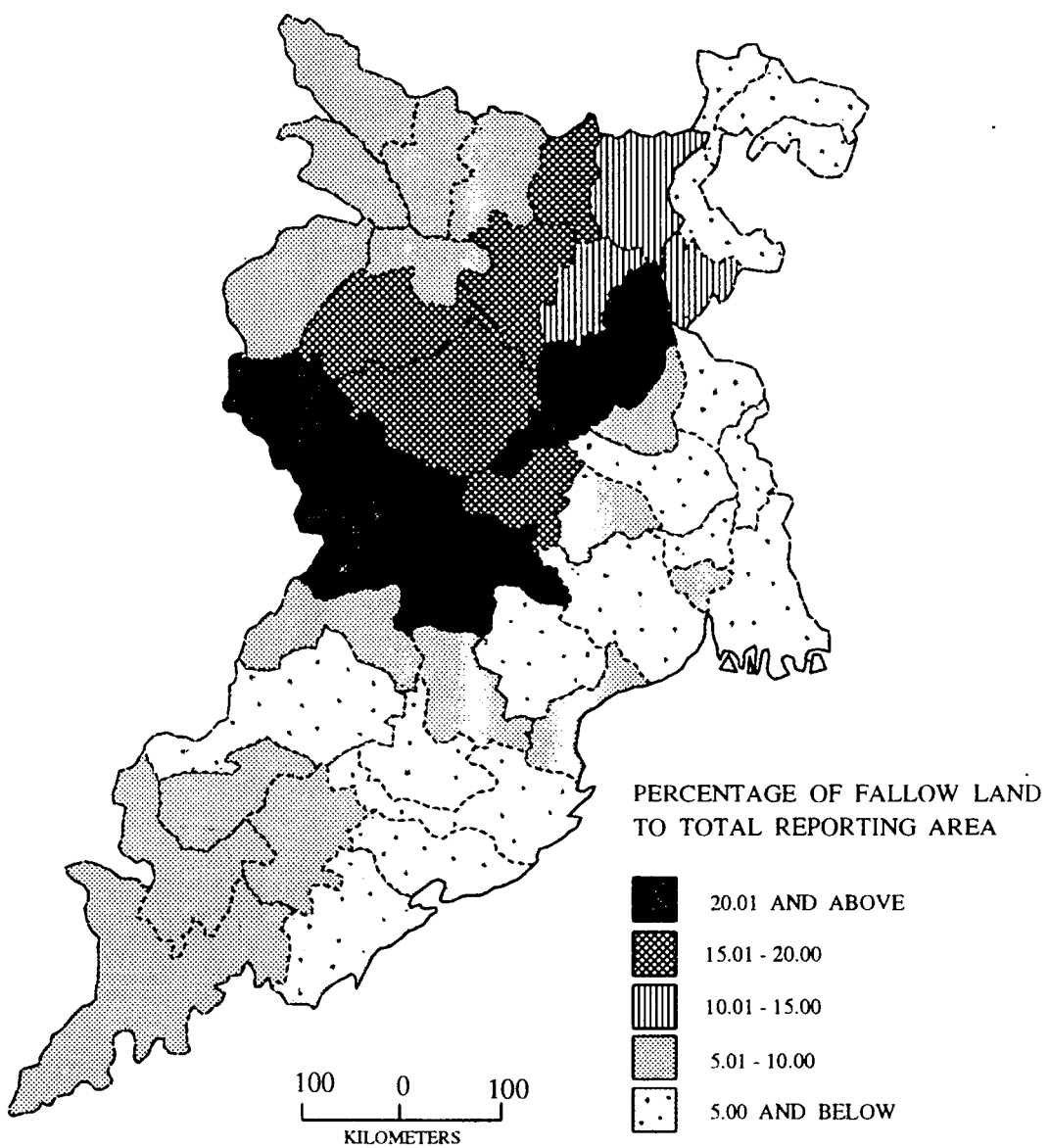

Fig 2.18

EASTERN INDIA

GROWTH RATE OF FALLOW LAND

(1974-77 OVER 1961-64)

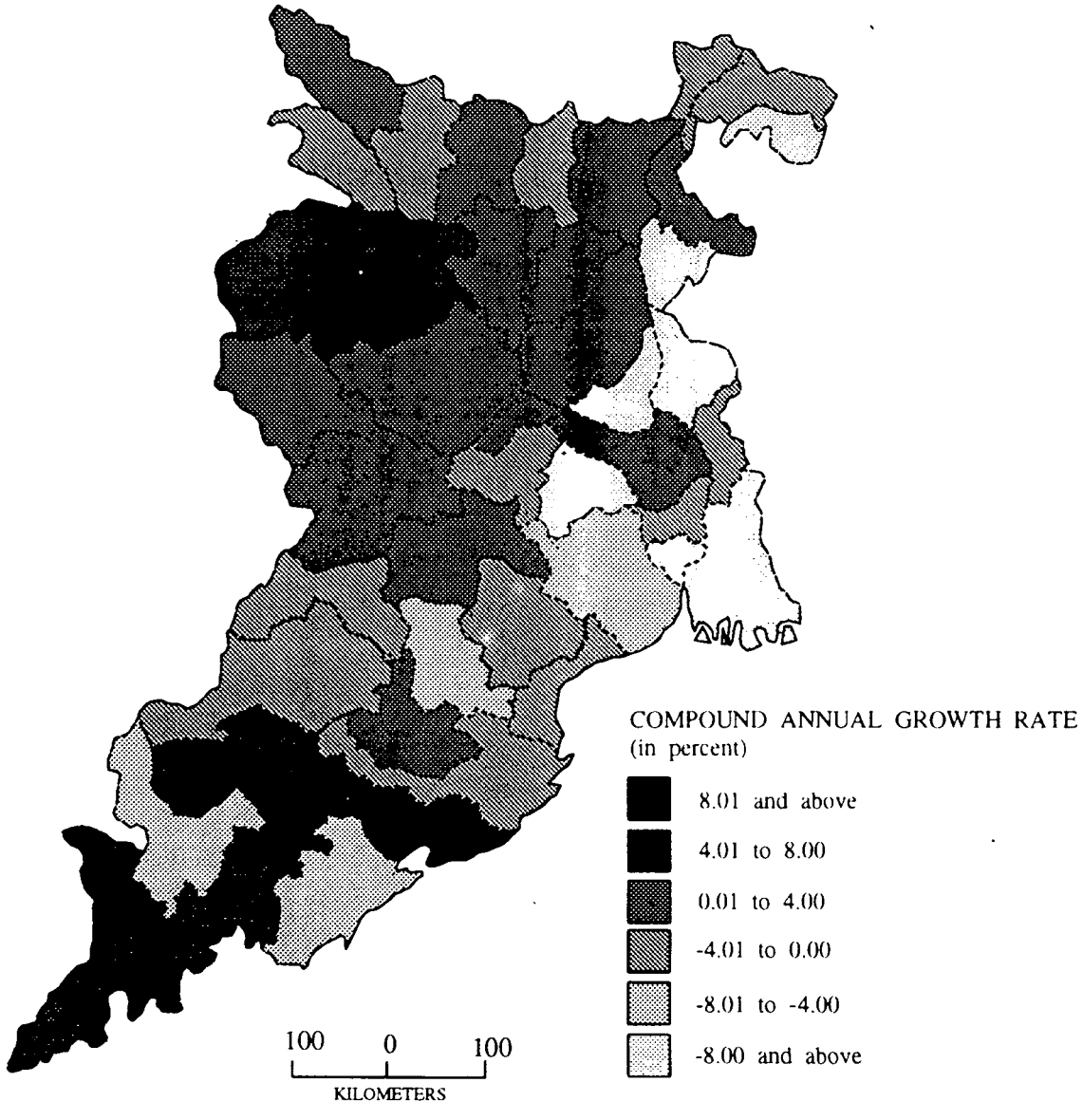

Fig. 2.19

area declined at a high rate (below -8 percent) in 24 Parganas, Haora, Bankura, Birbhum, Murshidabad, Malda and Koch Bihar districts, while at a medium rate (-4 to -8 percent) in Kalahandi, Ganjam, Kendujhar and Medinipur districts. In the remaining districts, a low growth rate was noticed.

The figure 2.20 reveals that fallow lands recorded positive growth rate in 1986-89 over 1974-77 in 14 out of the 15 districts in West Bengal, 12 out of the 17 districts in Bihar, and three out of the 13 districts in Orissa. The rate of growth was low in Bihar and Orissa while it was moderate in Bankura, Purulia, Medinipur, Barddhaman and Jalpaiguri districts of West Bengal. Major parts of North and south Bengal plains recorded high rate of growth in fallow land. In contrast to these, fallow land declined at a high rate in Balangir, Sambalpur, Mayurbhanj, at a medium rate in Sundargarh, Puri, Cuttack, Ganjam districts, while at a low rate in the rest.

The overall growth in 1986-89 over 1961-64 reveals that the fallow land had considerably increased but at a low rate in the entire state of Bihar, and the coastal plains of West Bengal. In Phulbani district, fallow land recorded growth at higher rate, whereas medium rate of growth was found in a few districts namely Koraput, Hugli, Nadia, West-Dinajpur, Darjiling and Gaya. Fallow land declined moderately in Mayurbhanj, Sambalpur, Ganjam and Murshidabad districts. Low rate of growth was recorded in Sundargarh, Kalahandi,

EASTERN INDIA

GROWTH RATE OF FALLOW LAND

(1986-89 OVER 1974-77)

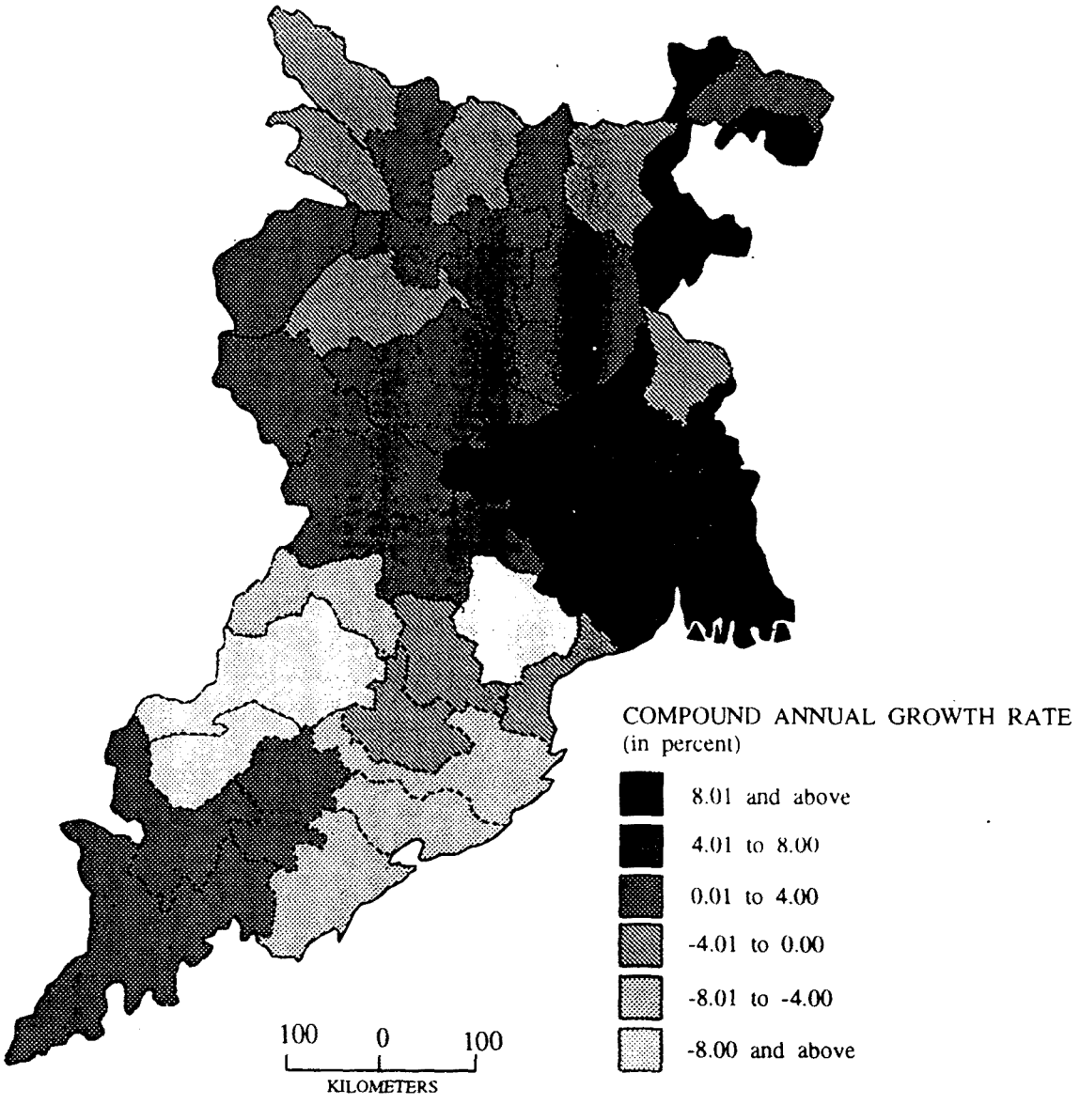

Fig . 2.20

EASTERN INDIA

GROWTH RATE OF FALLOW LAND

(1986-89 OVER 1961-64)

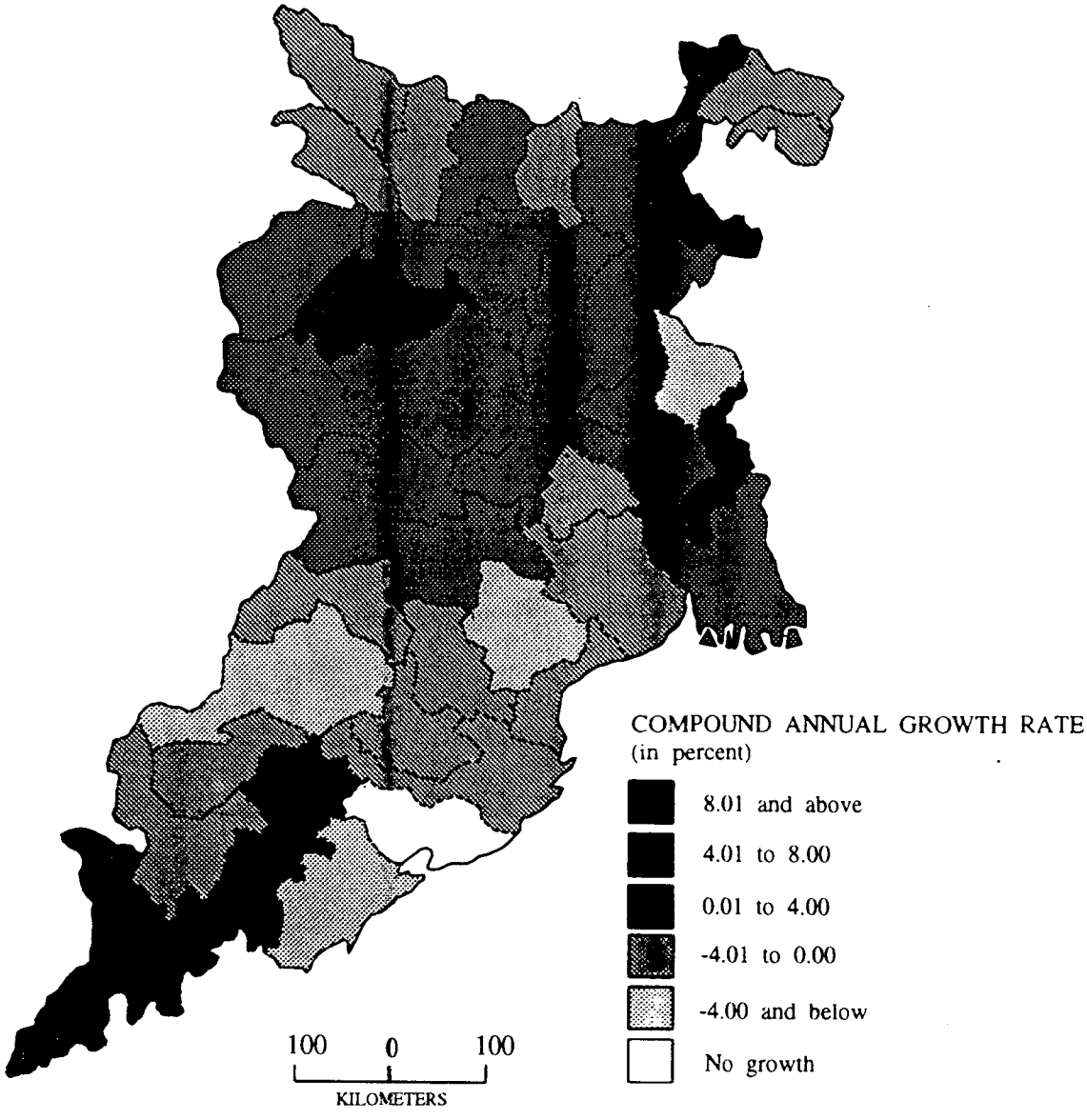

Fig . 2.21

Balangir, Balasore, Cuttack, Kendujhar, Dhenkanal in Orissa; Muzaffarpur, Saran, Champaran, Saharsa districts in Bihar; Medinipur, Bankura, Koch Bihar and Jalpaiguri districts in West Bengal (Fig. 2.21).

Net Sown Area

Net sown area denotes the geographical extent of cultivated land during a year. About 47.70 percent of total reporting area was devoted to cultivation land, during both the periods i.e. 1961-64 and 1974-77. But in late 1980s, the area under cultivation dropped to 45.81 percent in eastern India. In the present analysis, the districts are categorised into 5 classes. These are districts with very high proportions, (more than 80 percent), high (60 to 80 percent), medium (40 to 60 percent), low (20 to 40 percent) and very low (less than 20 percent) of net sown area. The pattern of net sown area has been represented in figs. 2.22, 2.23 and 2.24 for the three periods of time for which study has been attempted.

In 1961-64, a very high proportion of net sown area (more than 80 percent) was reported in Nadia and West Dinajpur. Proportions were also high, but below 80 percent, in coastal Orissa, alluvial and Rarh plains of West Bengal and north Bihar plains. The plateau region of Bihar, northern highlands and southwest plateau districts of Orissa and hilly districts of West Bengal had reported low proportion of net sown area

EASTERN INDIA

NET SOWN AREA

(TRIENNIUM AVERAGE 1961-1964)

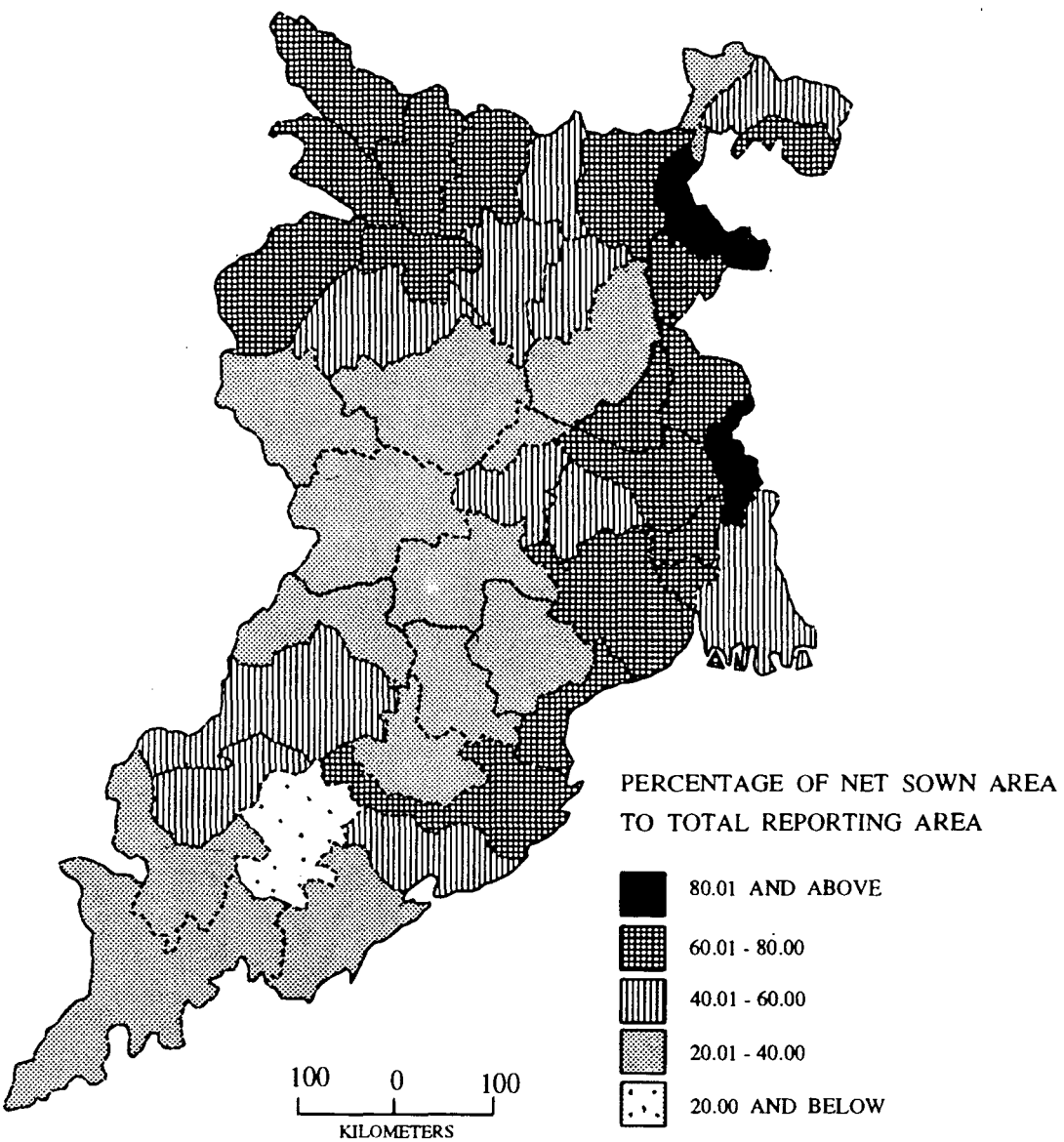

Fig . 2.22

(Fig. 2.22). It was very low in Phulbani district in Orissa, accounting for 18 percent of the total reporting area. The highest proportion of net sown area was recorded in West Dinajpur district (82 percent). Medium proportions were reported in Balangir, Puri, Sambalpur, Gaya, Bhagalpur, Monger, Saharsha, Bankura, Purulia, 24 Parganas and Jalpaiguri districts.

During 1974-77, the net sown area accounted for 63.38 percent, 48.41 percent and 38.02 percent of the total reporting area of West Bengal, Bihar and Orissa respectively. The category-wise distribution was more or less unchanged at the district level from 1961-64 to 1974-77. The proportions of net sown area were very high in four districts, viz. Nadia, Murshidabad, West Dinajpur and Malda (Fig. 2.23). Very low values had been recorded in Phulbani and Hazaribag. In plateau region of Bihar and Orissa, the proportion of net sown area changed from low to medium.

In 1986-89, West Dinajpur was the only district with very high proportion of net sown area. High proportions were recorded in the districts of Saran, Champaran, Muzaffarpur, Sahabad, Darbhanga, Purnea, Patna in Bihar, Medinipur, Hugli, Barddhaman, Birbhum, Nadia, Murshidabad, Koch Bihar in West Bengal and Baleshwar, Cuttack districts in Orissa. Districts having medium proportion of net sown area were Saharsa, Munger, Bhagalpur and Gaya districts in Bihar; Mayurbhanj, Kalahandi, Balangir districts in Orissa, Darjiling,

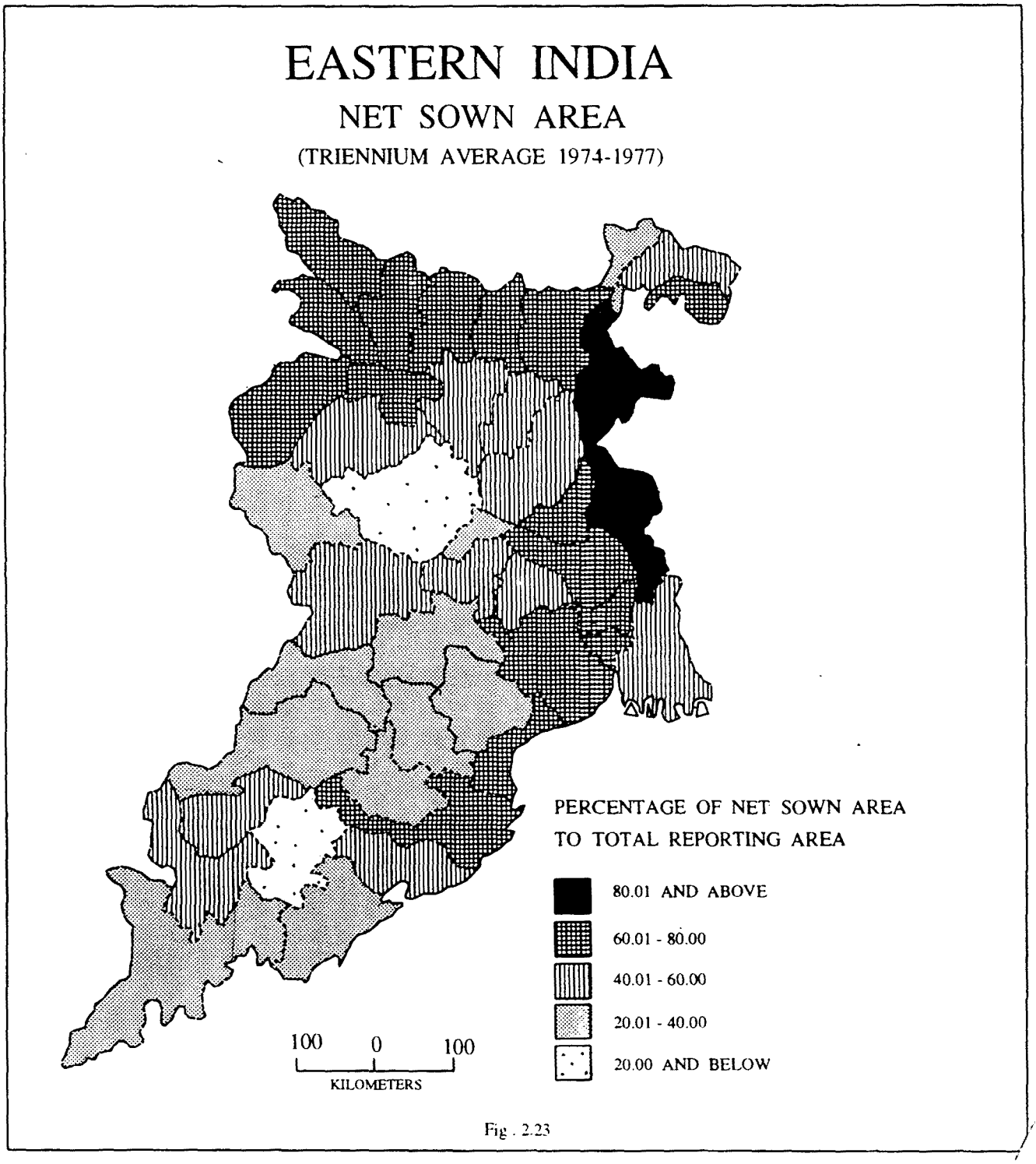
EASTERN INDIA
NET SOWN AREA
(TRIENNIUM AVERAGE 1974-1977)
PERCENTAGE OF NET SOWN AREA
TO TOTAL REPORTING AREA
80.01 AND ABOVE
60.01 - 80.00
40.01 - 60.00
20.01 - 40.00
20.00 AND BELOW
100 0 100
KILOMETERS

Fig . 2.23

EASTERN INDIA

NET SOWN AREA

(TRIENNIUM AVERAGE 1986-1989)

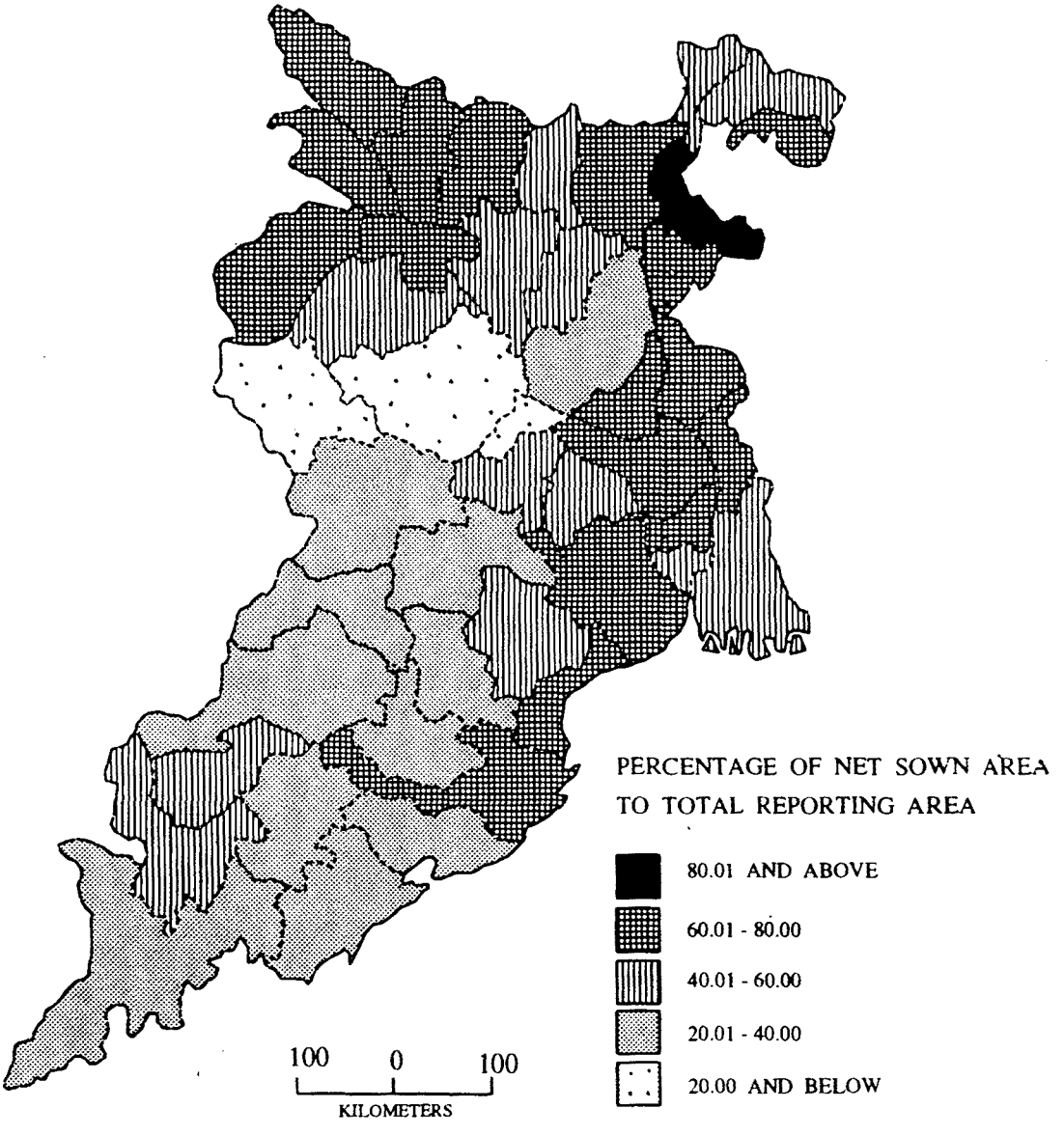

Fig . 2.24

Jalpaiguri, Haora, 24 Parganas, Bankura, Purulia districts in West Bengal (Fig. 2.24). On an average, the proportion of net sown area in West Bengal was much higher than the adjoining states. In 1986-89, it accounted for 60.65 percent of the total reporting area in West Bengal, whereas in Orissa and Bihar, it accounted for 39.68 percent and 43.78 percent respectively. The overall spatial variation reveals that coastal and riverine plain in eastern India have larger share of net sown area, whereas the plateaus and highlands have a lower share during time period of the study.

A wide range of variation has been recorded in the pattern of growth of net sown area. The fig. 2.25 shows that out of 45 districts in eastern India, 24 districts recorded a negative trend in net sown area from 1961-64 to 1974-77. Negative growth was mainly found in north and south Bihar plain, northern part of Chotanagpur plateau, alluvial and Rarh plains of West Bengal, central and south western hilly districts of Orissa. The rate of growth was low (0 to 2 percent) in all these districts, except Hazaribag, where net sown area witnessed growth rate below -2 percent. Positive growth was witnessed in southern parts of the plateau region of Bihar; west plateau districts alongwith coastal and alluvial plain of West Bengal, and coastal Orissa alongwith the parts of northern and southern highlands. Net sown area increased at a low rate in these districts.

From 1974-77 to 1986-89, the annual growth of net sown

EASTERN INDIA

GROWTH RATE OF NET SOWN AREA

(1974-77 OVER 1961-64)

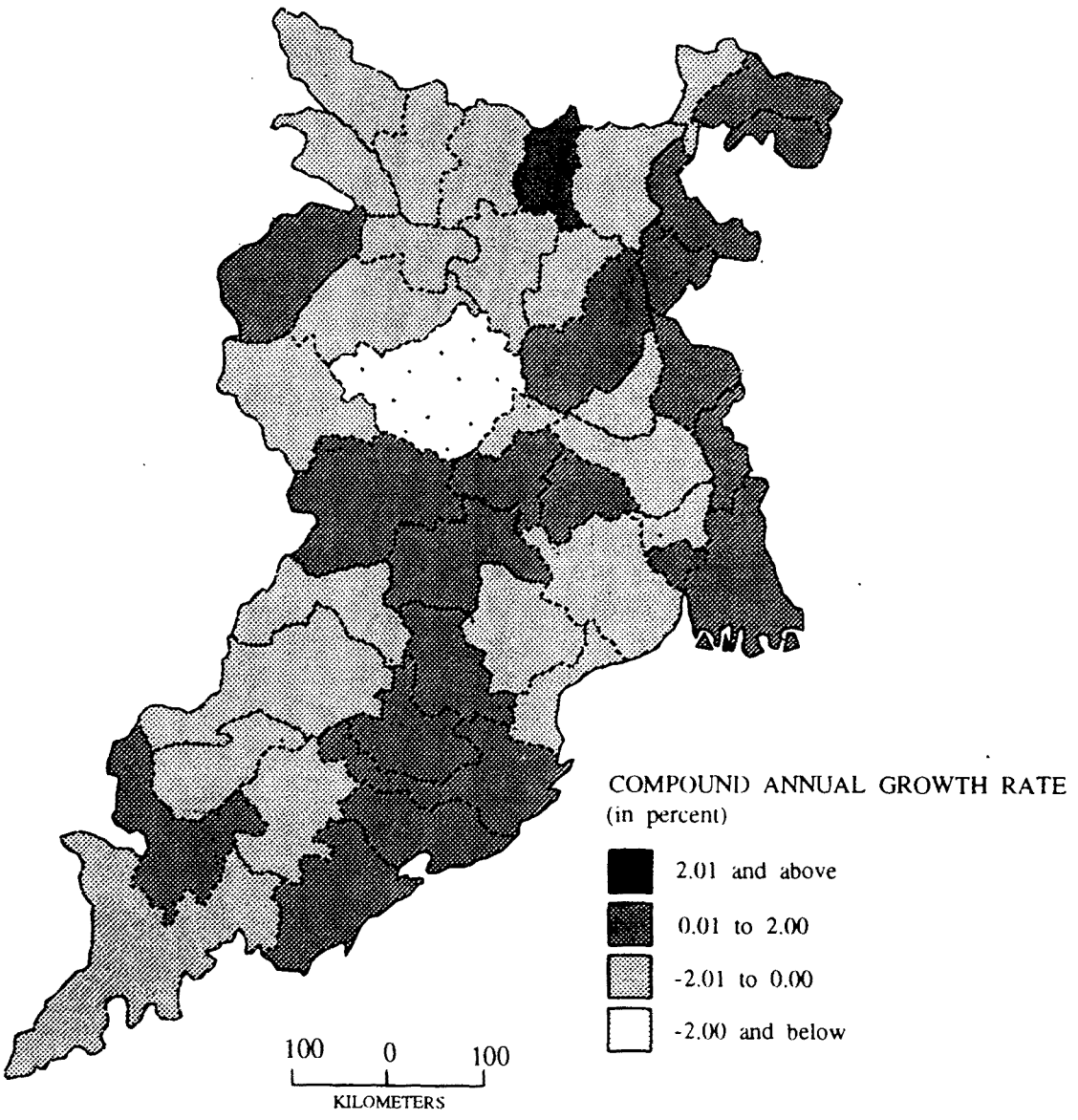

Fig . 2.25

area was negative in all districts of Bihar and most of the districts of West Bengal. It witnessed a low negative growth rate in all the districts except Palamau, which experienced a high negative growth rate (below -2 percent). The most striking feature emerging out of Fig. 2.26 is that the districts in the coastal and alluvial plains of West Bengal witnessed negative trend whereas districts like Purulia and Bankura in the eastern plateau and hilly Darjiling districts registered a positive trend in net area sown. In Orissa, only three districts had shown low rate of negative growth namely Kalahandi, Ganjam and Cuttack. The remaining districts registered low rate of positive growth in net sown area from 1974-77 to 1986-89.

The overall trend reveals that net sown area increased in Orissa while it decreased in Bihar and West Bengal from 1961-64 to 1986-89. Low rate of negative growth was witnessed in almost all the districts of Bihar and West Bengal with a few exceptions. The exceptions are Saharsha, Singhbhum, Purulia, Bankura, Koch Bihar which recorded a low positive growth rate (Fig. 2.27). Contrary to the pattern of growth in Bihar and West Bengal, net sown area recorded low positive trend in all districts of Orissa except Baleshwar, Sambhalpur, Balangir and Koraput which recorded low rate of negative growth.

The entire discussion, including large number of maps, clearly brings out the variation in spatial and temporal pattern of landuse in eastern India. The above analysis

EASTERN INDIA

GROWTH RATE OF NET SOWN AREA

(1986-89 OVER 1974-77)

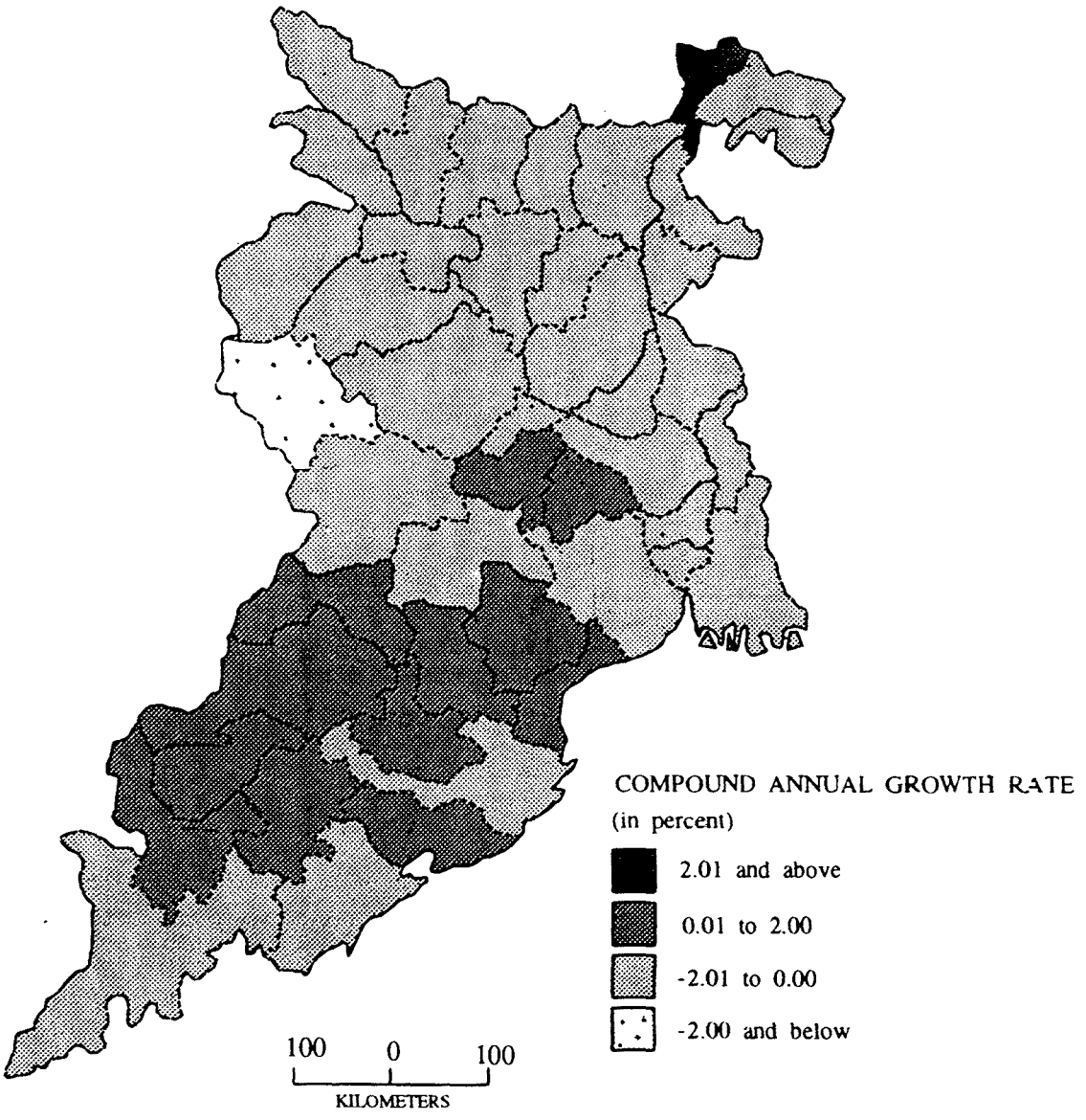

Fig . 2.26

EASTERN INDIA

GROWTH RATE OF NET SOWN AREA

(1986-89 OVER 1961-64)

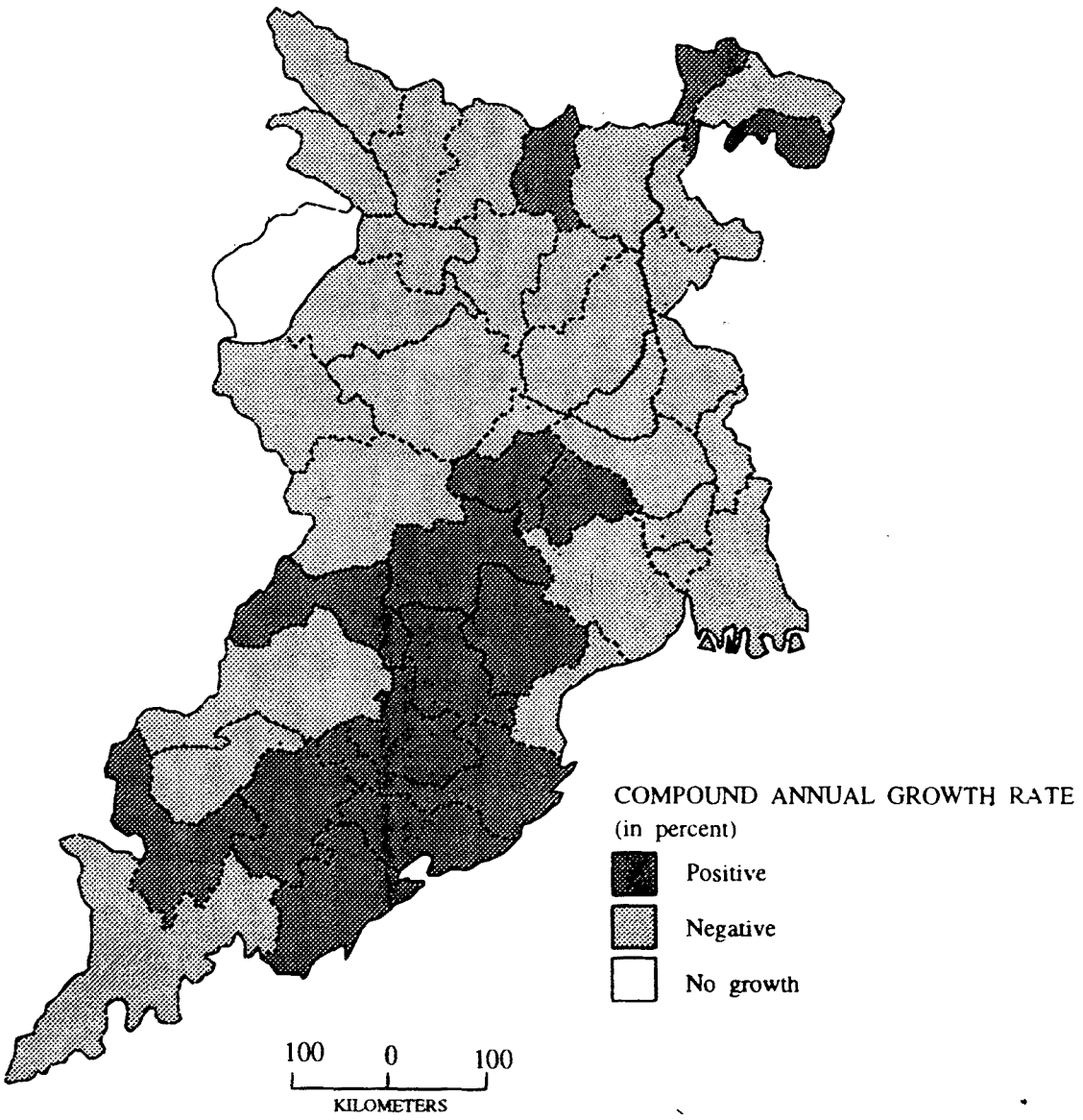

Fig .2.27

reveals that very large proportion of physical area has been devoted to cultivation in riverine plain and coastal plains of eastern India. In contrast to this, the landuse pattern of Chotanagpur plateau, southwest hilly region and northern plateau region of Orissa has been dominated by forest lands. Fallow land, though small in proportion to total reporting area, has largely grown up in Chotanagpur plateau, whereas area not available for cultivation has covered a large belt of West Bengal and Bihar plain. The trend in landuse pattern illustrates a large reduction in proportion of net sown area from 1961-64 to 1986-89 and a simultaneous increase in fallow land and non-agricultural land. The presence of culturable waste land to a lesser extent shows the degraded character of the existing land. Again, it also represents much scope for extension of cultivation, particularly in the plateau region of Orissa and Bihar, where agricultural land is scarce.

CHAPTER III

FACTORS AFFECTING THE LANDUSE PATTERN

The preceding chapter underlined that there are wide spatial and temporal variations in land utilization in the study area. Thus, it is desirable to investigate the factors behind such variations in pattern of landuse. Landuse pattern is influenced by numerous natural and socio-economic factors. This chapter attempts to examine the impact of some selected natural and technological determinants on the landuse pattern. It is divided into two sections wherein section I analyses the influence of natural factors, whereas the technological factors are dealt in section II.

Section I

III.1 NATURAL DETERMINANTS OF LANDUSE

Natural factors are the important factors influencing the landuse pattern in eastern India. The spatial variation in physiography, drainage, climate and soil affect the pattern of landuse.

Physiography

The surface of the study area is characterized by vast range of variation. The extreme northern and north eastern margins are formed by the Himalayas while in south there is a series of plateaus having varying elevations, hills and intermontane valleys. In between, there is a vast stretch of

EASTERN INDIA

PHYSIOGRAPHY

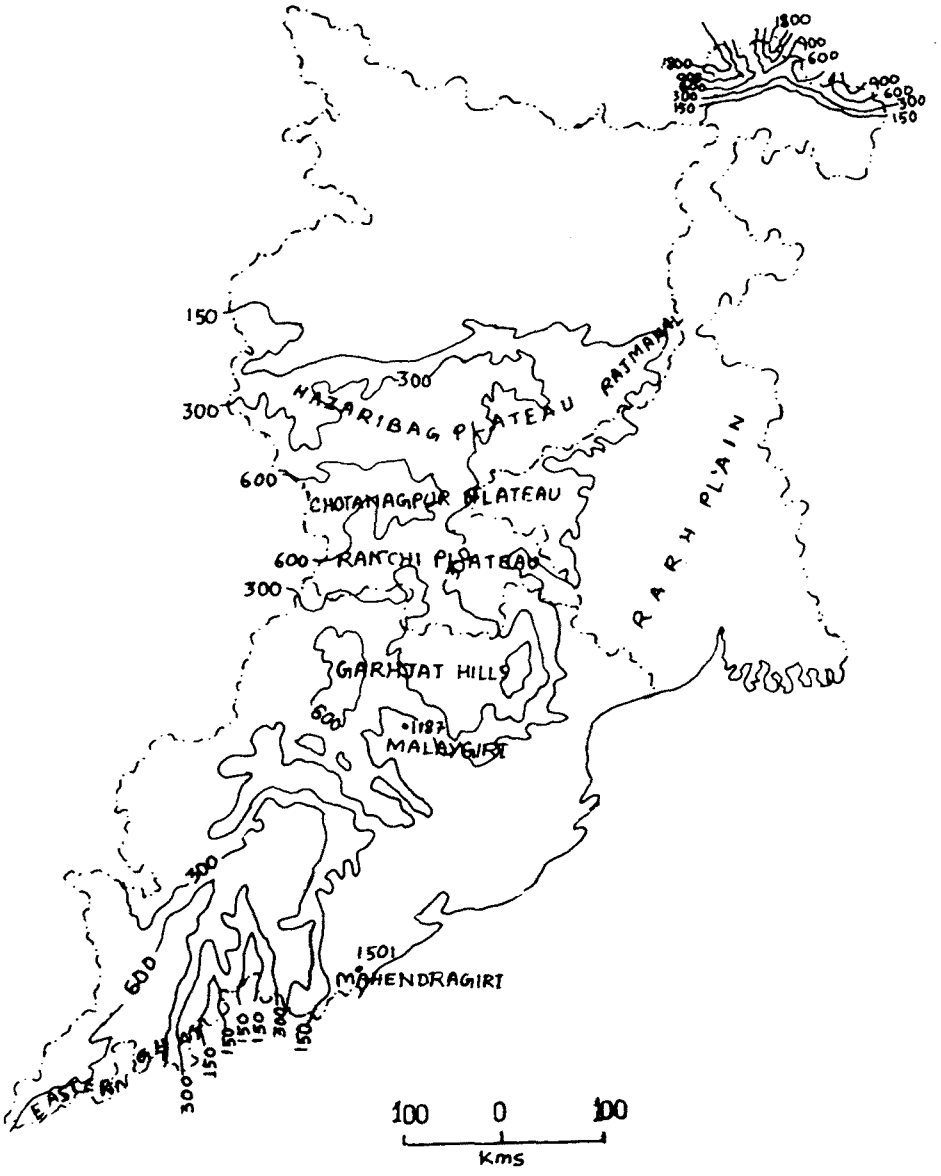

FIG. 3.1

alluvial plain marked with a very gentle slope. Along the coastal margin of Orissa and West Bengal there is a narrow strip of alluvial deposit in the form of coastal plain. Landuse pattern varies greatly between plateaus and plains of eastern India (fig. 3.1).

Plains

The vast stretch of alluvial plain in Bihar is the eastern part of Middle Ganga plain. The Ganga divides the Bihar plains into two unequal divisions, north Bihar plains and south Bihar plains. North Bihar plain includes Purnea, Saharsha, Darbhanga, Muzaffarpur and northern part of Munger districts while south Bihar plain includes Patna, Gaya, Bhagalpur, Sahabad and northern part of Santhal Pargana districts. In the south, the 150 meter contour marks the boundary of south Bihar plain and seperates it from Chotanagpur plateau. North Bihar plain is a flat surface, whereas south Bihar plains are broken by river levees, ox-bow lakes, chaurs, badlands and ravines. Therefore, landuse pattern slightly differs between the two plains. Forest cover is very limited in north Bihar plain, the range being below 10 per cent of the total reporting area during the three periods of study. The proportion of area under forest was comparatively higher (10 to 20 percent) during 1974-77 and 1986-89. In contrast to the pattern of forest, the net sown area has recorded higher proportion in northern plain than the

southern plain. In 1986-89, the proportion of net sown area was 60 to 80 percent in north Bihar Plain, excluding Saharsha district, while 40 to 60 percent in the south, excluding Patna.

The lower Ganga plain stretches from Jalpaiguri and Koch Bihar in the north to Sundarban creeks of 24 Parganas and Kanthi littoral and Medinipur in the south. The north plains and Barind tract comprise five districts Jalpaiguri, Koch Bihar, West Dinajpur and northern part of Malda. The mature delta in southern plain includes Birbhum, Barddhaman, Medinipur, Hugli and Haora, whereas the western Rarh region is the lateritic alluvial landscap of Bankura and Purulia bordering the Chotanagpur highlands. The deposition of fine silt by inundating rivers form the flat surface of this plain. Due to the new alluvial soil, the plain is highly productive accounting for higher share of net area sown. Multiple cropping is a common practice in lower Ganga plain. A critical analysis of the component of landuse indicates that more than 60 percent of the area was devoted to cultivation which had increased from early 1960s to mid 1970s, but decreased from mid 1970s to late 1980s. Forest and fallows occupied very low proportion of the total reporting area. The percentage of culturable waste land has gone down in the western highland from 1974-77 to 1986-89 as a large proportion of it has been reclaimed for various purposes. Mangrove forests occupy larger proportion of area in 24 Parganas due to the presence of

swampy surface of the coast.

In Orissa, the coastal plain is termed as the land of six deltas. The major portion of Puri, Cuttuck, Baleshwar and Ganjam districts form the coastal plain. The plain is narrow in the north and broad in the south. In south coastal plain, forest accounted for more than 40 percent of the total reporting area which has decreased towards north coastal plain during 1974-77 and 1986-89. The main reason of this is the presence of the extended portion of eastern Ghat in the south of the coast of Orissa. On the other hand, the proportion of net sown area was high in the northern coastal plain.

Plateaus and highlands

Orissa highlands present a complicated physiographic unit with denuded hills, plateaus, ridges and mature valleys. Physically, the region may be broadly divided into three distinct units (i) northern uplands, (ii) the erosional plains of Mahanadi valley and (iii) south western hilly region of Eastern ghats.[1]

Northern uplands covering Mayurbhanj, Kendujhar and Sundargarh districts are demarcated by the 300 meter contour. These districts are intersected by hill ranges with a general slope from north to south. The east and west blocks, comprising Sundargarh, Mayurbhanj, Dhenkanal and Kendujhar

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[1] R.L. Singh (1971). India: A Regional Geography, National Geophysical Society of India, Varanasi, p.757.

districts are heavily forested zones. During 1974-77, more than 40 percent of the total reporting area of these districts was under forest.

The erosional plains of Mahanadi river basin covers two-thirds of the area of Sambalpur and Balangir districts and one-third of Dhenkanal district. It is demarcated by 150 meter contours. Forests and net sown area occupied low proportion of the total reporting area whereas culturable waste land has registered higher proportion of land during later period of the study.

South western hilly region of Orissa constitutes northern extension of eastern Ghat, demarcated by 600 meter contour lying to the south and southwest of Mahanadi valley region. It covers Kalahandi, Koraput, Phulbani and parts of Ganjam and Bolangir districts. The hill slopes have thick and valuable forest cover. In 1974-77, 75 percent of the total reporting area in Phulbani district was under forest. It was also high in the remaining three districts during 1974-77 and 1986-89. Owing to the difficult terrain and extensive forest cover, the net sown area ranged between 20 to 40 percent of the total reporting area during three time periods of the study. Area under fallows was low, (below 10 percent). Also, the proportion of area not available for cultivation has strikingly gone down from early 1960s to late 1980s.

The Chotanagpur plateau covers 34 to 35 thousand square miles areas in the southern half of Bihar. There are four

plateaus, the highest being the pat land in mid western portion. The Hazaribag and Ranchi plateau are separated by Damodar valley, and the Subarnarekha river separates the Bagmundi highland from Ranchi plateau. A number of huge isolated, rounded conical hills greatly affect the landuse pattern of the region. On the north eastern side, the plateau continues into the Rajmahal highlands comprising a chain of level lava plateau. Forests occupy larger proportion of land in different districts, varying between 20 to 50 percent during the three time periods of study. About half of the reporting area in Palamau and Hazaribag districts is occupied by forests. The net sown area is very low, occupying one-fifth of the total reporting area on an average. In 1974-77, net sown area was comparatively higher in Ranchi district (50 percent) than the remaining districts of Chotanagpur plateau. The areas affected by gully erosion or covered by steep slopes are either occupied by forests or fall under the category of wastelands. The cultivated lands are confined either to flat plateaus or to valley bottom where terracing is feasible.

Mountains

In the north western corner of Bihar, there are two parallel ranges, the Sumeswar Range and Ramnagar Dun. This region, comprising Champaran and parts of Muzaffarpur district is mainly occupied by marshy and unhealthy fallow lands. Therefore, the proportion of fallows are higher in the north

west of Bihar as compared to the eastern plain region during these periods of the study.

One of the loftiest peaks of the world - Kanchanjunga (8578 mts.) - is situated in Sikkim, and is very close to the border of West Bengal. Therefore, a number of connected ranges and spurs have covered the greater parts of Darjiling and Jalpaiguri districts. Landuse pattern is dominated by thicker forest cover and large non-agricultural land. Net sown area accounts for 40 to 60 percent of the total reporting area during 1986-89. Agriculture cannot be fully practised in this region because of the constraints put by its relief.

Drainage

Drainage holds a particular significance in governing the human occupance of land. As most of the agricultural land develop near river valleys, it plays an important role in determining the landuse pattern. The Ganga and its tributaries drain almost half of the states of Bihar and West Bengal (Fig. 3.2). The Ganga river has a great impact on the development of large arable land in north and south Bihar plain and alluvial plain of West Bengal. The north Ganga plain is drained by Ghaghara, Gandak, Kosi and Mahananda while south Ganga plain is mainly drained by the Son river. South Gangetic plain is higher in the south but slopes towards the Ganga. North is liable to flood, the southern plain is table land not subject to floods except in a limited area.

EASTERN INDIA

DRAINAGE PATTERN

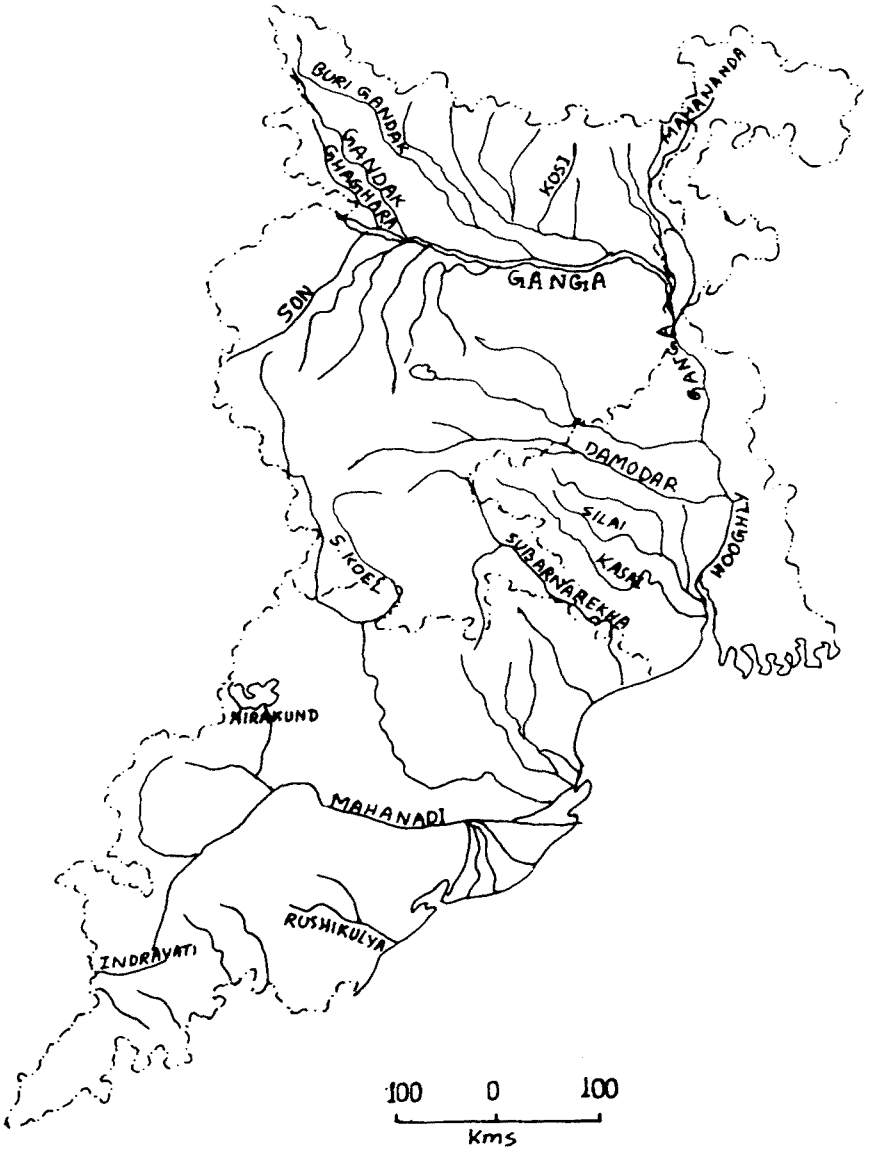

FIG 3.2

Therefore, the Gangetic plain of the north presents a more fertile land for cultivation while southern plains are comparatively less fertile for cultivation.

In West Bengal, the Ganga river drains whole Barind tract and alluvial tract of south Bengal plain. It is known as Bhagirathi and Hugli in the southern parts. The northern part of West Bengal is drained by Tista and its tributaries while southern and western parts get water from Damodar, Subarnarekha, Silai and Kasai rivers. The fertile lands in the Duars and the Barind are the results of deposits of mountainous streams at the foothills. Net sown area occupies a large proportion in Barind tract. The land of dead and decaying rivers of the Moriband delta in Murshidabad and Nadia have registered more than 60 percent of the total reporting area under plough during the three periods of the study. Forest cover is high in active delta of Sundarban in 24 Parganas. Whereas the mature delta in parts of Birbhum, Barddhaman, Medinipur, Haora and Hugli is devoted to cultivation to a greater extent. Although landuse in West Bengal is dominated by cultivation, a major proportion of land (about 20 percent) has been used for industrial uses. The industries and settlements are mainly developed along the riverbasins of West Bengal. In the western plateau of Bengal, large increase in net sown area is also facilitated by river Damodar.

Chotanagpur plateau is drained by rivers namely Phalgu,

Punpun and Koel etc. These rivers display all the characteristic features of youthful stage marked by steep sided narrow valley, gorges, frequent rapids and waterfalls which hinder the growth of cultivable land in Chotanagpur plateau. Damodar is the most important river. The runoff ratio is exceedingly high because of the removal of vegetation from its catchment areas. Therefore, it is liable to severe flood which leads to the formation of large areas under fallow and culturable wastes in this region.

The Orissa upland and the coastal plains is drained by the major river systems of Mahanadi, Brahmani, Baitarani rivers. Mahanadi forms a delta near the coast of Cuttuck. All the major rivers in the rugged areas of Orissa are ideal for causing damage and wasteland development. The orography in Balangir and Kalahandi districts is interrupted by river valleys so that 40 to 60 percent area accounted for net sown area which is comparatively higher than the adjoining highlands during the three study periods. In the coastal Orissa, the formation of delta facilitates the growth of agricultural land.

Climate

Eastern India has a remarkable variation in climatic conditions from one part to another. However, it displays all characteristics of tropical monsoon type of climate. The year can be divided into three distinct seasons, (i) the hot summer

EASTERN INDIA

AVERAGE ANNUAL RAINFALL

(1974-1977)

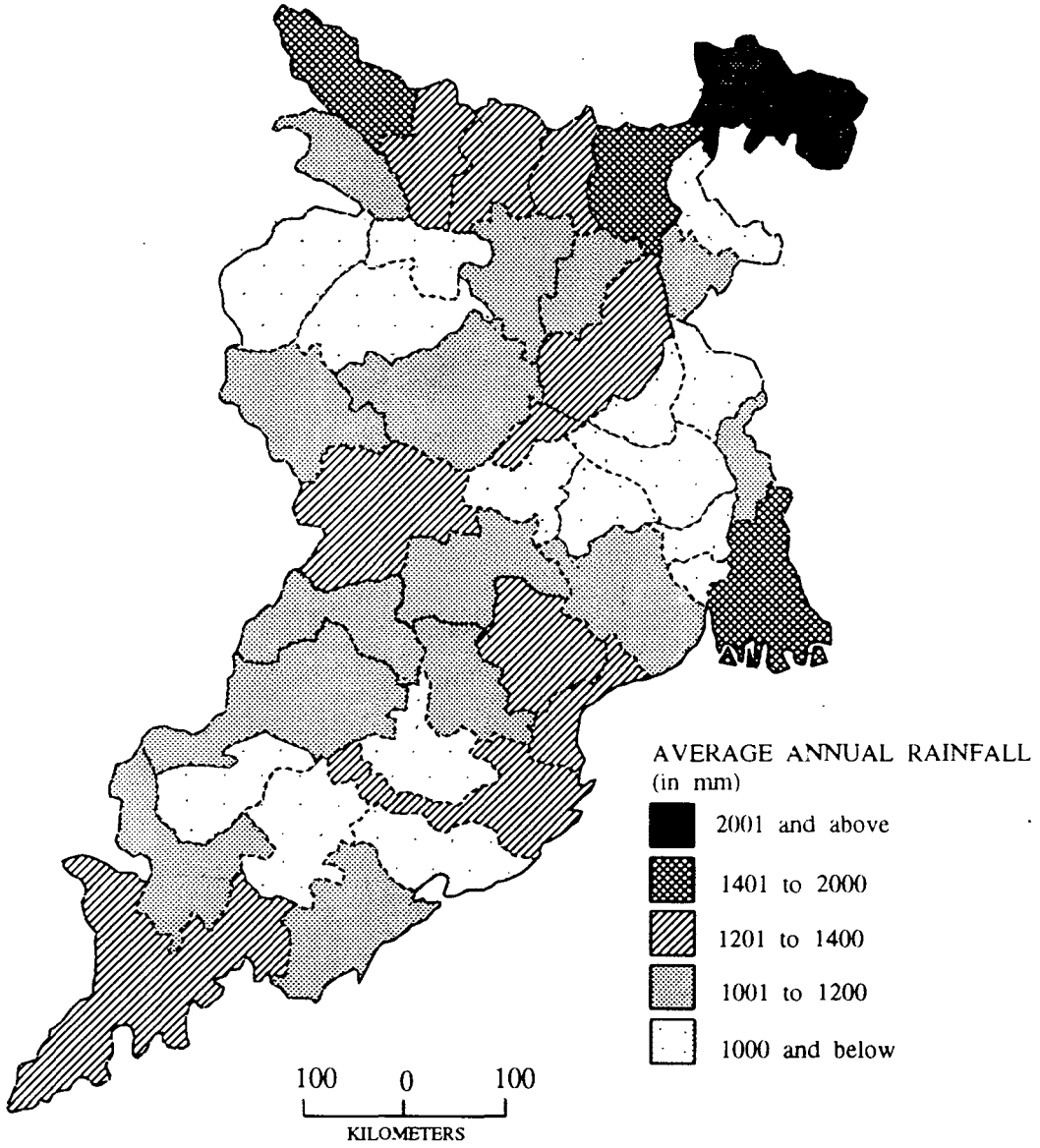

Fig . 3.3

season, (ii) the rainy moist season, and (iii) the cold winter season.

Landuse pattern in eastern India is greatly effected by one of the major elements of the climate, i.e. rainfall. The annual rainfall distribution has been shown by figures 3.3 and 3.4 which represents the triennium average of annual rainfall at two periods, 1974-77 and 1986-89.

Figure 3.3 reveals that two third of the districts in eastern India received very low rainfall (below 1000 mm) during 1974-77. These districts are Sahabad, Patna, Gaya and Santhal Pargana in Bihar, Balangir, Dhenkanal, Phulbani and Ganjam in Orissa, Purulia, Bankura, Barddhaman, Hugli, Haora, Murshidabad, West Dinajpur and Birbhum in West Bengal. Maximum rainfall was recorded in Jalpaiguri (2799 mm) followed by Koch Bihar (2721 mm) and Darjiling (2221 mm) districts while the minimum was recorded in Haora(435 mm). Rainfall was also high (1400 to 2000 mm) in 24 Parganas, Champaran and Purnea districts. The north Bihar plain, costal Orissa, Chotanagpur plateau, south western hilly parts and northern highlands of Orissa have received medium to low rainfall (1000 to 1400 mm).

During 1974-77, there was no significant correlation existing between annual rainfall and landuse pattern in eastern India. Rainfall has a positive impact on the growth of forest. The 'r' value was 0.0743 during 1974-77. But

EASTERN INDIA

AVERAGE ANNUAL RAINFALL

(1986 - 1989)

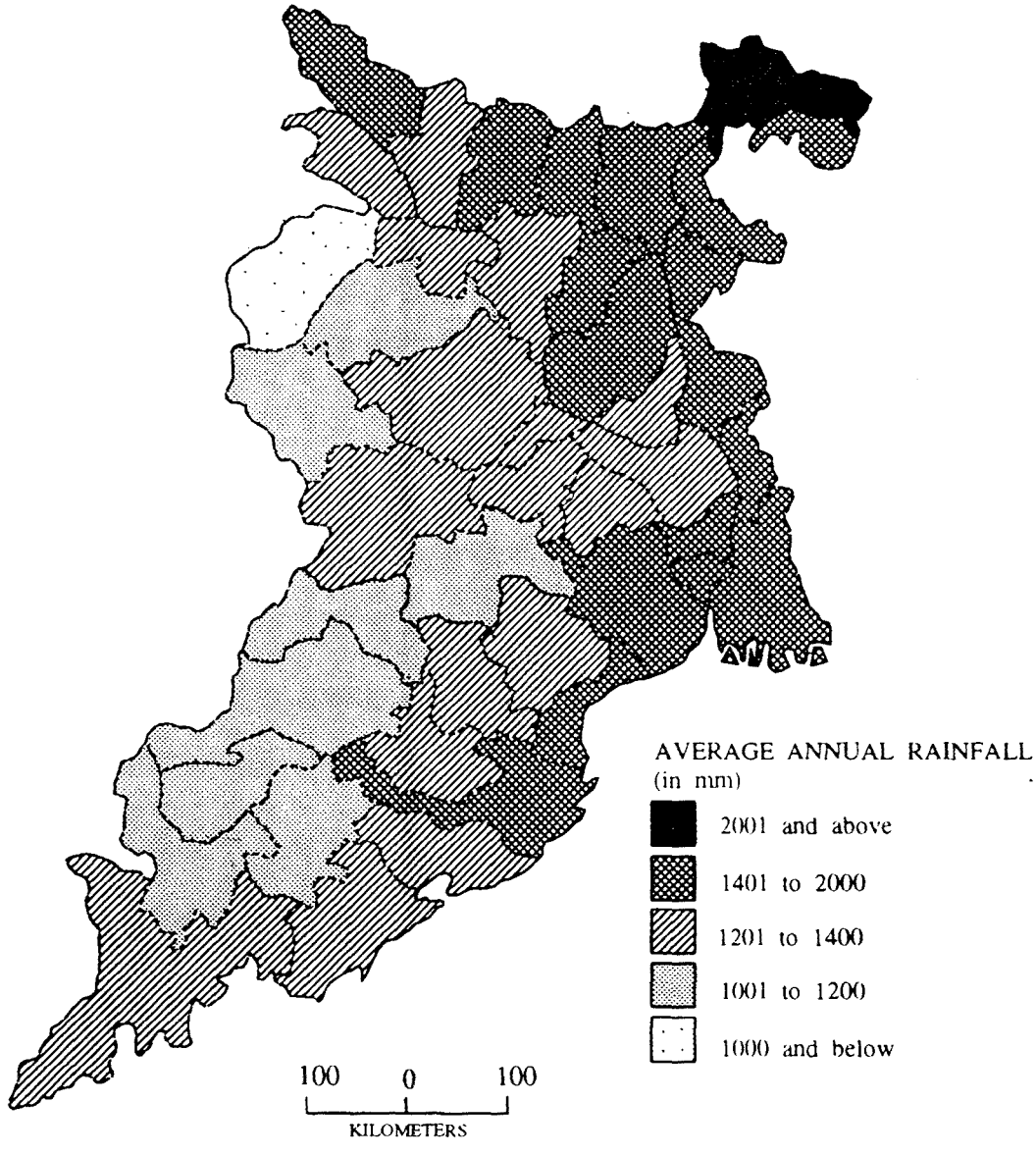

Fig. 3.4

fallow land and net sown area have shown negative association with average annual rainfall. The correlation coefficients were -0.0893 for rainfall and fallow land; and -0.0626 for rainfall and net sown area. The negative relation between net sown area and rainfall is profound in Nadia, Murshidabad, Barddhaman, West Dinajpur, Hugli and Haora districts which received below 1000 mm rainfall but registered more than 60 percent are under plough during 1974-77.

The average annual rainfall in 1986-89 is quite higher than 1974-77 in most of the districts in eastern India (Fig. 3.4). Rainfall received by the northern districts of West Bengal namely Jalpaiguri, Koch Bihar and Darjiling is exceptionally high (more than 3000 mm) during 1986-89. High rainfall (1400-2000 mm) has been recorded by Champaran, Darbhanga, Bhagalpur, Saharsa, Purnea, Santhal Pargana districts in Bihar; Balasore, Cuttack districts in Orissa; and 24 Parganas, Nadia, Murshidabad, Midnapore, Haora, Hugli, Malda and West Dinajpur in West Bengal. Sahabad is the only district having less than 1000 mm rainfall. Low rainfall (1000 to 1200 mm) was also received by the Gaya, Palamau and Singhbhum districts of Bihar and Bolangir, Kalahandi, Phulbani, Sambalpur and Sundargarh districts of Orissa. The remaining districts of eastern India have received medium rainfall, i.e. 1200 to 1400 mm.

In 1986-89, rainfall shows negative association with proportion of area under forest. The value of 'r' is -0.2336.

Table 3.1 Correlation Matrix: 1974-77 and 1986-89

Correlation	X_1	X_2	X_3	X_4
1974-77				
X_1	1.0000			
X_2	0.0743	1.0000		
X_3	-0.0893	0.0996	1.0000	
X_4	-0.0626	-0.8768**	-0.4873**	1.0000
1986-89				
X_1	1.0000			
X_2	-0.2336	1.0000		
X_3	-0.2866	0.0466	1.0000	
X_4	0.2423	-0.8294**	-0.4975**	1.0000

No. of cases: 45,
1 Tailed significance: ** -0.001

Where
X_1 = Annual rainfall in mm
X_2 = percentage of area under forest to total reporting area
X_3 = percentage of fallow land to total reporting area
X_4 = percentage of net sown area to total reporting area

In eastern India fallow land is negatively correlated with rainfall. The correlation coefficient is -0.2866. But net sown area is positively correlated with rainfall with 'r' value of 0.2423. Similarly as in 1974-77 there is no significant correlation existing between rainfall and landuse pattern during 1986-89.

Although eastern India receives high rainfall, its spatial and temporal distribution is erratic and uncertain. Sometimes severe droughts have been witnessed in some districts concentrated in northern and southern plateau region of Orissa, western part of Bihar and western part of West Bengal. Besides, water deficit, excess water stress causes frequent floods throughout eastern India which adversely affect the landuse pattern of the region. In fact, scarcity of rainfall is not a great problem in this region as its seasonal distribution. About 80 percent of the total annual rainfall is concentrated in the rainy season with the result that most of the rainfall drains off. This water can be harnessed for better utilisation in agricultural activities.

Soil

Soil is the basic determinant of landuse in any region. According to the nature of the parent rocks, soils vary greatly in eastern India. In all the plains of eastern India, specially in riverine plains, alluvial soil predominates. In comparison to this, plateaus and hilly areas are covered by

EASTERN INDIA

SOILS

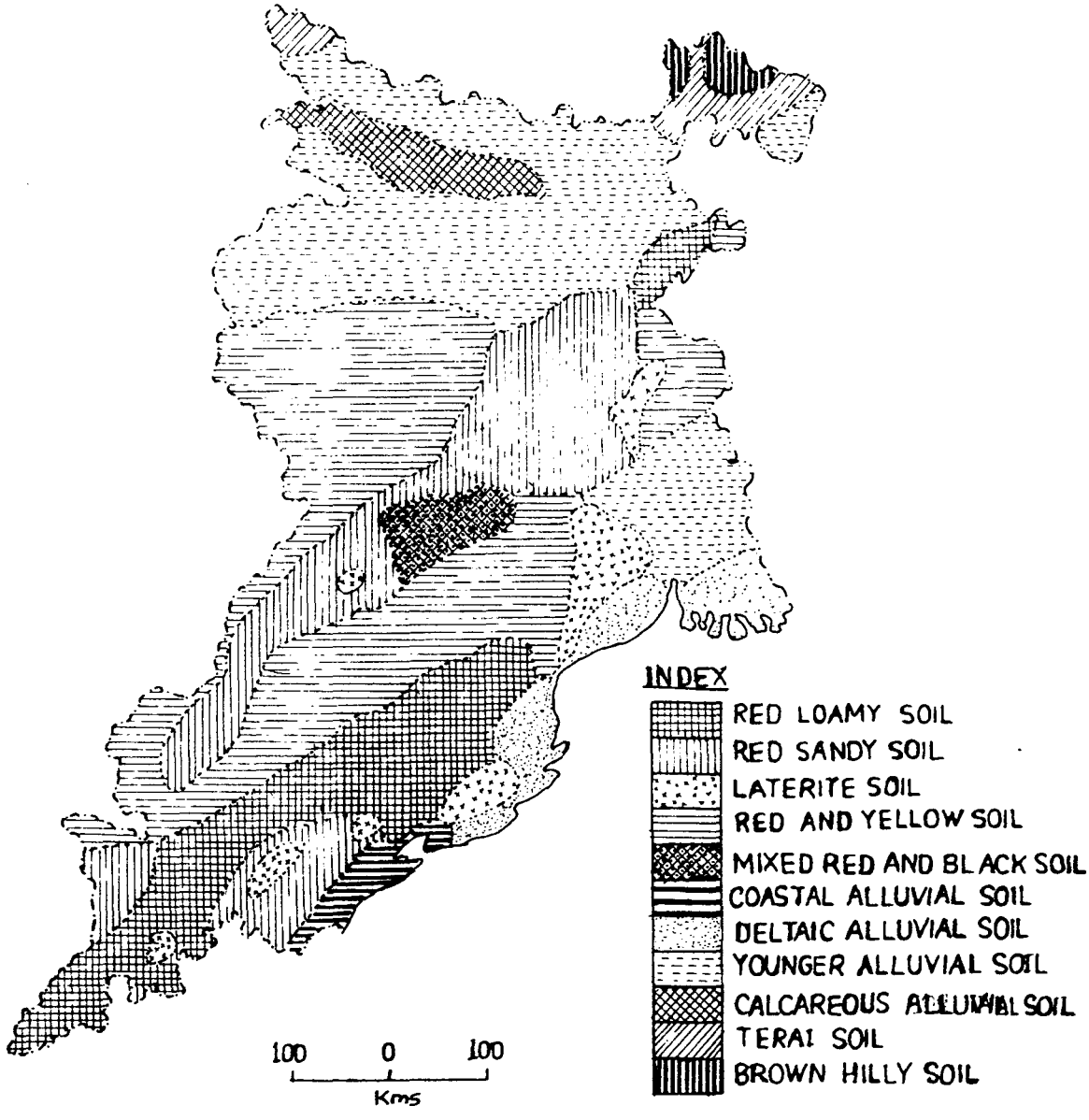

FIG.3·5

coarse sandy soils, lateritic or red soils which are not suitable for agricultural landuse. In those areas, culturable waste land, pasture or grazing lands or forests are dominating the utilization of land. Alluvial soil, red soil, laterite soil, red and yellow soil, brown forest soil, coastal saline soil and mixed red and black soils occupy most of the land area in West Bengal, Bihar and Orissa. The figure 3.5 shows the distribution of soils in eastern India in 1971.

By far the most important soil in eastern India is alluvial soil, both areally and agriculturally. The minor difference in the parent material differentiate the alluvial soil which has distinct spatial location. The younger alluvial soils are found in north and south Ganga plain of Bihar, covering 34.33 percent of the total area of the state. Older alluvial soil covers the upland of south Bihar plain, occupying 8.51 percent of total area of the state. Bhat or calcareous soil of the western north Bihar plain is a chemical variant of alluvial soil. It is riverine, lowlying but well drained and highly fertile.

In West Bengal, the younger alluvial soils occupy 40.12 percent of total area of the state. The deltaic alluvial and coastal alluvial soil are the outcome of interaction of rivers and tides. It is spread over 24 Parganas, coastal Medinipur and coastal belt of Orissa including Balasore, Cuttuck and Puri districts.

Red sandy soil is found in plateau region of Purulia,

parts of Birbhum districts. It is largely found in Chotanagpur plateau comprising Singhbhum, Ranchi, Dhanbad, Hazaribag and a small portion of Santhal Pargana districts. It occupies 20.02 percent of the area of the state of Bihar. This soil is coarse in texture and highly acidic in character and not suitable for agricultural uses. So these districts are covered by fallow and forests as revealed by data from early 1960s to late 1980s.

Red sandy soils and red loamy soils occupy 33.28 percent and 30.10 percent respectively of the total area of the Orissa State. These soils mainly cover the south western hilly districts and northern plateau region of Orissa, where less fertility of the soil leads to the growth of high forest cover and low cultivable land during three time periods of study. Red and yellow soils account for 9.74 percent of total area in West Bengal, 19.43 percent in Bihar and 9.43 percent in Orissa. This soil is found in Birbhum, Murshidabad, Bankura districts of West Bengal, Santhal Pargana, Hazaribag, Palamau, Ranchi, Singhbhum and Dhanbad districts of Bihar and Sundargarh, Puri, Mayurbhunj, Dhenkanal and Balasore districts of Orissa. Forest covers to a large extent of the soil of Orissa and Bihar.

Lateritic soils occupy small proportion of land in Balasore, Cuttuck, Ganjam, Kendujhar, Koraput, Mayurbhanj, Puri and Sundargarh districts covering 7.84 percent of the total area of the state. In West Bengal, it is found in major

Table 3.2 Acid Soils in Eastern India

State	Locations	Estimated Area
West Bengal	Laterite soils of Birbhum, Bankura and part of Medinipur, red gravelly soils of Purulia and red soil of Malda and West Dinajpur, Terai region of Darjiling and Jalpaiguri districts	NA
Bihar	Red laterite soils of the Chotanagpur plateau, (i.e. Palamau, Hazaribag, Santhal Pargana, Dhanbad, Ranchi) and black soil of Singhbhum	6.7 lakh hectare (Source: Soil Conservation Directorate, Bihar)
Orissa	Cuttuck, Puri, part of Baleshwar, Ganjam and Dhenkanal	48 lakh hectare (Source: Soil Conservation Directorate, Orissa)

Source: Perspective Plan for Conservation, Management and Development of Land Resources in the Eastern Zone of India, (unpublished report) Volume III, Chart: 12.8, Centre for Management in Agriculture, Indian Institute of Management, Ahmedabad, 1993.

part of Medinipur, Bankura, Birbhum and Barddhaman districts covering 9.90 percent of the total area of the state. These soils are acidic in character and deficient in organic matter. In Orissa, landuse pattern in this soil type is dominated by large area under forest and culturable waste land, whereas in West Bengal districts having this soil show high proportion of area under fallow.

The unassorted materials deposited at the foothills of Himalayas form the typical terai soil. It covers the parts of Jalpaiguri, Koch Bihar, Darjiling and Champaran districts. This soil has developed under moist conditions. Once under the cover of forests and tall grasses, these are being reclaimed fast for cultivation. The hilly parts of Darjiling and Jalpaiguri districts have reported higher proportion of forest cover.

Acidity in soil has been increasing in eastern India (Fig. 3.2). In West Bengal lateritic soil of Birbhum, Bankura and parts of Medinipur districts and red soils of Malda and West Dinajpur districts have been affected by acidity. The decomposed organic matter is also responsible for soil acidity in Darjiling and Jalpaiguri districts.

Red soil of Chotanagpur plateau, black soils of Singhbhum district and the soils of coastal districts in Orissa are affected by acidity. Acidity in the soils is responsible for degrading character of cultivable land in these areas. It may also be a reason for the negative growth rate of net sown area

Table 3.3 Saline Land in Eastern India

State	Locations	Estimated Area (in hectare)
West Bengal	Coastal tracts of Medinipur and 24 Parganas	80,50,202 (Source: Planning Commission, 1963)
Bihar	Muzaffarpur, Saran, Darbhanga	4,50,000 (Source: Soil Conservation Directorate, Bihar)
Orissa	Coastal tracts of Ganjam, Puri, Cuttuck and Baleshwar	2,55,721 (Source: ORSAC, Orissa)

Source: Perspective Plan for Conservation, Management and Development of Land Resources in the Eastern Zone of India, (unpublished report) Volume III, Chart: 12.4, Centre for Management in Agriculture, Indian Institute of Management, Ahmedabad, 1993.

and positive growth of fallow land from 1961-64 to 1986-89 in these parts of eastern India.

The table 3.3 reveals the distribution of saline land in eastern India. Most of the land in coastal areas remain fallow either because of high salinity or because of lack of irrigation with water of good quality.[2] Salinity is found in the soil of Medinipur, 24 Pargana, Muzaffarpur, Saran, Darbhanga, Ganjam, Puri, Cuttuck and Balasore districts. The growth of fallow lands in 24 Pargana, Darbhanga, Muzaffarpur and Medinipur districts during 1974-77 to 1986-89 is due to the serious problem of soil salinity.

Soil erosion is also a major problem in eastern districts of Orissa, Chotanagpur plateau of Bihar, Darjiling hills of West Bengal. It is responsible for decreasing cultivated land in eastern India from early 1960s to late 1980s. In West Bengal, 22.71 percent of the geographical area suffers from soil erosion, land degradation and inundation.[3]

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[2] C. Mishra and D. Panda (1994) Land and Water Management in Eastern India. Symposium on Management of Land and Water Resources for Sustainable Agriculture and Environment, Indian Society of Soil Science, New Delhi, p.130.

[3] Y.P. Rao (1990) Workshop on Research Needs on Land and Water Management for Enhancing Agricultural Production in Eastern Region, October 4-5, Water Technology Centre for Eastern Region, Bhubaneshwar.

Section II

III. 2 TECHNOLOGICAL FACTORS AFFECTING THE LANDUSE PATTERN

Though the natural environment has always been a powerful force in determining the landuse, technological factors loosen the shackles of environment. There is a very little scope of increasing the agricultural production through physical extension or horizontal extension of area. Therefore, the gross cropped area has to be increased in order to increase the quantum of production. The inputs and practices such as irrigation and use of chemical fertilizers contribute to the expansion of total cropped area through multiple cropping. Before discussing these two technological determinants of landuse, it is necessary to analyse the spatial and temporal variation in cropping intensity in the study area. The changing cropping intensity is greatly influenced by the degree of advancement of technology.

Cropping Intensity

As regards the temporal trends of each individual district, cropping intensity registered considerable increase in the three periods. The spatial pattern shows that cropping intensity is very high in north Bihar plain, coastal Orissa and Moriband deltaic tract of West Bengal along with the northern plai, while it is very low in Chotanagpur plateau region of Bihar, northern and central highlands of Orissa and

EASTERN INDIA

CROPPING INTENSITY

(TRIENNIUM AVERAGE 1961-1964)

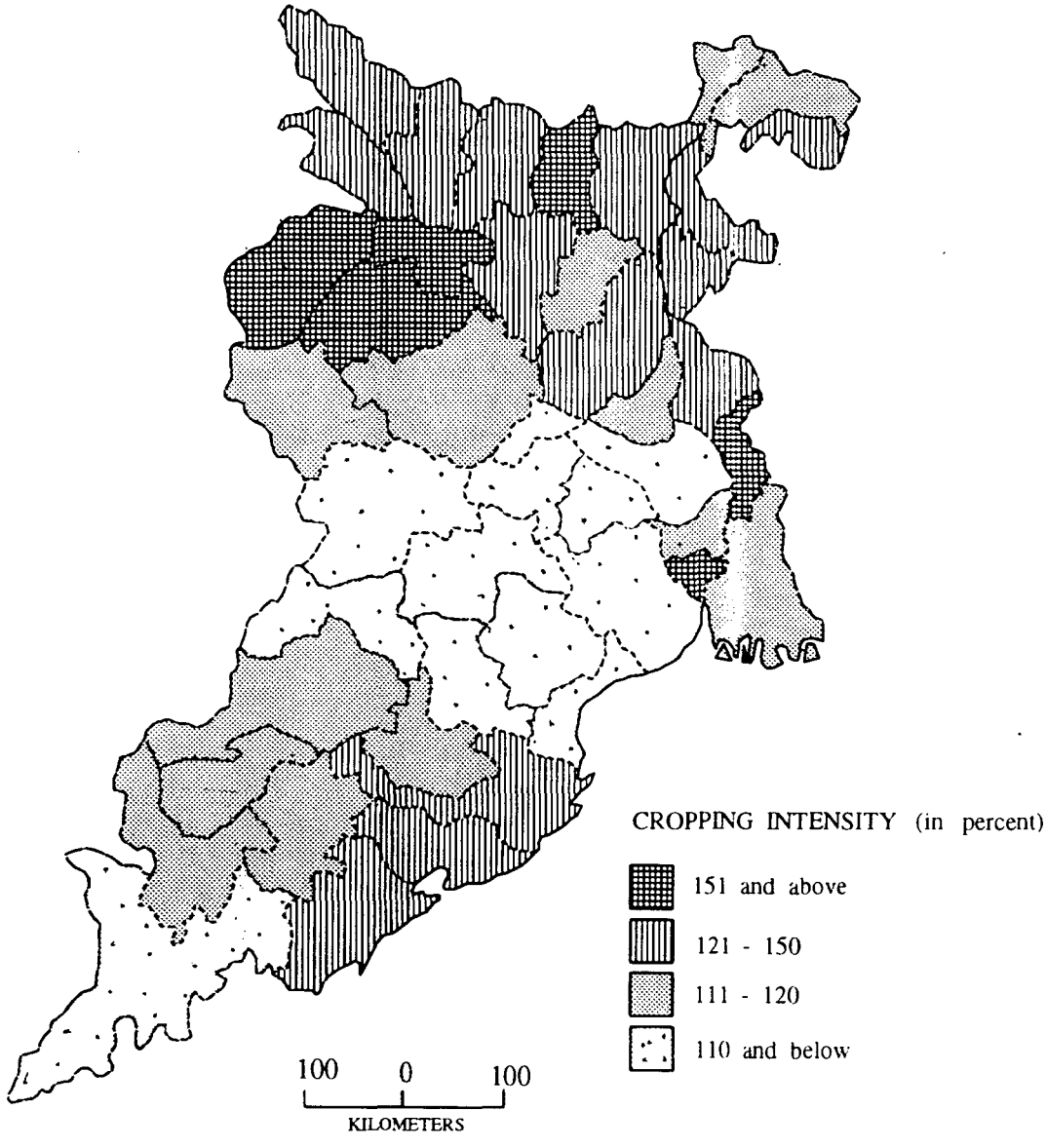

Fig . 3.6

eastern plateau region of West Bengal.

Throughout the period the spatial pattern of cropping intensity has considerably changed as revealed from the figures 3.6, 3.7 and 3.8. In 1961-64, districts of the Bihar plain namely Gaya, Patna, Sahabad and Saharsa recorded high cropping intensity, i.e. more than 150 percent. In West Bengal, Nadia was the only district which recorded a cropping intensity of more than 150 percent. Contrary to this, very low cropping intensity (below 105 percent) had been recorded by Purulia and Bankura districts of West Bengal, Ranchi and Dhanbad districts of Bihar, Sundargarh, Mayurbhanj, Kendujhar and Baleshwar districts of Orissa (Fig. 3.6).

Compared to the intensity of cropping in 1961-64, there is a considerable increase during 1974-77. Cropping intensity was as high as 173 percent in Nadia followed by Murshidabad (166%) and Malda (162%). Most of the districts of West Bengal, Bihar and Orissa had registered an increase in intensity of cropping whereas low cropping intensity had been recorded in Gaya, Singbhum and Purnea districts of Bihar and Koraput district of Orissa (Fig. 3.7).

A remarkable change in cropping intensity has been noticed in districts of West Bengal and Orissa during 1986-89 (Fig. 3.8). The value has exceeded 236 percent in Malda and 201 percent in Nadia, 185 percent in Hugli, 183 percent in Koch Bihar, 183 percent in Haora district. High intensity of cropping (140-160%) has also been reported in north and south

EASTERN INDIA

CROPPING INTENSITY

(TRIENNIUM AVERAGE 1974-1977)

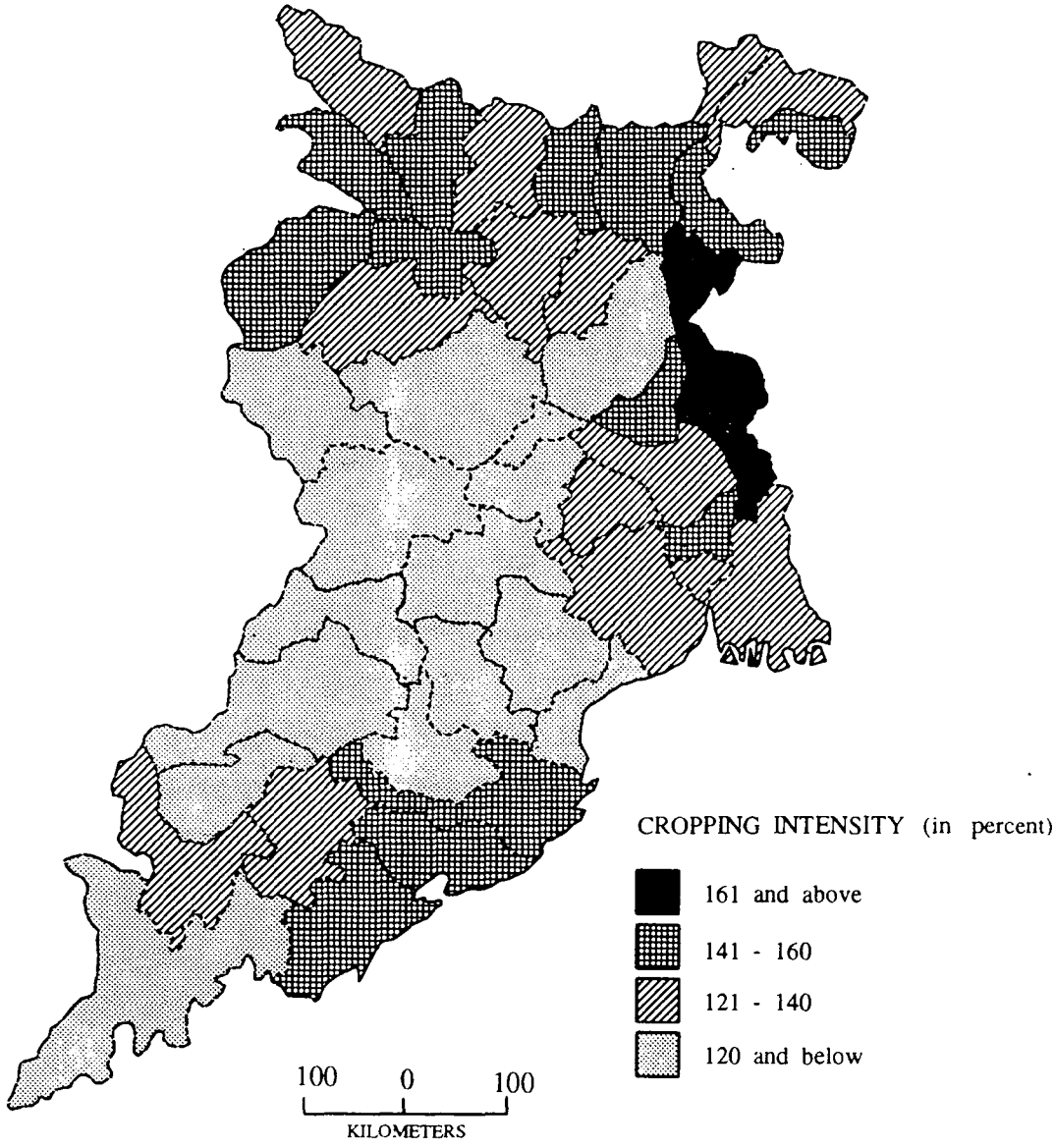

Fig . 3.7

EASTERN INDIA

CROPPING INTENSITY

(TRIENNIUM AVERAGE 1986-1989)

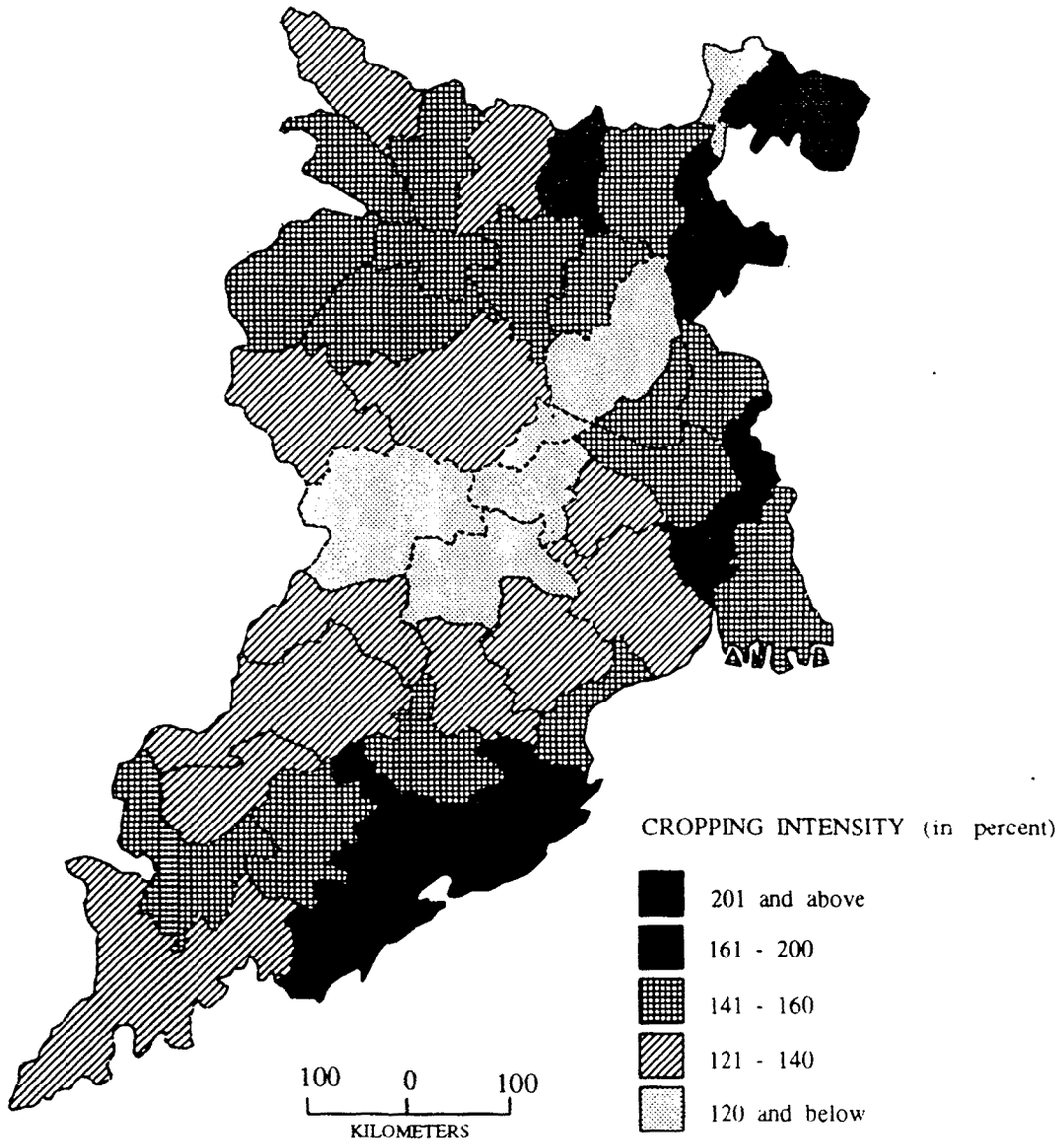

Fig . 3.8

Bihar plains, central part of Orissa, whereas the coastal districts of Orissa recorded very high cropping intensity. It is low (below 120%) in Purulia, Darjiling, Santhal Pargana, Dhanbad, Ranchi and Singbhum districts during 1986-89. Medium values (120-140%) have been registered in Medinipur, Bankura, Palamau, Hazaribag, Sundargarh, Mayurbhanj, Kendujhar, Sambalpur, Balangir and Koraput districts.

Irrigation

Irrigation is essentially, the artificial application of water to overcome deficiencies in rainfall. The impact of irrigation on landuse is best comprehended when two aspects, net sown area and area sown more than once are considered. Net sown area extends over the arable land through extended irrigation facilities. An increase in cropping intensity, on the other hand, is possible only through intensive agriculture.

The analysis is based on data of net and gross irrigated areas during 1974-77 and 1986-89. Data is not available for West Bengal in these two periods of study. On the basis of the percentage of net irrigated area to net sown area, the districts of eastern India have been divided into four categories.

During 1974-77, very highly irrigated zone (above 60%) covered three districts of Bihar namely Gaya, Patna and Sahabad. Predominant source of irrigation was tubewells

Table 3.4 Level of Irrigation in Orissa and Bihar

Categories	%age of net irrigated area to net sown area	Years	Orissa Districts	Bihar Districts
Very highly irrigated zone	Above 60 percent	1974-77		Patna, Gaya, Sahabad
		1986-89		Patna, Gaya, Saran, Sahabad
Highly irrigated zone	40-60 percent	1974-77		Saran, Bhagalpur
		1986-89	Cuttuck, Ganjam, Puri	Munger, Bhagalpur
Moderately irrigated zone	20-40 percent	1974-77	Cuttuck, Ganjam, Puri, Sambalpur	Champaran, Muzaffar-pur, Darbhanga, Munger, Saharsha, Palamau
		1986-89	Balasore, Bolangir Dhenkanal, Phulbani, Sambalpur	Champaran, Muzaffar-pur, Darbhanga, Saharsha, Purnea, Palamau
Poorly irrigated zone	Below 20 percent	1974-77	Balasore, Bolangir, Dhenkanal, Koraput, Kalahandi, Mayur-bhunj, Kendujhar, Phulbani, Sundargarh	Purnea, S. Pargana Hazaribag, Ranchi, Dhanbad, Singhbhum
		1986-89	Kalahandi, Kendujhar, Koraput, Sundargarh Mayurbhanj	S. Pargana, Hazari-bag, Ranchi, Dhanbad, Singhbum

Source: Indian Agricultural Statistics, Volume II, Table 2. 1974-77, 1986-89.

though canal irrigation was also important. Highly irrigated zone (40-60%) extends over Saran and Bhagalpur districts of Bihar. There was no district in Orissa which could be included in these two zones during 1974-77 (Table 3.4). Most of the northern districts of Bihar comprising of Champaran, Muzaffarpur, Darbhanga, Munger and Saharsa were moderately irrigated. This zone with 20 to 40 percent net irrigated area is confined to the coastal parts of Orissa including Cuttuck, Puri, Ganjam and plateau district of Sambalpur. The remaining districts of Bihar and Orissa comprising of the districts of Chotanagpur plateau, northern and southern highlands of Orissa had been poorly irrigated having less than 20 percent of the net sown area under irrigation in 1974-77.

The proportion of net irrigated area to net sown area has gradually increased from 1974-77 to 1986-89. During 1986-89, very highly irrigated zone was concentrated in four districts namely Patna (80%), Gaya (86%), Sahabad (87%) and Saran (70%). The coastal districts of Orissa including Cuttuck, Ganjam and Puri districts and north eastern districts of Bihar including Bhagalpur and Munger were highly irrigated during 1986-89. Moderately irrigated zone includes the south western hilly and plateau districts of Orissa and south Bihar plains. The number of districts under poorly irrigated zone has decreased from 15 districts in 1974-77 to 10 districts in 1986-89. These ten districts are mainly concentrated in northern highlands of Orissa and Chotanagpur plateau of Bihar.

Table 3.5 Comparative Analsyis Between Cropping Intensity and Intensity of Irrigation in Bihar and Orissa, 1986-89

Categories	Irrigation Intensity (%) (below 120%) Low	(120-140%) Medium	(more than 140%) High
Below 120% Low	Ranchi Singhbhum	Santhal Pargana Dhanbad	
120-140% Medium		Darbhanga Champaran Palamau Kendujhar	Hazaribag, Bolangir Koraput Mayurbhunj Sambalpur Sundargarh
More than 140% High	Munger Muzaffarpur Saran Ganjam	Patna Gaya Sahabad Bhagalpur Phulbani	Saharsha Purnea Balasore Cuttuck Dhenkanal Kalahandi Puri

Source: Indian Agricultural Statistics, Volume II, Table 1 and 2, 1974-77, 1986-89.

The impact of irrigation on land utilization can be observed from the analysis of cropping and irrigation intensity. The beneficial aspect of irrigation has been more conspicuous in the field of cropping intensity rather than in net sown area. A positive relationship exists between cropping intensity and intensity of irrigation as revealed from Table 3.5. On the basis of data of both these variables in 1986-89, districts are categorised into high, medium and low values.

High values of cropping intensity (above 140%) are confined to Bihar plains. The cropping as well as irrigation intensity are high (above 140%) in five districts of Orissa including Baleshwar, Cuttuck, Dhenkanal, Kalahandi and Puri while in Bihar only two districts, Saharsa and Purnea have shown high values of both these variables. Both these variables show low values in Ranchi and Singbhum districts whereas both of them have shown medium intensity in Darbhanga, Champaran, Palamau and Kendujhar districts. Cropping intensity has been very high in Munger, Muzaffarpur, Saran and Ganjam districts against a low intensity of irrigation in 1986-89.

Consumption of Chemical Fertilizers

In early 1960s, there was very little use of fertilizers in eastern India. The use of chemical fertilizers had been rising steadily from the early 1970s. The ratio of nitrogen,

EASTERN INDIA

FERTILIZER CONSUMPTION ($N+P_2O_5+K_2O$)

(TRIENNIUM AVERAGE 1961-1964)

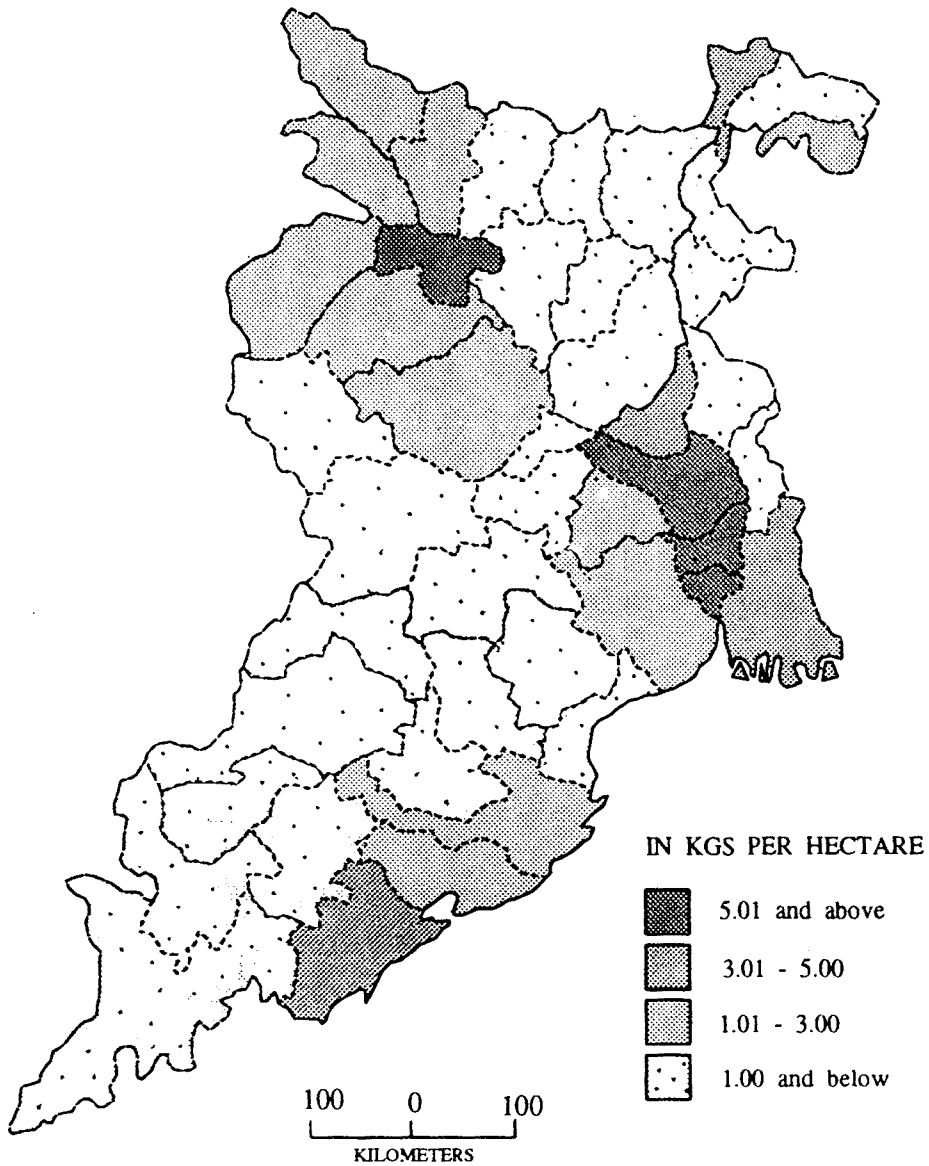

Fig . 3.9

EASTERN INDIA

FERTILIZER CONSUMPTION ($N+P_2O_5+K_2O$)

(TRIENNIUM AVERAGE 1974-1977)

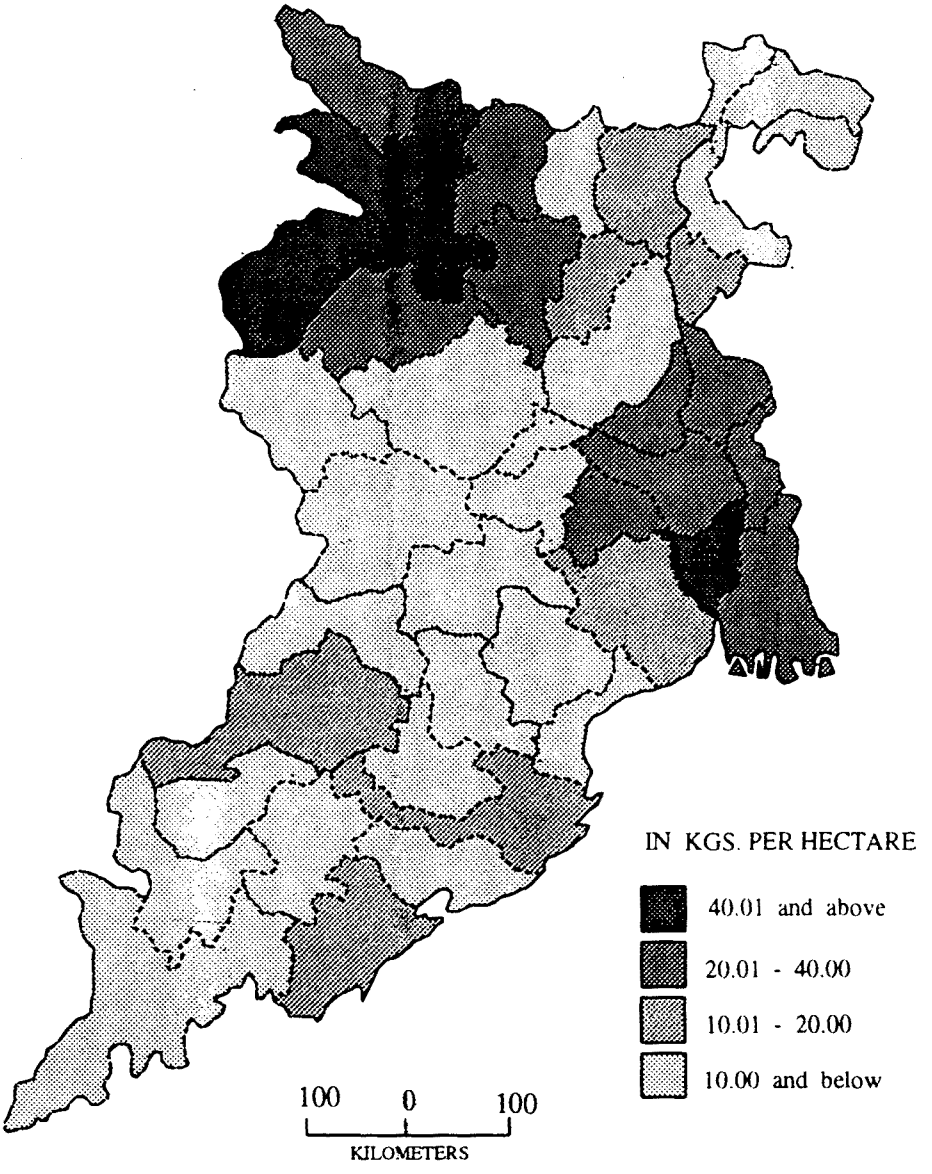

Fig . 3.10

phosphorus and potash used had remained more or less unchanged till recent periods. The district-wise variation in the use of fertilizers are shown in Figures 3.9, 3.10 and 3.11 for three selected periods, 1961-64, 1074-77 and 1986-89.

In 1961-64, only in four districts of eastern India per hectare consumption of fertilizer was more than 5 kg while the remaining districts show a very little fertilizer consumption. These four districts are Hugli, Haora, Barddhaman and Patna. The consumption of fertilizer was 3 to 5 kg per hectare in Ganjam, 24 Parganas, Birbhum and Darjiling districts whereas it was less than 1 kg in northern plateau and southern highlands of Orissa, Chotanagpur plateau of Bihar, northern plain of West Bengal and eastern plain of Bihar (Fig. 3.9).

The spatial variation in use of fertilizer during 1974-77 reveals that the north western part of Bihar plain and alluvial plain of Bengal have witnessed very high level of consumption. The consumption was more than 40 kg per hectare in Saran, Muzaffarpur, Sahabad and Patna districts of Bihar and Haora and Hugli districts of West Bengal (Fig. 3.10). The consumption was high (20-40 kg/hectare) in Champaran, Gaya, Darbhanga and Bhagalpur districts of Bihar, and Bankura, Burdwan, Nadia, 24 Parganas, Murshidabad and Birbhum districts of West Bengal. Low level of consumption (below 10 kg) has been registered in all districts of Orissa except Cuttuck, Ganjam and Sambalpur districts where medium level of consumption has been recorded. The spatial variation is very

EASTERN INDIA

FERTILIZER CONSUMPTION ($N+P_2O_5+K_2O$)

(TRIENNIUM AVERAGE 1986-1989)

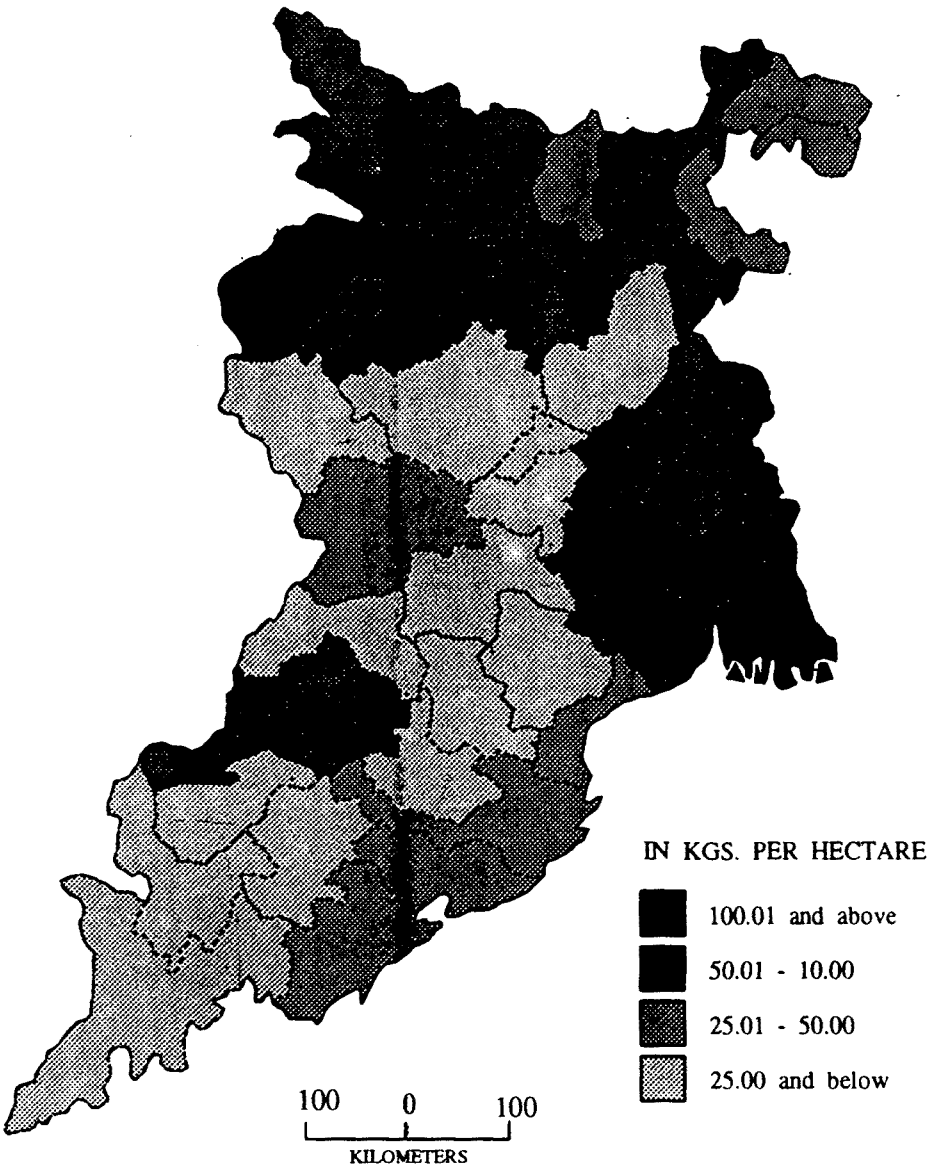

Fig . 3.11

significant in Bihar and West Bengal. Southern districts of Bihar and northern districts of West Bengal have recorded lower rate of fertilizer consumption than the remaining districts. In this period, fertilizer consumption was highest in Saran (62 kg/hectare) while lowest in Kalahandi district (0.60 kg/hectare).

In 1986-89, the consumption of chemical fertilizers has increased by a greater extent in north and south Bihar plain; Rarh plain and alluvial plain of Bengal. The consumption was maximum in Haora which has exceeded 200 kg per hectare followed Hugli with 170 kh per hectare, 121 kg in Patna and 103 kg in Sahabad districts. The level of consumption was also high in districts of north and south Bihar plain, southern deltaic tract, Barind tract and Rarh plain of West Bengal.

Fertilizer consumption was low in all districts of Orissa except Sambalpur where more than 50 kg per hectare fertilizers have been consumed during 1986-89 (Fig.3.11). Darjiling has witnessed high growth rate in consumption of fertilizers which has increased from 4 kg per hectare in 1974-77 to 72 kg per hectare in 1986-89. The disparity in level of consumption is noticeable between plain and plateau regions of Bihar.

Intensive use of fertilizers on agricultural land is a determinant of intensive cropping. The bivariate analysis between cropping intensity and consumption of fertilizer is shown in Figure 3.12. On the basis of the 1986-89 data, the

EASTERN INDIA

CORRELATION BETWEEN CROPPING INTENSITY AND FERTILIZER CONSUMPTION

(1986-89)

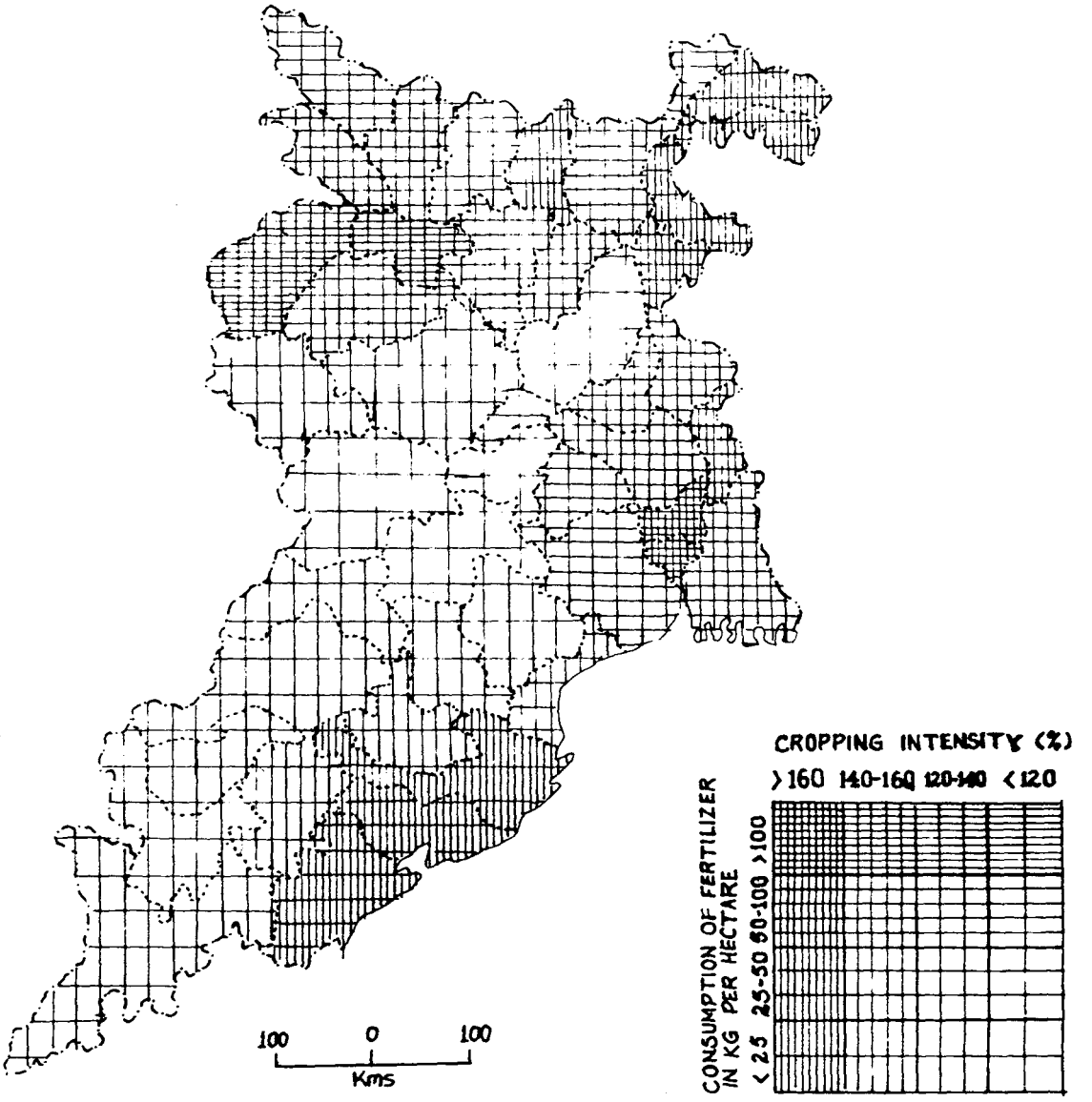

FIG. 3.12

districts of eastern India have been categorised into very high, high, medium and low categories. It reveals that both these variables are very high in Haora and Hugli districts having more than 160 percent cropping intensity and more than 100 kg per hectare consumption of fertilizer. On the other hand, Purulia, Santhal Pargana, Dhanbad and Singbhum districts experienced low level of fertilizer consumption (below 25 kg per hectare) and low cropping intensity (below 120 percent). Most of the districts in southern and northern uplands of Orissa registered low level of fertilizer consumption but medium to high intensity of cropping. The fertilizer consumption is high in Darjiling (72 kg/hectare) and medium in Ranchi district (28 kg/hectare), though both these districts have low cropping intensity during 1986-89. Both variables show high values in 24 Parganas, Murshidabad, Barddhaman and Birbhum districts of West Bengal, and Gaya, Saran, Muzaffarpur, Munger, Bhagalpur and Purnea districts of Bihar. Cropping intensity is high (140-160%) in Patna and Sahabad districts, where fertilizer consumption is very high (above 100 kg/hectare). Likewise, in Nadia and Malda districts, cropping intensity is very high (above 160%) with high level of consumption of fertilizer. The overall picture reveals that both cropping intensity and consumption of fertilizer are high in plains while low in plateaus and highlands of eastern India.

The correlation matrix in Table 3.6 respresents the

Table 3.6 Correlation Matrix 1974-77 and 1986-89

Correlations	X_5	X_6	X_7	X_8
1974-77				
X_5	1.0000			
X_6	0.6659**	1.0000		
X_7	0.0797	-0.1271	1.0000	
X_8	0.7270**	0.7679**	-0.1343	1.0000
1986-89				
X_5	1.0000			
X_6	0.2489	1.0000		
X_7	0.3044	-0.3787	1.0000	
X_8	0.5679**	0.8123**	-0.1754	1.0000

No. of cases 30
1 Tailed significance: * -0.01, ** -0.001

X_5 = cropping intensity
X_6 = consumption of fertiliser
X_7 = irrigation intensity
X_8 = percentage of net irrigated area to net sown area

association between the four variables, cropping intensity, fertilizer consumption, irrigation intensity and percentage of net irrigated area to net sown area. During 1974-77, cropping intensity and consumption fertilizer showed a positive association. The value of 'r' was 0.6659 which was significant at a 99 percent level of significance. During this period irrigation intensity and percentage of net irrigated area were not significantly correlated with cropping intensity, though they have shown a positive association. In 1986-89 the percentage of net irrigated area to net sown area was highly correlated with cropping intensity. The correlation coefficient was 0.5679. It was significant at 99 percent level of significance. During both these period the consumption of fertiliser was significantly correlated with the proportion of net irrigated area to net sown area. The 'r' values were 0.7679 and 0.8123 for 1974-77 and 1986-89 respectively.

This chapter highlighted that the landuse pattern in eastern India responds to the environmental factors like physiography, drainage, climate, soil etc. There is a close association of all natural determinants of landuse. The landuse pattern varies between highlands and lowlands of eastern India due to the difference in relief, effectiveness of surface drainage and variation in soil types. The presence of flat surface, fertile soil and plenty of rainfall and surface water in the plains have resulted in high proportion

of area under cultivation, low cover of forest, low percentage of fallow land. Contrary to this, the plateaus and highlands with rugged terrain, less fertile red and lateritic soils have been devoted to forest to a larger extent. Fallows and cultivable wastelands are very common while agriculture is rarely practiced on these tracts.

During the period under study, the agricultural landuse has experienced remarkable progress in the use of such technological inputs as chemical fertilizers and irrigation. The proportion of net sown area under irrigation shows a very high correlation with cropping intensity in eastern India. In the plains, particularly around Haora and Hugli districts in West Bengal, the intensive farming is associated with a higher level of fertilizer consumption per hectare of gross cropped area.

CHAPTER IV

MAN AND LAND USE PATTERN

The present chapter focusses the nature and direction of relations between man and land in the eastern India.

The growth of population has several impacts on landuse pattern. A higher pressure of population over land generally necessitates the expansion of the net sown area. Consequently, while net sown area shows a positive association with population density, the forested area, cultivable waste land and fallow land exhibit negative association. The study area is by far the most thickly populated part of India. It has recorded a constant higher density than nation's average throughout the present century. However, the heterogeneity in the physical attributes, like physiography, soil type and its fertility, local climate, distribution of rainfall and availability of underground water have led to wide range of variations in population distribution over eastern India.

Population pressure is generally viewed in relation to the availability of land resources, and is therefore, measured in terms of density of population. As the population is increasing in eastern India, the pressure on arable land is increasing. Hence, in order to have a better understanding of population pressure on agricultural land, some measures such as agricultural density, land-man ratio have been examined in this chapter.

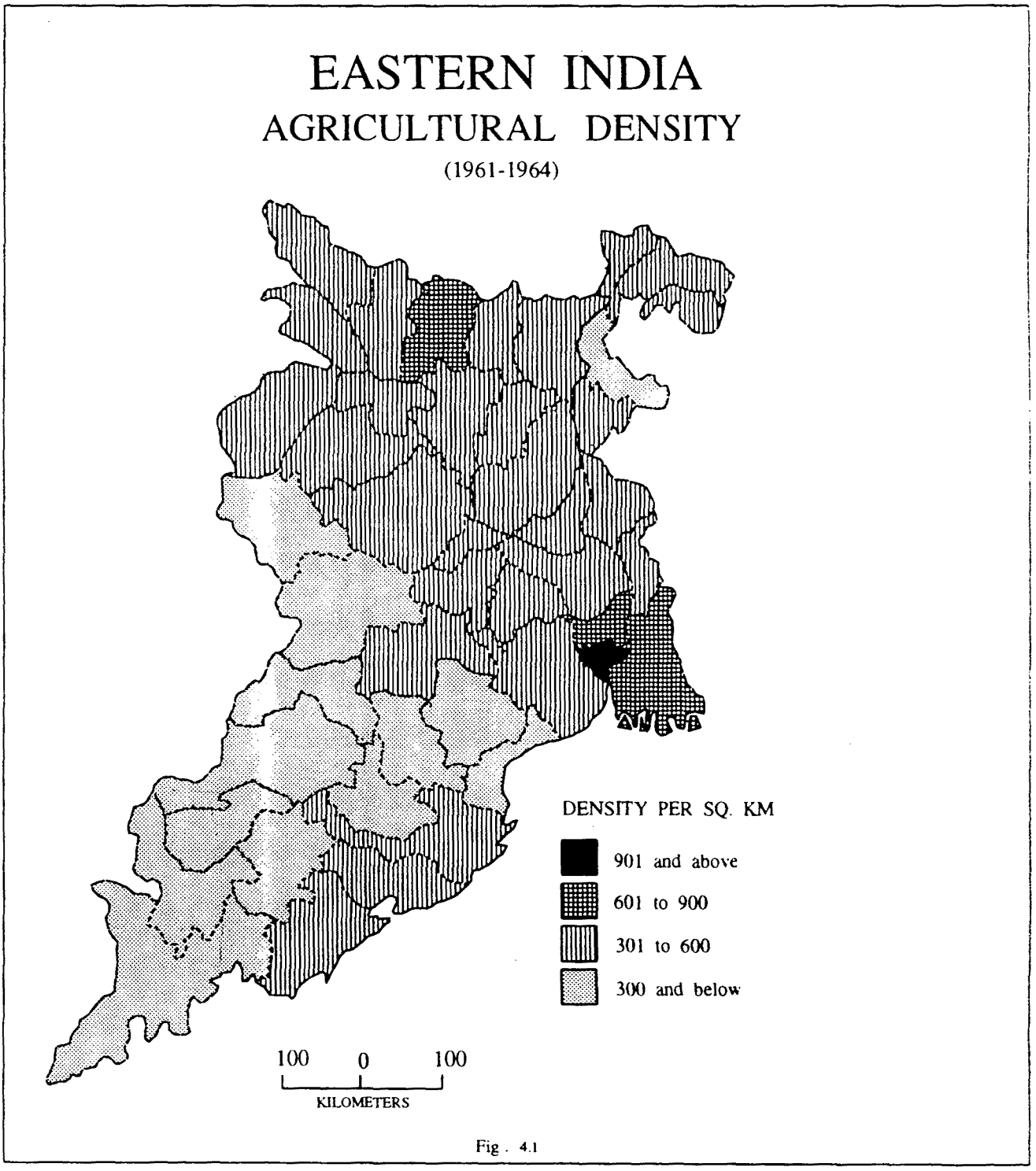
EASTERN INDIA
AGRICULTURAL DENSITY
(1961-1964)
DENSITY PER SQ. KM
901 and above
601 to 900
301 to 600
300 and below
100 0 100
KILOMETERS

Fig . 4.1

Agricultural Density

The state of West Bengal has relatively higher agricultural density i.e., number of persons per sq. km. arable land, in comparison to other states included in the study. The districts of the study area have been divided into four levels of agricultural density, viz., very high, high, medium and low having more than 9, 6 to 9, 3 to 6 and below 3 persons per sq. km. of arable land respectively.

The agricultural density in eastern India was 392 persons per sq. km. in 1961-64. Highest density has been recorded in Haora district, i.e. 1200 persons per sq. km. followed by Hugli, 24 Parganas, Darbhanga districts where density ranged from 600 to 900 persons per sq. km. The density had been low in the entire state of Orissa excluding three coastal districts and also in Ranchi and Palamau districts of Bihar, and West Dinajpur district in West Bengal whereas, the remaining parts of eastern India had recorded medium density (Fig. 4.1).

As compared to 1961-64, the pressure of population on cultivated land increased considerably in 1974-77. The density has increased to 507 persons per sq. km. in 1986-89 as compared to 392 persons per sq. km. in 1974-77. The change was evident in West Bengal. The two districts, namely Haora and Hugli registered very high density. On the other hand, the districts of 24 Parganas, Medinipur, Barddhaman, Nadia, Murshidabad and Darjiling in West Bengal, Patna, Saran,

EASTERN INDIA

AGRICULTURAL DENSITY

(1974-1977)

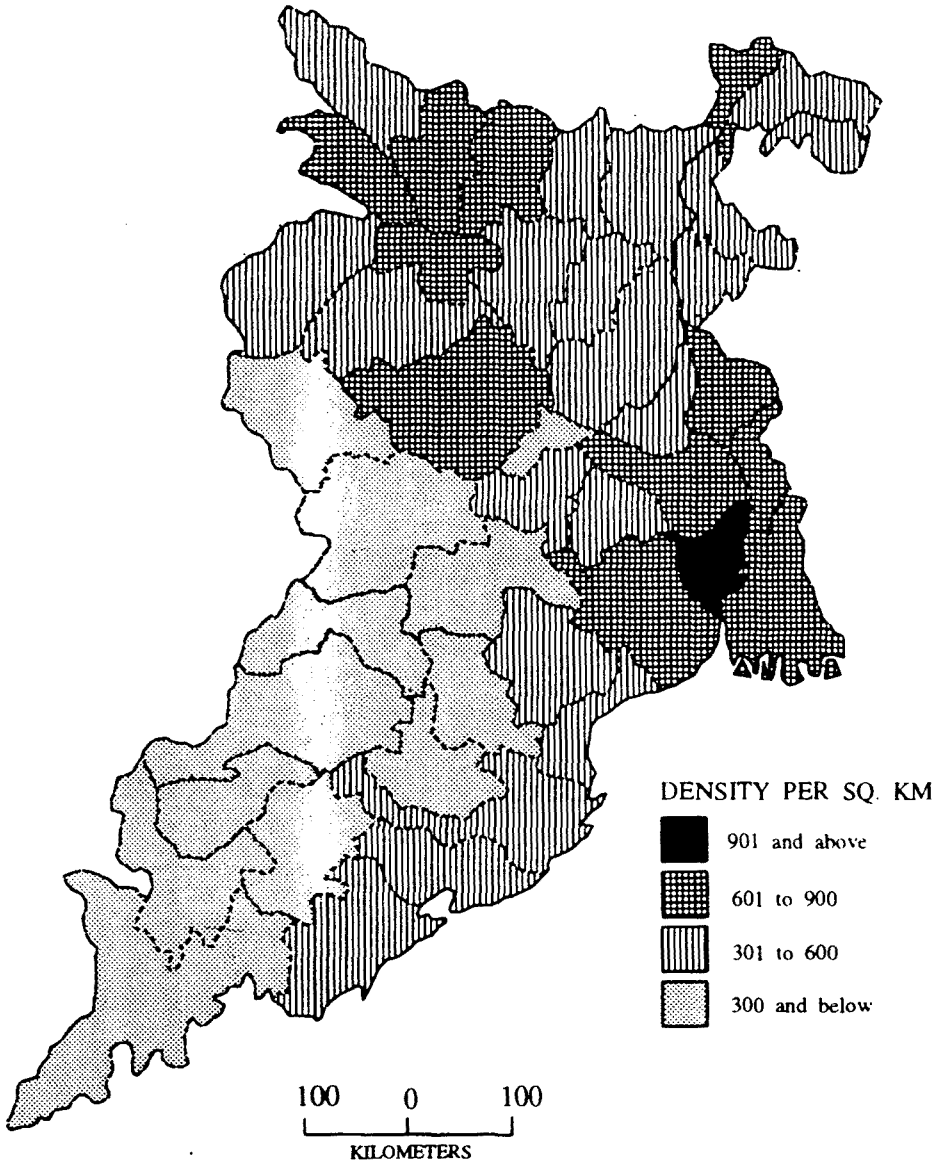

Fig. 4.2

Muzaffarpur, Darbhanga districts in Bihar recorded high agricultural density (Fig. 4.2). The increase in net sown area in majority of districts of West Bengal and Bihar was accompanied by increasing dependency on cultivable land due to higher rate of population growth. The alluvial plains of Bihar, western plateau and Barind tract of West Bengal registered medium densities. In contrast, low agricultural density was registered in Chotanagpur plateau of Bihar.

The average agricultural density has further increased to 650 persons per sq. km. during 1986-89. The number of districts belonging to very high density increased from 2 in 1974-77 to 8 in 1986-89. These are Saran, Muzaffarpur, Darbhanga and Hazaribag in Bihar and Nadia, Hugli, Haora and 24 Parganas in West Bengal. The high density (6 to 9 persons per hectare) has been recorded by districts situated in Bihar plains and the plains of West Bengal (Fig. 4.3) whereas, medium densities were found in northern and coastal districts of Orissa, western and northern districts of West Bengal. Densities are low in districts of southwest Orissa viz. Kalahandi, Koraput, Phulbani and Balangir districts; and Chotanagpur plateau in Bihar. During 1986-89, highest agricultural density has been recorded in Haora district (1800 persons per sq. km.) while lowest has been in Kalahandi district (200 persons per sq. km.).

Agricultural landuse has been greatly affected by the distribution of population in eastern India. Net sown area

EASTERN INDIA

AGRICULTURAL DENSITY

(1986-1989)

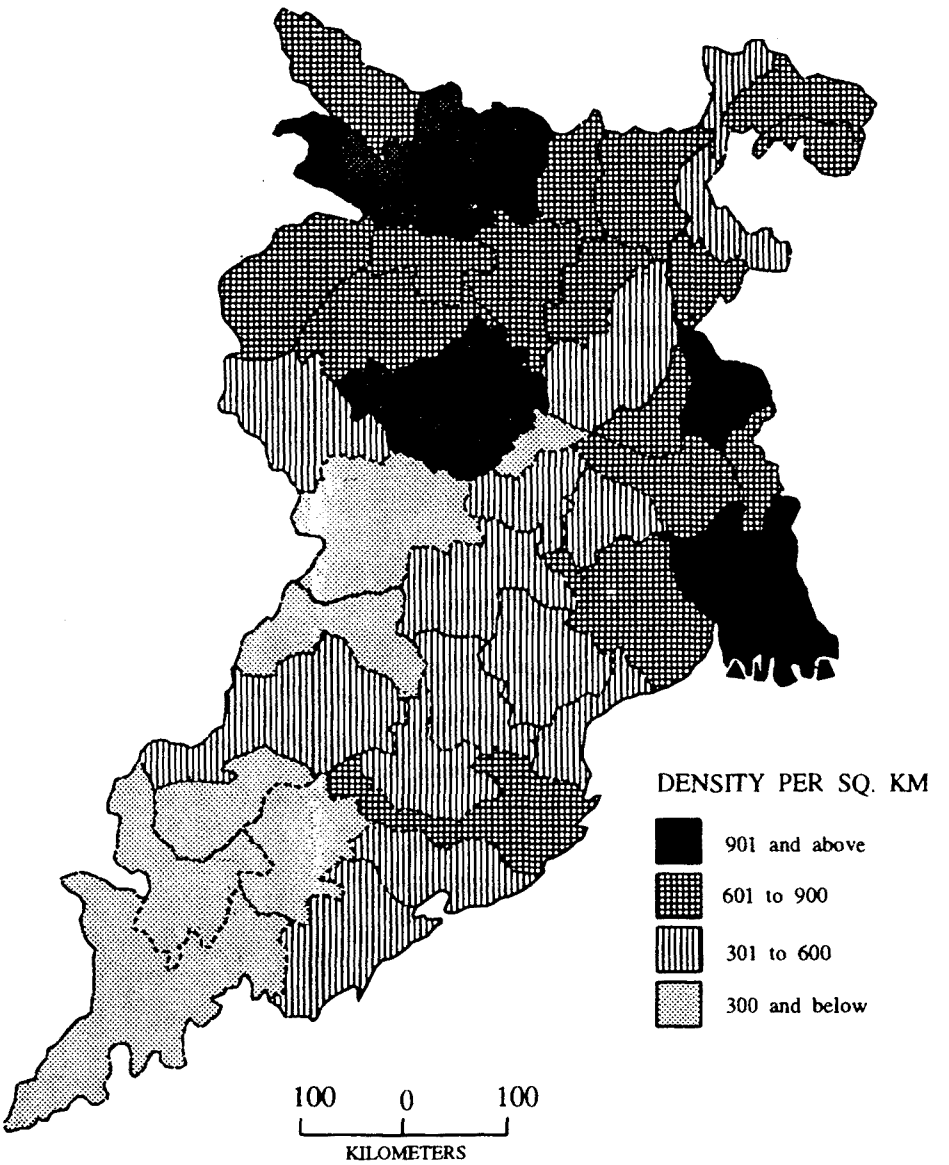

Fig . 4.3

and population density show a positive association. Inspite of a positive association, the expansion in net sown area has not kept pace with the growing population because the land is an extensible resource. The agricultural density of population has increased more rapidly with limited scope of expansion in cultivated area.

Land Man Ratio

The incessant growth in the agricultural workforce with very little or no expansion of net cropped area has very adversely affected the land-man ratio in the region. On an average, the plains display extremely higher pressure of population on land. The figures 4.4, 4.5 and 4.6 represent the land man ratio during three periods of study.

In 1961-64 land man ratio in eastern India was 0.18 hectare per capita. Figure 4.4 reveals that the land man ratio was comparatively higher in Orissa than the other two states of the study area. In Orissa the districts located in densely forested areas recorded high land man ratio, i.e. above 0.30 hect per capita whereas in the coastal plains it ranges from 0.20 hect to 0.30 hect per capita. High land man ratio was recorded in Malda and West Dinajpur districts of West Bengal and Ranchi district of Bihar. The districts having low land man ratio (below 0.20 hect) have been mainly located in north and south Bihar plains, Chotanagpur plateau, coastal and alluvial plains of West Bengal along with the hilly

EASTERN INDIA

LAND MAN RATIO

(1961-1964)

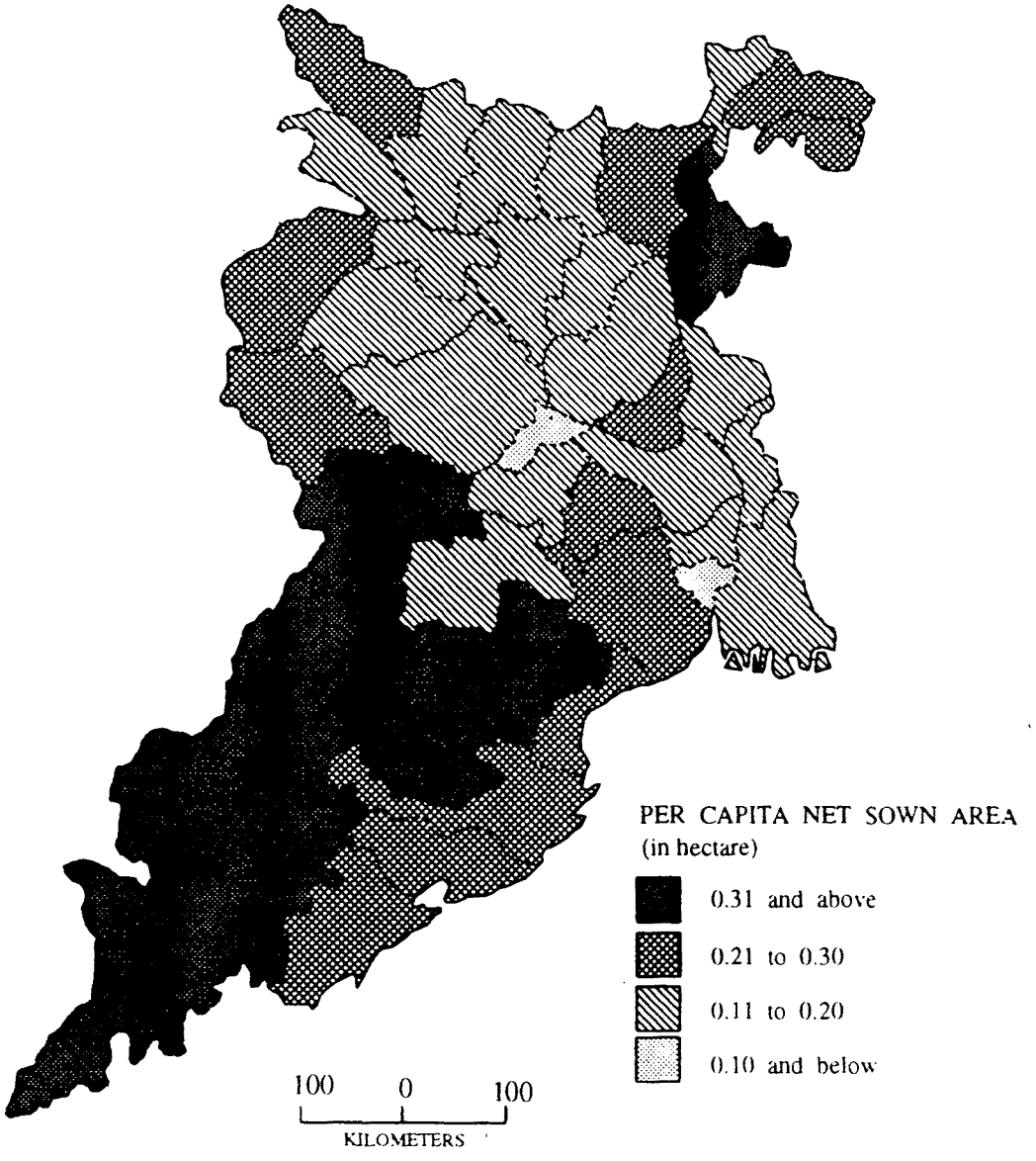

Fig . 4.4

Darjiling district and coastal belt of Orissa. Very low ratio (below 0.10 hect) had been registered by Dhanbad district of Bihar and Haora district of West Bengal.

Land man ratio decreased from 0.18 hectare in 1961-64 to 0.14 hectare in 1974-77. The number of the districts having high land man ratio also declined from 12 in 1961-64 to 3 in 1974-77. These three districts are Koraput, Kalahandi and Dhenkanal. The ratio was better in the northern districts of West Bengal as compared to the southern districts. Similarly in Ranchi district, the land man ratio was comparatively higher (0.26 hect) than the remaining districts of Bihar (0.20 hect). All districts of Orissa recorded higher land man ratio as compared to West Bengal and Bihar (Fig. 4.5).

The land man ratio further decreased to 0.11 hectare during 1986-89 in eastern India. It was highest in Kalahandi district (0.36 hect) while lowest in Hoara district (0.02 hect). The increasing pressure of population in eastern India from early 1960s to late 1980s has resulted in the increase in area under plough in major part of Orissa, plateau and hilly districts of West Bengal and Chotanagpur plateau of Bihar. In these districts, rate of growth of net sown area was very low, i.e. lower than the rate of growth of population. The temporal changes show a declining trend in land man ratio in the entire regions, with a greater decline in the districts situated in the western part of Bihar plain and southern part of lower Ganga plain (Fig. 4.6).

EASTERN INDIA

LAND MAN RATIO

(1974-1977)

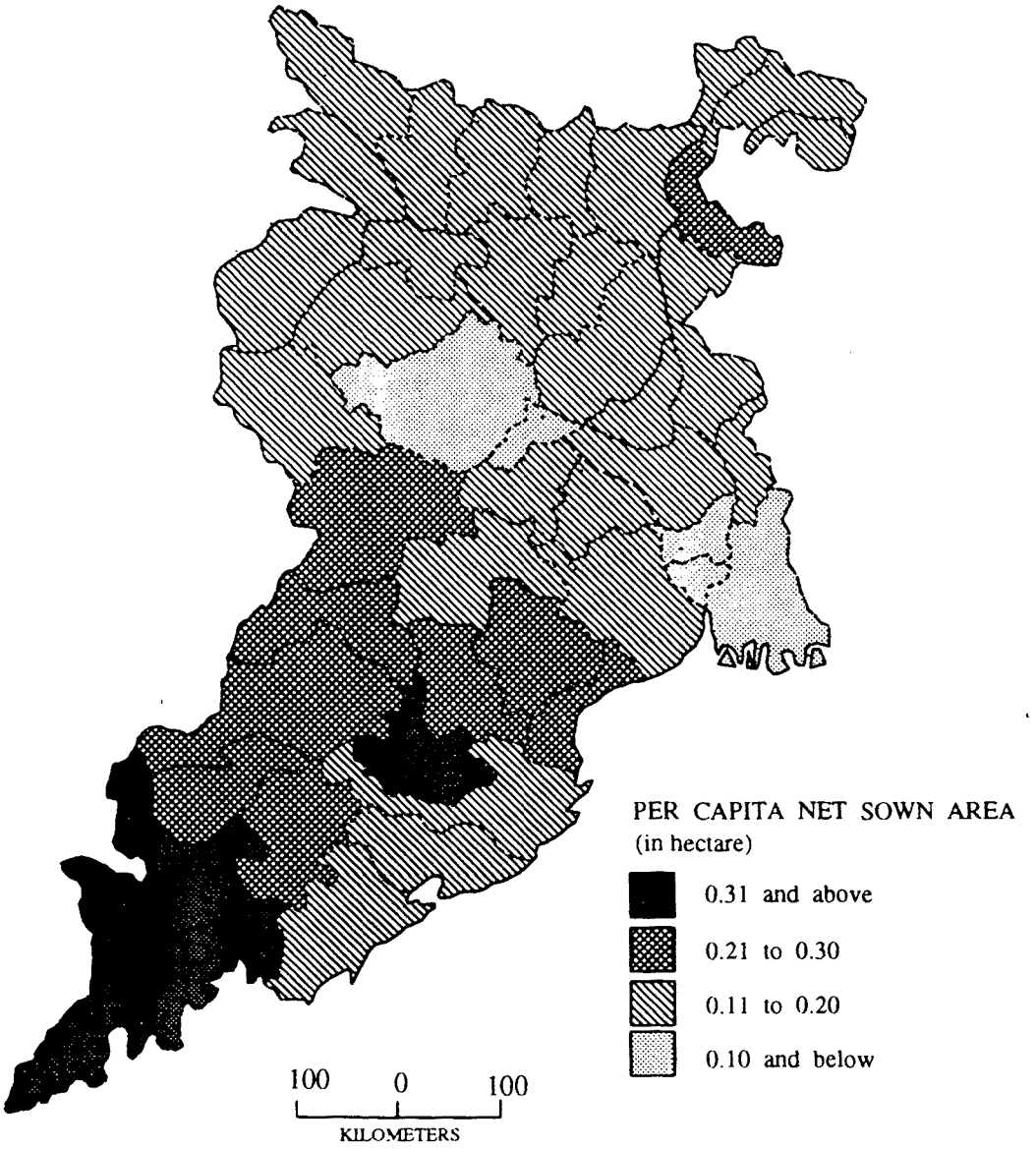

Fig . 4 . 5

EASTERN INDIA

LAND MAN RATIO

(1986-1989)

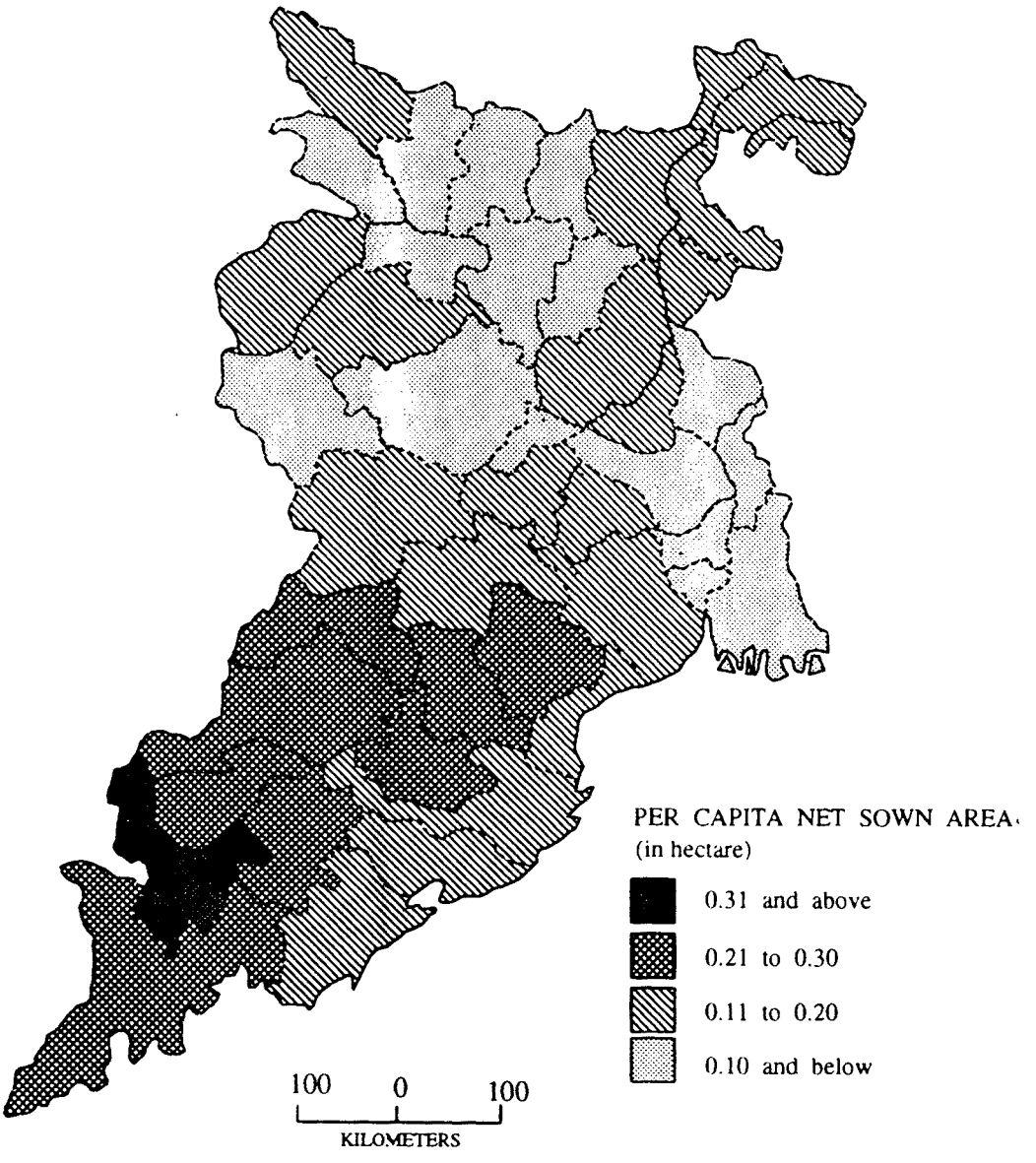

Fig . 4.6

Comparative Analysis of Population Density and Cropping Intensity

Population pressure has evidently led to a higher intensity of cropping. Figure 4.7 illustrates a bivariate analysis between density of population and intensity of cropping during 1986-89. On an average, the plains of Bihar and West Bengal with recent alluvial deposits, soil fertility and continuous supply of water enjoy higher density than the plateaus and uplands which are characterised by rugged topography and forest cover. Both cropping intensity and population density recorded very high values in Haora, Hugli and Nadia districts. High population density, i.e. more than 800 persons per sq. km. in 24 Parganas, Murshidabad, Saran, Muzaffarpur and Patna districts recorded high cropping intensity ranging from 140 to 160 percent. High values of both these variables have been reported in Barddhaman and Malda districts. Contrary to this, districts having low cropping intensity (less than 120 percent) such as Singbhum, Purulia, Santhal Pargana, Ranchi and Dhanbad districts also display low density of population (less than 400 persons per sq km.) during late 1980s. The districts located in the north Bihar plain, Chotanagpur plateau and south Bengal plain show a positive association between cropping intensity and density of population. But the districts of Orissa shows an inverse association between cropping intensity and density of population. In Phulbani, Kalahandi, Dhenkanal districts

EASTERN INDIA

CORRELATION BETWEEN POPULATION DENSITY AND CROPPING INTENSITY

(1986-89)

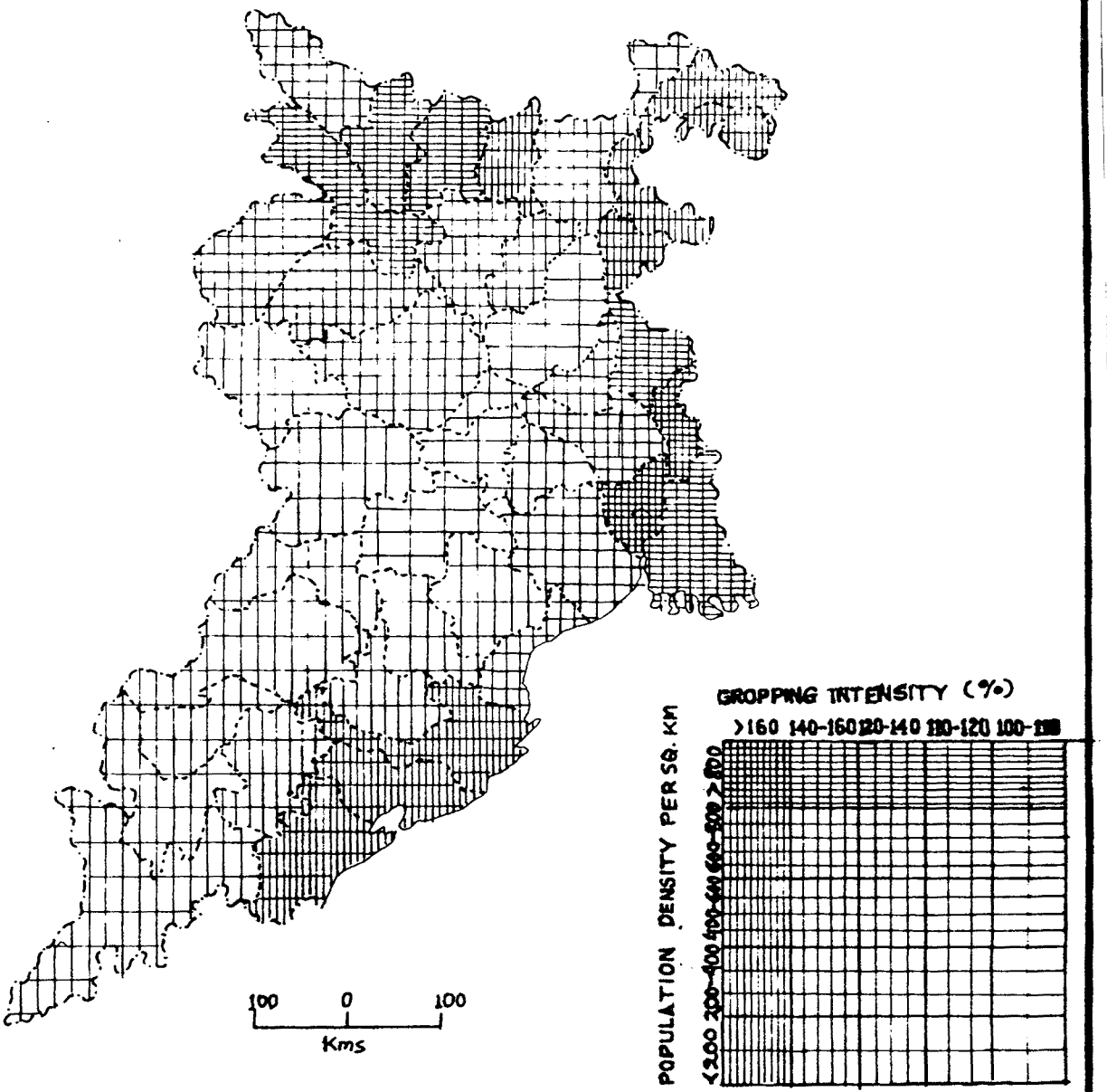

FIG. 4.7

cropping intensity is high (140-160%) but population density is very low (below 200 person per sq. km.) whereas in Gangam and Puri districts the cropping intensity is very high (more than 160%) and population density is low (200 to 400 persons per sq. km). The south western and northern hilly districts recorded medium intensity of cropping (120-140%) and very low density of population (below 200 persons per sq. km). Therefore it is evident that the high density of population is not effective to the cropping multiplicity in most of the districts of Orissa.

The landuse pattern evidently corresponds to the spatial pattern of the distribution of rural and urban population of a region. There was a noticeable pattern in the net sown area which considerably shrunk in Bihar and West Bengal from 1974-77 to 1986-89. The shrink was probably been caused by heavy transfer of land to non-agricultural uses necessitated by expanding population. A higher pressure of population causes transfer of land to building houses and roads. Therefore the growth of population in the urban fringe has been associated with the decrease in agricultural land and increase in non-agricultural land.

Growth of Rural and Urban Population

The variation in growth of urban and rural population have significant impact on arable land utilization. The growth rate of urban population is higher than rural

EASTERN INDIA

GROWTH RATE OF RURAL POPULATION

(1974-77 OVER 1961-64)

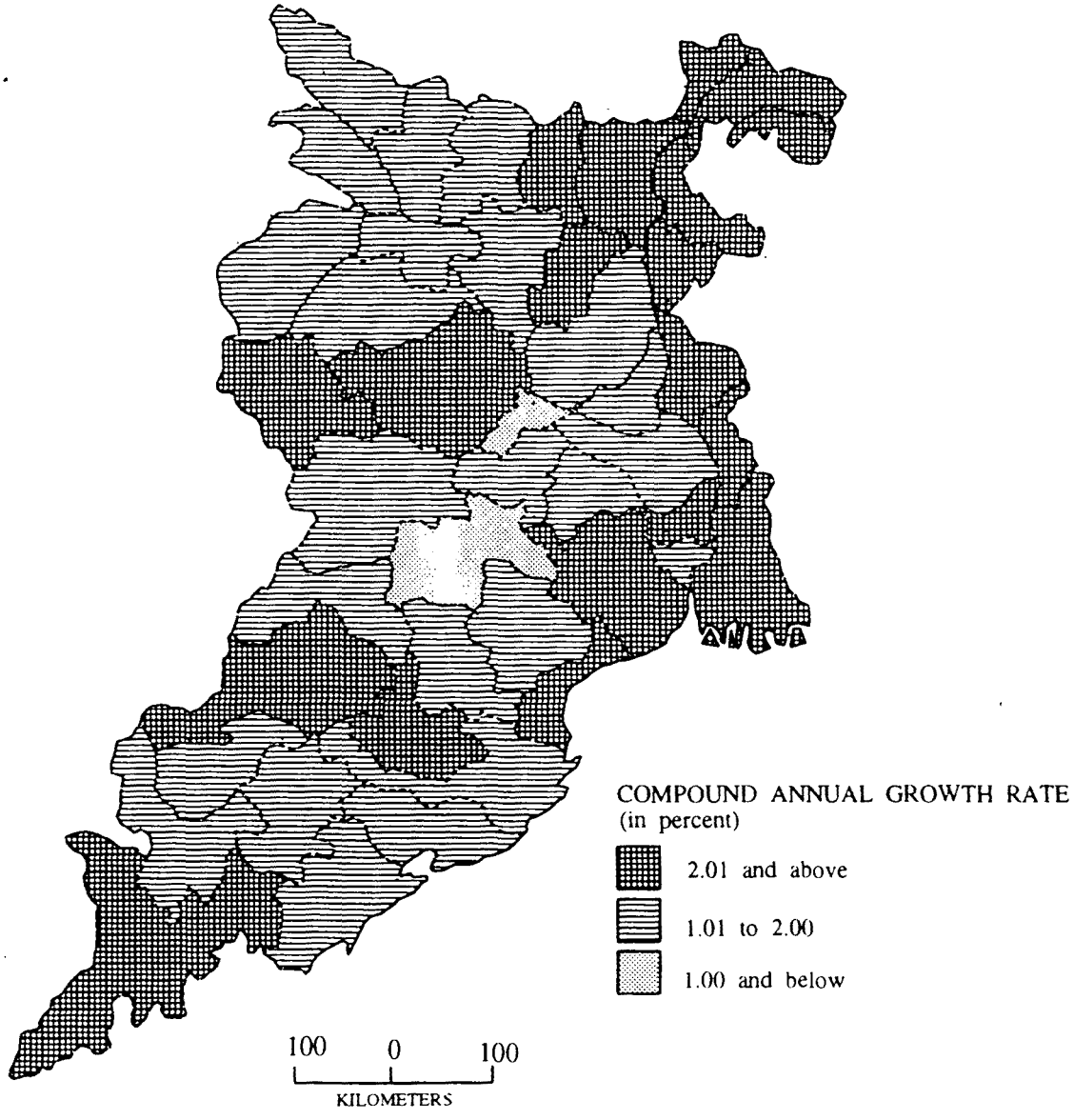

Fig . 4.8

EASTERN INDIA

GROWTH RATE OF URBAN POPULATION

(1974-77 OVER 1961-64)

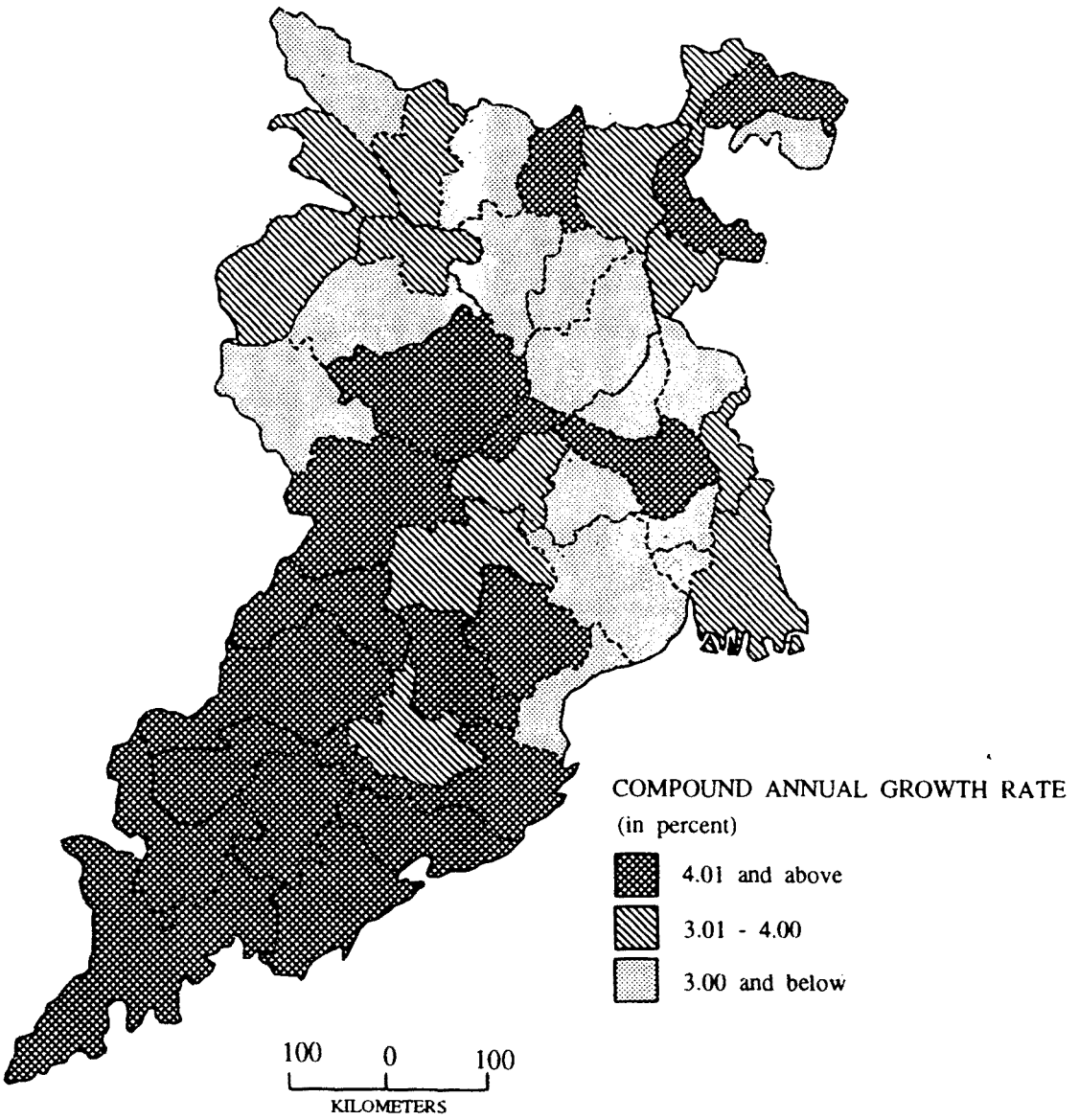

Fig . 4.9

population in eastern India. Very few districts have experienced more than 2 percent growth of rural population whereas all districts in eastern India have recorded more than 2 percent growth rate of urban population from early 1960s to late 1980s.

The growth rate of rural population in West Bengal is higher than two other states included in the study area. Figure 4.8 reveals that all districts of West Bengal excluding Bankura, Purulia, Barddhaman, Murshidabad and Haora experienced high rate of increase in rural population. Very few districts namely Palamau, Hazaribag, Saharsa, Purnea, Bhagalpur, Dhenukanal and Koraput in Orissa recorded high rate of growth (more than 2 %) in rural population from 1961-64 to 1974-77. The growth rate was below 2 percent in the remaining districts of Bihar and Orissa excluding Dhanbad and Singhbhum where very low growth rate (below 1%) of rural population were recorded.

At the same time, the urban population has grown at a very high rate (above 4 percent) in all districts of Orissa except Dhenkanal and Baleshwar districts. The growth is also high in Palamau, Hazaribag, Dhanbad and Saharsa districts of Bihar; and Barddhaman, West Dinajpur, Jalpaiguri districts of West Bengal. On an average the growth of urban population was much higher in Orissa than the other two states. It is evident from Figure 4.9 that urban population has increased at a low rate (below 3 percent) in north and south Bihar plain

EASTERN INDIA

GROWTH RATE OF RURAL POPULATION

(1986-89 OVER 1974-77)

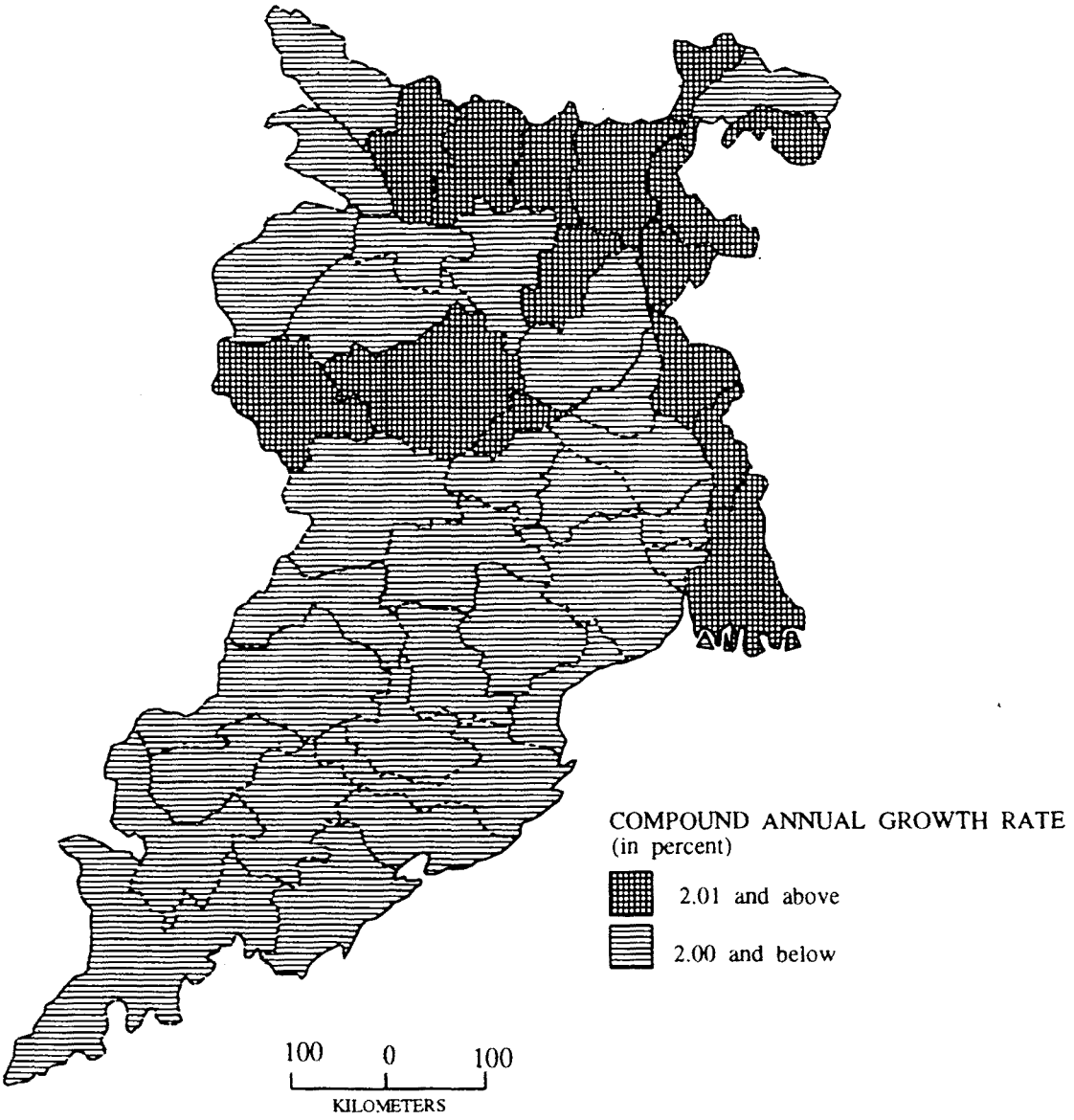

Fig . 4.10

EASTERN INDIA

GROWTH RATE OF URBAN POPULATION

(1986-89 OVER 1974-77)

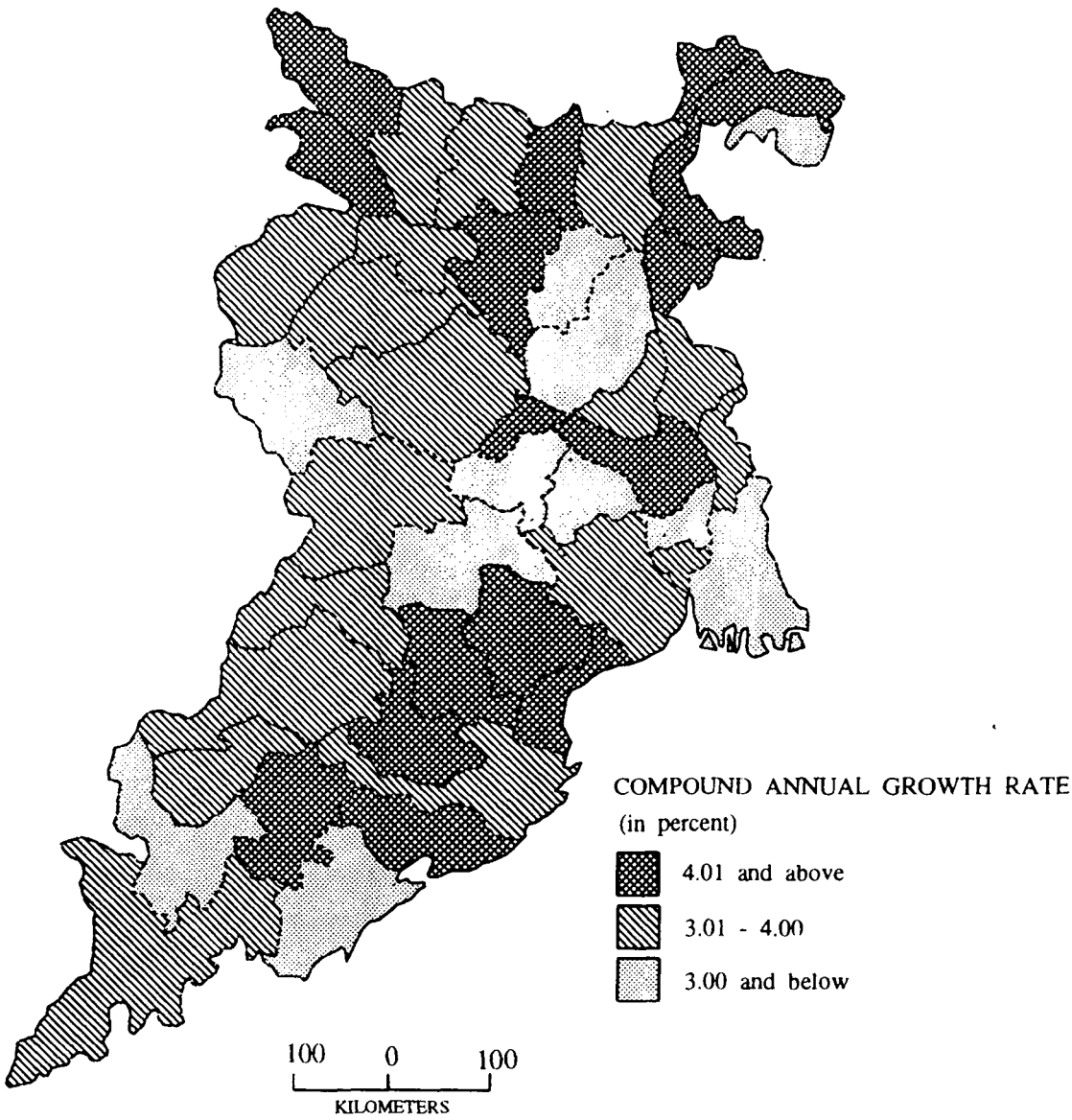

Fig . 4.11

and in the entire West Bengal except few districts namely Patna, Sahabad, Saran, Muzaffarpur, Purnea, 24 Pargana, Purulia, Darjiling and Malda where medium rate of growth (3-4 percent) has been noticed.

The variation in growth rates of rural and urban population shows a correlation with the pattern of landuse in eastern India. From 1961-64 to 1974-77, net sown area decreased in those districts of Orissa which had undergone high growth of urban population, whereas in West Bengal net sown area increased in areas with low growth rates of urban population and high growth of rural population. The most striking feature emerging out of these two figures 4.8 and 4.9 is that urban population has grown at a high rate in plateaus and highlands. In contrast to this, rural population has increased in plains of Bihar, West Bengal and coastal Orissa.

The growth of rural population in 1986-89 over 1974-77 was below 2 percent in two-third of the districts of eastern India. Growth rate was more than 2 percent in north Bihar plain, central part of Chotanagpur plateau and alluvial plain and terai region of West Bengal.

During the same period urban population has grown at a rate of above 4 percent in 16 districts, namely Munger, Malda, Mayurbhanj, Dhenkanal and Ganjam, Saran, Champaran, Saharsa, Phulbani, Kendujhar, Dhanbad, Barddhaman, West Dinajpur, Darjiling and Jalpaiguri districts (Fig. 4.11). It is evident from the above analysis that the growth of both urban and

EASTERN INDIA

CORRELATION BETWEEN GROWTH RATE OF URBAN POPULATION AND GROWTH RATE OF AREA PUT TO NONAGRICULTURAL USES

(1986-89)

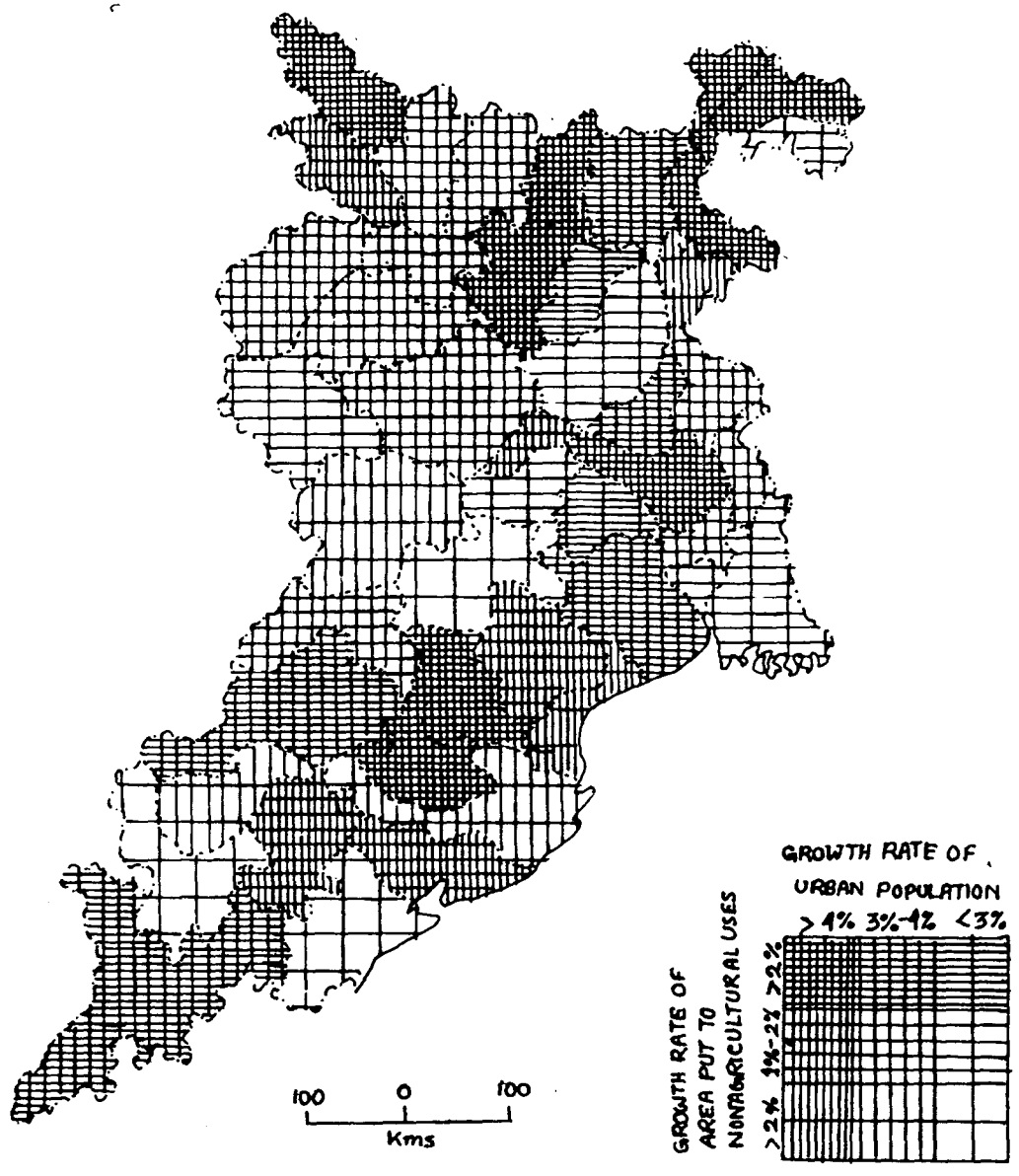

FIG. 4.12

rural population were high in 1974-77 over 1961-64. During this period the high growth rate of population has mainly taken place in alluvial plain of West Bengal, north eastern plain of Bihar where net sown area occupied a large proportion of total reporting area. Whereas the high growth of urban population has been profound in the entire districts of Orissa which is characterised by low proportion of net sown area to total reporting area.

Growth rate in urban population shows a positive association with the growth of area put to non-agricultural uses. The area put to non-agricultural uses is the part of land not available for cultivation. It mainly includes the area under urban land-uses like area under settlement, roads, industries, etc. It has increased in each and every district of eastern India from 1974-77 to 1986-89 associated with a simultaneous increase in urban population.

Figure 4.12 shows the bivariate mapping of two variables, growth of urban population and growth of area put to non-agricultural uses. It reveals that a high rate of growth of two variables has been registered in Dhenkanal and Kendujhar districts in Orissa; Barddhaman, Darjiling and West Dinajpur in West Bengal; and Champaran, Saharsa and Munger districts in Bihar. Growth of urban population is also high (above 4 percent) in Puri, Mayurbhanj, Phulbani, Dhanbad and Saran districts, all of which have recorded medium growth (1-2 percent) of non-agricultural land. Similarly, Koraput and

Sambalpur, Medinipur, and Birbhum districts reported high rate of growth (above 2 percent), in non-agricultural land and medium rate of growth (3-4 percent) in urban population from 1974-77 to 1986-89. Both the variables show medium rate of growth in districts namely Hazaribag, Darbhanga, Sahabad, Patna, Gaya, Muzaffarpur in Bihar; Nadia, Murshidabad districts in West Bengal and Sundagarh district in Orissa. Both the growth of urban population and area put to non-agricultural uses recorded low percentage in Ganjam, Kalahandi, Singhbhum districts. In Bhagalpur and Bankura districts the growth of non-agricultural land is high but the growth of urban population is low, while in Malda and Baleshwar district an opposite situation has been noticed.

It is found that the densely populated areas are markedly associated with a higher proportion of net sown area and equally higher cropping intensity in West Bengal and Bihar. A continuous growth in population has thus, led to a very unfavourable land man ratio and an ever increasing agricultural density throughout the period of the study. The area under cultivation has reached almost to its optimum limit with no further possibility of an expansion. Rather in major parts of the eastern India, the proportion of net sown area has been decreased during the later period of the study.

The study also highlights the fact that the urban population has grown at a faster rate than the rural population, also urban centers have grown faster than rural

areas. The states of eastern India have experienced remarkable growth of urbanization throughout the decades. In majority of the districts of this region, high growth of area under non-agirulcural uses, particularly for building roads, settlements and industries have been taking place to keep pace withe the growin gurban population. The development activities have also transformed the rural areas to gigantic urban settlements in parts of Orissa. New urban settlements have come up in recent decades around the mining and industrial areas of Bihar, West Bengal and Orissa. Therefore, the problem faced by eastern India is that the expansion in net sown area has not responded at all to the growing population, though it has displayed a positive correlation all through the period. Even the expansion in multiple cropped area is not significantly related to population growth. The gradual weakening of association between growth of population and cultivated area suggests a suitable switch-over from expansion to intensification.

CHAPTER V

SUMMARY AND CONCLUSION

The landuse pattern in eastern India comprising the states of Bihar, Orissa and West Bengal, exhibits great variation. The changing land utilization has been studied to examine the pattern and growth of area under different categories of landuse during early 60s, mid 70s and late 80s. The present study has also attempted to investigate the various determinants of landuse pattern. Eastern India is one of the most thickly populated parts of India. A whole range of factors like physical, technological and cultural, have led to a wide range of variations in landuse pattern of the region.

In the present analysis land has been divided into two broad categories: non-arable land and arable land. Non arable land included the areas under forests, areas not available for cultivation and culturable waste lands. Two aspects may reflect the spatial and temporal variation of land use patterns, i.e. proportion of area under each category and growth rate of landuse in each category.

Area under forest occupies very low proportion of the total reporting area in West Bengal and Bihar as compared to Orissa during the three periods of the study. In Orissa, it accounted for more than 40 percent of the total reporting area. The most striking feature is that the forested area has been rising continuously in eastern India both in absolute

terms and in terms of its percentage share. Almost the entire increase is reported from Orissa and West Bengal since early 1960s.

A slow rate of increase in proportion of area not available for cultivation has taken place in the states of Bihar and West Bengal whereas Orissa experienced a faster rate of decline. It seems that in Orissa the decline in area not available for cultivation has occurred in favour of forest area.

Culturable waste lands occupied less than 3 percent of the total reporting area under study. During 1974-77 the proportion of culturable waste land was very high (more than 10 percent) in Purulia and Bankura districts of West Bengal. However, the wastelands have decreased by a higher rate in West Bengal during the later period of the study which has been reflected in the overall trend of growth in eastern India. It is remarkable that the area under culturable waste has been increasing gradually in Orissa, representing a degrading character of existing land since mid 70s.

Less than 10 percent of the total reporting land in eastern India has been reported as fallow land. In Bihar, the proportions of fallow are comparatively higher than the other two states. The pattern of growth reveals that area under fallow has been increasing gradually in Bihar and West Bengal whereas Orissa reported a remarkable fall in the share of fallow land till 1986-89.

Net sown area is the most important category of landuse in eastern India sharing more than 45 percent of the total reporting area during the three study periods. It is interesting to note that the share has managed to be the same in 1961-64 and 1974-77 while decreased gradually in 1986-89. Among the three states, West Bengal reported the highest share (60.56%), followed by Bihar (43.78%) and Orissa (39.68%) during 1986-89. The growth rate reveals the overall declining trend in net sown area in eastern India from early 60s to late 80s.

The spatial variation in the pattern of land utilization is, to a greater extent, the result of difference in local geographical factors like topography, drainage, soil and amount of rainfall etc. The physiographical diversities of the region are clearly reflected in the landuse pattern from plains to highlands due to the difference in relief, effectiveness of surface drainage and variation in soil types and climate. The fact becomes evident if we look at the district-wise pattern of landuse. It is found that a major concentration of forested area occurs in the hilly and rugged terrain of Orissa uplands and Chotanagpur plateau. During 1974-77, the districts namely Hazaribag, Palamau in Chotanagpur plateau and Dhenkanal, Ganjam, Kendujhar, Koraput and Mayurbhanj in the northern and southern upland of Orissa reported more than 40 percent of the total reporting area under forest. It had exceeded 75 percent in Phulbani district

during the same year.

Contrary to this, in the plains, a long history of human occupance and maximum possible expansion of agricultural land caused serious depletion of forest cover. It is clearly seen in the districts of north and south Bihar plain, alluvial plains of West Bengal and coastal plains of Orissa where less than 10 percent area had been devoted to forest during the three periods of study. The proportion of culturable waste land has increased in highlands of Orissa and north western marshy plain of Bihar as well as Chotanagpur plateau since mid 70s. It is also noticed that the share of culturable waste land has declined in West Bengal between mid 70s and late 80s. It represents the scope of reclamation of land and extension of area under cultivation. As far as the share of area under fallow lands is concerned, it is noticed that the whole of the Chotanagpur plateau comprising of districts, Singbhum, Ranchi, Dhanbad, Palamau, Hazaribag and Santhal Pargana displays higher share than the remaining districts of eastern India. The proportion of net sown area is found to be higher in the areas of richer alluvium in Bengal plain, the Bihar and coastal districts of Orissa. While the upland districts of Orissa and Bihar with hilly terrain, in different soil types and unfavourable climate have relatively low share of net sown area. West Dinajpur district of West Bengal reported more than 80 percent of net sown area during the three periods of study whereas Phulbani district recorded less than 20 percent.

Drainage holds a particular significance in governing the human occupance on land. In eastern India most of the agricultural land developed near riverine plains and deltaic tracts while in the plateau and highland rivers form gorges, rapids flowing in the rugged terrain and their water can not be harnessed for agricultural purposes.

Although the districts in eastern India receive high rainfall, it is not showing any significant correlation with the landuse pattern. In fact scarcity of rainfall is not as great a problem in this region as its faulty seasonal distribution.

Soil is also a basic determinant of landuse pattern which shows variation according to the physiography of the region. A large number of districts in the plain region of eastern India are covered by older and younger alluvial soils, deltaic and coastal alluvial soil, and calcareous alluvial soil which are highly fertile and devoted to cultivation. On the other hand, red and laterite soil with coarse texture and highly acidic in character are found in the plateaus and highlands where forest and fallows are dominating the landuse pattern.

The acidity and alkalinity of the red, laterite and brown forest soils and salinity of the soils in the coastal plains are the degrading factors of landuse.

As a whole, the presence of flat surface, fertile alluvial soil and plenty of rainfall and surface water in the plains have resulted in high proportion of area under

cultivation, low forest cover, low share of fallow land and large area under urban landuse. Contrary to this, the plateau and hilly areas with rugged terrain, less fertile red and lateritic soil, have reported high forest cover and large fallow lands.

The role of technology in the determination of landuse pattern is brought out by the intensification of cropping. During the periods under study, the agricultural landuse has experienced remarkable progress in the use of such technological inputs as chemical fertilizers and irrigation. The use of chemical fertilizer in eastern India as a whole has been rising steadily from early 60s to late 80s. The state level consumption pattern shows that the use of fertilizer is less in Orissa as compared to Bihar and West Bengal. It has been revealed from the bivariate analysis that in the plains particularly in and around Haora and Hugli districts in West Bengal the intensive farming is associated with higher level of fertilizer consumption per hectare of gross cropped area. Also in all the districts of Bihar the cropping intensity and consumption of chemical fertilizers were very significantly correlated both in 1974-77 and 1986-89.

The agricultural scenario is rapidly changing with an increased and assured irrigation system. In Bihar and Orissa, the proportion of net irrigated area to net sown area shows very high correlation with cropping intensity during 1974-77 and 1986-89. As one of the prime objectives of the

technological revolution is to reduce the dependence upon uncertain climatic conditions, it can be said that the technological advancement has gone a long way in achieving its objectives.

The approach to the study of land utilization is basically conditioned by the nature of relationships between man and land. Eastern India is a very densely populated region of the country. The heterogeneity in physical attributes like physiography, soil types, local climate and seasonal distribution of rainfall led to wide range of variation in population distribution. It has been observed in the area under study that the densely populated areas are markedly associated with a higher proportion of net sown area and equally higher cropping intensity, particularly in West Bengal and Bihar. In the highlands, the dominant category of landuse is the forest where low density of population has resulted in the comparatively low intensity of cropping and lower proportion of net sown area. But the land is limited and the population is growing at a much higher rate than the growth rate of area under cultivation. As a whole, a continuous growth in population has led to a very unfavourable land-man ratio and an ever increasing agricultural density in eastern India. The agricultural density has increased more rapidly in densely populated areas due to the higher growth of rural population with limited scope of extension of cultivated area.

The landuse pattern also corresponds to the spatial pattern of growth of rural and urban population. Urban population is growing at a faster rate than the growth or rural population in eastern India. The states of eastern India have experienced remarkable growth of urbanization throughout the periods. However, a higher pressure of population causes transfer of land for building purposes, development of industries and communication. It has emerged out of the study that the growth rate or urban population is markedly associated with the growth rate of area put to non-agricultural uses.

Since the land is an inextensible resource, it is necessary to develop the intensive measures of landuse. Alongwith the process of intensification, farmers are found to have adopted a wider application of chemical fertilizers and irrigation to improve the level of production.

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APPENDICES

Table A.2.1 Proportion of Area Under Forest to Total Reporting Area (in per cent)

Sl.No.	Districts	1961-64	1974-77	1986-89
1.	24 Parganas	28.99	29.10	29.27
2.	Nadia	0.15	0.31	0.32
3.	Murshidabad	0.12	0.15	0.14
4.	Barddhaman	2.58	4.26	4.22
5.	Birbhum	1.05	3.49	3.51
6.	Bankura	20.09	20.36	20.79
7.	Medinipur	10.50	13.14	12.61
8.	Hugli	0.07	0.09	0.09
9.	Haora	0.0	0.0	0.0
10.	Jalpaiguri	27.19	28.11	28.36
11.	Darjiling	38.09	39.35	19.28
12.	Malda	0.15	0.38	0.43
13.	West Dinajpur	0.14	0.24	0.27
14.	Koch Bihar	0.0	1.66	1.66
15.	Purulia	14.08	14.01	14.05
16.	Patna	0.83	0.73	0.84
17.	Gaya	18.04	11.91	11.88
18.	Sahabad	22.13	15.43	15.80
19.	Saran	0.04	0.01	0.02
20.	Champaran	7.53	8.99	10.02
21.	Muzaffarpur	0.0	0.0	0.0
22.	Darbhanga	0.0	0.0	0.0
23.	Munger	8.92	13.69	13.87
24.	Bhagalpur	11.26	8.48	8.72
25.	Saharsha	0.15	0.06	0.0
26.	Purnea	1.37	0.13	0.32
27.	Santhal Pargana	23.70	10.07	10.77
28.	Hazaribag	48.07	45.64	48.36
29.	Ranchi	25.71	22.89	23.58
30.	Palamau	49.99	43.94	43.68
31.	Dhanbad	15.39	26.49	26.11
32.	Singhbhum	46.82	24.16	28.01
33.	Baleshwar	6.02	5.61	4.01
34.	Balangir	18.51	19.74	23.66
35.	Cuttack	11.92	10.92	14.50
36.	Dhenkanal	30.99	47.06	44.32
37.	Ganjam	17.14	46.85	48.27
38.	Kalahandi	32.77	36.70	41.19
39.	Kendujhar	20.98	46.97	35.37
40.	Koraput	20.31	55.28	33.34
41.	Mayurbhanj	21.69	42.21	46.44
42.	Phulbani	45.76	75.09	56.43
43.	Puri	29.58	31.32	29.82
44.	Sambalpur	17.04	31.06	36.53
45.	Sundargarh	25.04	51.65	39.32

Source: Calculated from Agricultural Statistics, vol.2, Table 1 1961-64, 1974-77, 1986-89.

Table A.2.2 Compound Annual Growth Rate of Area under Forest
(in per cent)

Sl.No.	Districts	1961-64	1974-77	1986-89
1.	24 Parganas	0.02	0.04	0.02
2.	Nadia	5.90	0.09	3.06
3.	Murshidabad	1.41	0.07	0.78
4.	Barddhaman	3.82	-0.08	1.96
5.	Birbhum	9.60	0.02	4.92
6.	Bankura	0.09	0.17	0.13
7.	Medinipur	1.74	-0.34	0.73
8.	Hugli	1.89	-0.49	0.73
9.	Haora	0.0	0.0	0.0
10.	Jalpaiguri	0.26	0.07	0.17
11.	Darjiling	0.60	-5.77	-2.50
12.	Malda	7.02	1.20	4.18
13.	West Dinajpur	3.80	1.01	2.45
14.	Koch Bihar	0.0	0.01	0.0
15.	Purulia	-0.02	0.01	-0.03
16.	Patna	-1.01	1.16	0.02
17.	Gaya	-3.15	-0.02	-1.66
18.	Sahabad	-2.75	0.21	-1.34
19.	Saran	-1.03	0.0	0.0
20.	Champaran	1.36	0.90	1.04
21.	Muzaffarpur	0.0	0.0	0.0
22.	Darbhanga	0.0	0.0	0.0
23.	Munger	-2.97	0.10	-1.25
24.	Bhagalpur	2.15	0.23	-1.01
25.	Saharsha	-6.0	0.0	0.0
26.	Purnea	-16.4	7.67	-5.61
27.	Santhal Pargana	-6.37	0.56	-3.10
28.	Hazaribag	-4.07	0.48	-0.40
29.	Ranchi	-0.08	0.24	-0.34
30.	Palamau	-0.9	-0.04	-0.54
31.	Dhanbad	-4.2	-0.05	-2.40
32.	Singhbhum	-4.9	1.23	-2.03
33.	Baleshwar	-0.54	-2.75	-1.60
34.	Balangir	0.49	1.52	0.98
35.	Cuttack	-0.66	2.39	0.78
36.	Dhenkanal	3.23	-0.47	1.43
37.	Ganjam	8.03	0.24	4.22
38.	Kalahandi	0.54	0.96	0.74
39.	Kendujhar	6.38	-2.33	2.10
40.	Koraput	8.11	-4.12	2.05
41.	Mayurbhanj	5.25	0.79	3.09
42.	Phulbani	4.08	-2.35	0.94
43.	Puri	0.43	-0.40	0.29
44.	Sambalpur	4.72	1.36	3.09
45.	Sundargarh	5.40	-2.24	1.65

Source: Same as on Table A.2.1.

Table A.2.3 Proportion of Area not Available for Cultivation to Total Reporting Area (in per cent)

Sl.No.	Districts	1961-64	1974-77	1986-89
1.	24 Parganas	17.74	20.57	24.22
2.	Nadia	14.71	12.92	16.23
3.	Murshidabad	14.25	12.64	21.17
4.	Barddhaman	19.68	16.70	23.56
5.	Birbhum	15.59	11.24	17.80
6.	Bankura	5.83	10.80	14.11
7.	Medinipur	10.45	12.85	17.90
8.	Hugli	19.93	20.47	23.83
9.	Haora	25.30	25.86	30.79
10.	Jalpaiguri	15.92	13.28	23.04
11.	Darjiling	23.45	23.41	33.71
12.	Malda	9.94	14.86	15.76
13.	West Dinajpur	11.70	7.80	11.81
14.	Koch Bihar	13.47	16.15	18.87
15.	Purulia	14.32	13.87	14.36
16.	Patna	18.65	18.78	20.53
17.	Gaya	16.18	15.15	17.24
18.	Sahabad	10.82	13.31	14.76
19.	Saran	10.65	14.55	17.53
20.	Champaran	12.03	15.02	17.36
21.	Muzaffarpur	10.72	18.08	23.61
22.	Darbhanga	16.33	18.35	21.64
23.	Munger	17.63	17.60	20.09
24.	Bhagalpur	15.49	21.55	27.70
25.	Saharsha	21.71	18.89	23.79
26.	Purnea	17.20	17.43	20.59
27.	Santhal Pargana	12.31	13.63	14.73
28.	Hazaribag	10.22	14.39	14.54
29.	Ranchi	9.84	11.16	11.78
30.	Palamau	7.18	9.59	10.24
31.	Dhanbad	27.42	31.68	39.16
32.	Singhbhum	11.25	17.32	17.66
33.	Baleshwar	10.18	10.87	11.43
34.	Balangir	7.51	8.15	7.81
35.	Cuttack	9.36	9.61	10.10
36.	Dhenkanal	15.15	4.31	5.03
37.	Ganjam	19.72	5.54	5.16
38.	Kalahandi	8.17	4.20	3.02
39.	Kendujhar	16.99	5.05	7.34
40.	Koraput	24.44	4.31	12.84
41.	Mayurbhanj	18.87	6.76	5.57
42.	Phulbani	16.67	1.38	2.53
43.	Puri	11.94	7.55	10.51
44.	Sambalpur	20.94	5.31	6.97
45.	Sundargarh	15.95	3.57	4.18

Source: Same as on Table A.2.1.

Table A.2.4 Compound Growth Rate of Area not available for Cultivation (in per cent)

Sl.No.	Districts	1961-64	1974-77	1986-89
1.	24 Parganas	1.09	1.36	1.22
2.	Nadia	-0.99	1.91	0.39
3.	Murshidabad	-1.30	4.83	1.59
4.	Barddhaman	-1.28	2.90	0.70
5.	Birbhum	-2.48	3.90	0.53
6.	Bankura	4.85	2.25	3.59
7.	Medinipur	1.59	2.80	2.17
8.	Hugli	0.21	1.27	0.72
9.	Haora	0.16	1.46	0.78
10.	Jalpaiguri	-1.37	4.69	1.49
11.	Darjiling	0.34	3.08	1.64
12.	Malda	3.13	0.48	1.85
13.	West Dinajpur	-3.36	3.51	-0.12
14.	Koch Bihar	1.58	1.30	1.45
15.	Purulia	-0.22	0.26	0.04
16.	Patna	0.04	0.74	0.38
17.	Gaya	-0.50	1.07	0.25
18.	Sahabad	1.58	0.87	1.24
19.	Saran	2.42	1.56	2.01
20.	Champaran	1.71	1.21	1.47
21.	Muzaffarpur	4.09	2.24	3.20
22.	Darbhanga	0.89	1.38	1.13
23.	Munger	-0.37	1.91	0.71
24.	Bhagalpur	2.56	2.11	2.35
25.	Saharsha	-0.43	1.93	0.69
26.	Purnea	0.09	1.34	0.71
27.	Santhal Pargana	0.77	0.65	0.71
28.	Hazaribag	2.63	0.08	1.30
29.	Ranchi	0.96	0.45	0.72
30.	Palamau	2.23	0.55	1.42
31.	Dhanbad	1.40	1.70	1.50
32.	Singhbhum	3.36	0.16	1.81
33.	Baleshwar	0.49	0.42	0.45
34.	Balangir	0.62	-0.35	0.15
35.	Cuttack	0.24	0.36	0.30
36.	Dhenkanal	-9.23	1.31	-4.31
37.	Ganjam	-9.30	-0.59	-5.22
38.	Kalahandi	-5.30	-2.71	-4.06
39.	Kendujhar	-8.91	3.15	-3.33
40.	Koraput	-12.39	9.50	-2.49
41.	Mayurbhanj	-9.59	-1.59	-4.76
42.	Phulbani	-17.23	5.14	-7.16
43.	Puri	-3.47	2.79	-0.51
44.	Sambalpur	-10.00	2.28	-4.30
45.	Sundargarh	-10.87	1.32	-5.21

Source: Same as on Table A.2.1.

Table A.2.5 Proportion of Culturable Waste Land to Total Reporting Area and its Growth (in per cent)

Sl.No.	Districts	1974-77	1986-89	1986-89 over 1974-77
1.	24 Parganas	0.59	0.15	-10.31
2.	Nadia	0.57	0.95	4.34
3.	Murshidabad	1.70	1.02	-3.77
4.	Barddhaman	7.07	2.69	-7.78
5.	Birbhum	7.44	2.33	-9.20
6.	Bankura	10.09	2.54	-10.84
7.	Medinipur	4.74	1.13	-11.29
8.	Hugli	2.79	2.67	-0.31
9.	Haora	1.79	0.19	-16.92
10.	Jalpaiguri	3.54	0.55	-14.30
11.	Darjiling	0.00	0.42	0.00
12.	Malda	1.70	0.61	-8.12
13.	West Dinajpur	2.24	0.38	-13.66
14.	Koch Bihar	2.94	0.81	-10.12
15.	Purulia	13.69	3.07	-11.75
16.	Patna	0.65	0.30	-6.24
17.	Gaya	1.34	0.77	-4.44
18.	Sahabad	0.96	0.32	-8.67
19.	Saran	0.67	0.39	-4.32
20.	Champaran	0.40	0.59	3.28
21.	Muzaffarpur	0.06	0.09	2.77
22.	Darbhanga	0.25	0.13	-5.25
23.	Munger	2.62	1.66	-3.75
24.	Bhagalpur	3.25	2.72	-1.44
25.	Saharsha	1.67	0.87	-5.20
26.	Purnea	1.22	0.55	-6.41
27.	Santhal Pargana	6.63	5.63	-1.33
28.	Hazaribag	3.82	3.08	-1.72
29.	Ranchi	3.09	3.57	1.21
30.	Palamau	6.05	2.20	-8.05
31.	Dhanbad	7.24	6.38	4.52
32.	Singhbhum	6.02	5.89	-0.12
33.	Baleshwar	3.09	3.09	0.00
34.	Balangir	6.11	4.07	-3.34
35.	Cuttack	2.11	5.01	7.42
36.	Dhenkanal	1.25	0.54	-6.66
37.	Ganjam	0.95	0.40	-6.88
38.	Kalahandi	1.75	0.51	-9.67
39.	Kendujhar	2.76	4.33	3.81
40.	Koraput	1.25	3.92	9.90
41.	Mayurbhanj	1.47	0.57	-7.52
42.	Phulbani	0.45	3.35	18.11
43.	Puri	4.87	2.77	-4.52
44.	Sambalpur	4.19	5.03	1.53
45.	Sundargarh	1.02	2.75	8.64

Source: Same as on Table A.2.1.

Table A.2.6 Proportion of Fallow Land to Total Reporting Area (in per cent)

Sl.No.	Districts	1961-64	1974-77	1986-89
1.	24 Parganas	1.35	0.31	3.60
2.	Nadia	0.78	0.68	2.49
3.	Murshidabad	3.57	1.24	0.73
4.	Barddhaman	1.85	2.05	4.55
5.	Birbhum	4.37	1.38	5.18
6.	Bankura	11.87	3.45	6.96
7.	Medinipur	5.00	2.28	4.04
8.	Hugli	0.79	0.64	2.40
9.	Haora	5.05	1.10	8.76
10.	Jalpaiguri	1.21	0.78	0.92
11.	Darjiling	0.92	0.61	3.33
12.	Malda	7.47	0.69	10.83
13.	West Dinajpur	1.34	1.57	4.85
14.	Koch Bihar	1.74	0.27	0.76
15.	Purulia	10.38	7.96	16.57
16.	Patna	3.12	5.81	6.47
17.	Gaya	5.87	16.18	16.14
18.	Sahabad	3.00	5.20	5.91
19.	Saran	11.23	8.52	8.32
20.	Champaran	5.61	6.08	5.43
21.	Muzaffarpur	7.78	5.34	7.10
22.	Darbhanga	8.83	10.56	9.22
23.	Munger	11.77	15.18	15.70
24.	Bhagalpur	11.58	12.15	13.35
25.	Saharsha	18.89	15.20	15.47
26.	Purnea	13.46	15.29	14.44
27.	Santhal Pargana	16.95	22.26	29.48
28.	Hazaribag	10.41	17.11	20.59
29.	Ranchi	19.64	20.48	26.08
30.	Palamau	12.44	19.94	26.52
31.	Dhanbad	17.36	20.31	23.56
32.	Singhbhum	13.21	20.30	21.27
33.	Baleshwar	7.37	6.54	5.40
34.	Balangir	7.10	13.32	5.05
35.	Cuttack	5.08	4.80	2.87
36.	Dhenkanal	4.31	5.26	4.18
37.	Ganjam	7.25	2.86	1.66
38.	Kalahandi	8.88	4.05	5.32
39.	Kendujhar	11.79	6.65	6.09
40.	Koraput	2.63	5.11	7.14
41.	Mayurbhanj	8.34	7.08	2.01
42.	Phulbani	0.99	5.19	7.66
43.	Puri	3.76	6.34	3.76
44.	Sambalpur	9.24	7.68	2.63
45.	Sundargarh	12.13	9.83	5.68

Source: Same as on Table A.2.1.

Table A.2.7 Compound Growth Rate of Fallow Land

(in per cent)

Sl.No.	Districts	1961-64	1974-77	1986-89
1.	24 Parganas	-10.64	22.51	3.97
2.	Nadia	-0.99	11.34	4.74
3.	Murshidabad	-8.15	-3.85	-6.11
4.	Barddhaman	0.73	6.86	3.63
5.	Birbhum	-8.44	11.60	0.68
6.	Bankura	-9.06	6.02	-2.11
7.	Medinipur	-5.86	4.89	-0.84
8.	Hugli	-1.68	11.66	4.51
9.	Haora	-11.04	18.83	2.29
10.	Jalpaiguri	-3.29	1.40	-1.06
11.	Darjiling	-2.71	15.13	15.47
12.	Malda	-16.68	25.68	1.49
13.	West Dinajpur	0.90	9.89	5.10
14.	Koch Bihar	-13.04	8.90	-3.12
15.	Purulia	-1.99	6.26	1.88
16.	Patna	4.88	0.88	2.95
17.	Gaya	8.10	-0.02	4.12
18.	Sahabad	4.31	1.07	2.74
19.	Saran	-2.10	-0.19	-1.19
20.	Champaran	0.61	-0.94	-0.13
21.	Muzaffarpur	-2.85	2.39	-0.36
22.	Darbhanga	1.38	-1.11	0.17
23.	Munger	1.60	0.28	0.96
24.	Bhagalpur	0.36	0.78	0.56
25.	Saharsha	-1.00	0.14	-0.46
26.	Purnea	0.97	-0.47	0.27
27.	Santhal Pargana	2.11	2.36	2.23
28.	Hazaribag	3.80	1.56	2.77
29.	Ranchi	0.32	2.03	1.13
30.	Palamau	3.69	2.40	3.07
31.	Dhanbad	2.50	0.08	1.30
32.	Singhbhum	3.35	0.39	1.92
33.	Baleshwar	-0.92	-1.57	-1.23
34.	Balangir	4.95	-7.77	-1.35
35.	Cuttack	-0.42	-4.18	-2.24
36.	Dhenkanal	1.52	-1.87	-0.12
37.	Ganjam	-6.89	-4.42	-5.71
38.	Kalahandi	-6.15	2.29	-2.19
39.	Kendujhar	-4.31	-0.73	-2.60
40.	Koraput	5.35	2.81	4.12
41.	Mayurbhanj	-1.25	-9.93	-5.51
42.	Phulbani	13.81	3.30	8.64
43.	Puri	4.08	-4.26	0.01
44.	Sambalpur	-1.42	-8.54	-4.90
45.	Sundargarh	-1.60	-4.46	-2.99

Source: Same as on Table A.2.1.

Table A.2.8 Proportion of Net Sown Area to Total Reporting Area (in per cent)

Sl.No.	Districts	1961-64	1974-77	1986-89
1.	24 Parganas	45.66	48.51	42.48
2.	Nadia	80.15	82.97	79.29
3.	Murshidabad	76.96	82.97	76.61
4.	Barddhaman	70.72	68.58	64.74
5.	Birbhum	75.62	74.79	70.54
6.	Bankura	50.45	54.15	55.23
7.	Medinipur	67.29	64.08	63.43
8.	Hugli	76.19	73.62	70.40
9.	Howra	66.85	67.70	58.67
10.	Jalpaiguri	47.97	52.50	46.45
11.	Darjiling	32.45	31.64	41.39
12.	Malda	78.40	80.84	71.46
13.	West Dinajpur	82.64	86.73	81.96
14.	Koch Bihar	77.11	76.14	75.62
15.	Purulia	40.25	48.57	51.64
16.	Patna	76.89	73.41	71.46
17.	Gaya	56.32	54.20	53.24
18.	Sahabad	62.92	64.79	62.95
19.	Saran	74.87	73.57	70.68
20.	Champaran	69.57	67.01	62.08
21.	Muzaffarpur	78.23	73.30	64.96
22.	Darbhanga	70.55	67.10	64.36
23.	Munger	56.43	49.75	45.63
24.	Bhagalpur	57.57	53.43	45.74
25.	Saharsha	46.51	60.28	56.59
26.	Purnea	63.08	62.80	61.07
27.	Santhal Pargana	37.21	42.34	33.88
28.	Hazaribag	21.80	20.49	16.51
29.	Ranchi	38.07	40.61	33.88
30.	Palamau	25.66	23.59	16.47
31.	Dhanbad	33.92	27.08	21.41
32.	Singhbhum	24.99	29.93	25.50
33.	Baleshwar	68.33	65.73	68.00
34.	Balangir	52.01	43.94	51.90
35.	Cuttack	61.35	65.13	62.13
36.	Dhenkanal	35.43	39.34	39.59
37.	Ganjam	33.21	39.83	38.25
38.	Kalahandi	31.28	40.44	47.00
39.	Kendujhar	32.68	33.25	36.14
40.	Koraput	31.36	30.00	27.90
41.	Mayurbhanj	38.93	38.81	41.34
42.	Phulbani	18.16	14.05	21.49
43.	Puri	41.29	42.16	44.23
44.	Sambalpur	40.74	34.43	37.62
45.	Sundargarh	29.26	28.60	31.29

Source: Same as on Table A.2.1.

Table A.2.9 Compound Growth Rate of Net Sown Area
(in per cent)

Sl.No.	Districts	1961-64	1974-77	1986-89
1.	24 Parganas	0.41	-1.10	-0.31
2.	Nadia	0.26	-0.37	-0.04
3.	Murshidabad	0.18	-0.23	-0.02
4.	Barddhaman	-0.26	-0.48	-0.37
5.	Birbhum	-0.08	-0.48	-0.28
6.	Bankura	0.54	0.16	0.36
7.	Medinipur	-0.37	-0.08	-0.23
8.	Hugli	-0.25	-0.37	-0.31
9.	Haora	0.09	-1.18	-0.52
10.	Jalpaiguri	0.70	-1.01	-0.12
11.	Darjiling	-0.16	2.26	1.16
12.	Malda	0.23	-1.02	-0.37
13.	West Dinajpur	0.06	-0.47	-0.19
14.	Koch Bihar	-0.08	-0.05	0.01
15.	Purulia	1.47	0.48	0.99
16.	Patna	-0.36	-0.22	-0.29
17.	Gaya	-0.29	-0.14	-0.22
18.	Sahabad	0.20	-0.22	0.01
19.	Saran	-0.14	-0.32	-0.23
20.	Champaran	-0.29	-0.63	-0.45
21.	Muzaffarpur	-0.50	-1.00	-0.74
22.	Darbhanga	-0.38	-0.34	-0.36
23.	Munger	-1.32	-0.71	-1.03
24.	Bhagalpur	-0.57	-1.28	-0.91
25.	Saharsha	2.66	-0.52	1.12
26.	Purnea	-0.03	-0.23	-0.13
27.	Santhal Pargana	0.94	-1.84	-0.37
28.	Hazaribag	-5.20	-1.70	-1.10
29.	Ranchi	0.49	-1.50	-0.46
30.	Palamau	-1.60	-5.30	-1.75
31.	Dhanbad	-1.40	-1.90	-1.70
32.	Singhbhum	1.39	-1.32	0.07
33.	Baleshwar	-0.30	0.28	-0.02
34.	Balangir	-1.29	1.39	-0.01
35.	Cuttack	0.46	-0.39	0.05
36.	Dhenkanal	0.78	0.07	0.44
37.	Ganjam	1.40	-0.33	0.56
38.	Kalahandi	1.66	1.26	1.47
39.	Kendujhar	0.12	0.69	0.39
40.	Koraput	-0.24	-0.60	-0.41
41.	Mayurbhanj	-0.02	0.52	0.23
42.	Phulbani	-0.28	1.94	0.78
43.	Puri	0.15	0.40	0.27
44.	Sambalpur	-1.28	0.73	-0.32
45.	Sundargarh	-0.18	0.75	0.26

Source: Same as on Table A.2.1.

Table A.3.1 Distribution of Average Annual Rainfall (mm)

Sl.No.	Districts	1974-77	1986-89
1.	24 Parganas	1408	1924
2.	Nadia	1261	1557
3.	Murshidabad	976	1656
4.	Barddhaman	833	1374
5.	Birbhum	982	1398
6.	Bankura	593	1394
7.	Medinipur	1012	1483
8.	Hugli	767	1617
9.	Haora	435	1559
10.	Jalpaiguri	2799	3733
11.	Darjiling	2221	2901
12.	Malda	1016	1852
13.	West Dinajpur	540	1646
14.	Koch Bihar	2721	3475
15.	Purulia	818	1308
16.	Patna	981	1230
17.	Gaya	865	1192
18.	Sahabad	906	959
19.	Saran	1178	1291
20.	Champaran	1434	1748
21.	Muzaffarpur	1283	1324
22.	Darbhanga	1260	1426
23.	Munger	1036	1313
24.	Bhagalpur	932	1410
25.	Saharsha	1235	1674
26.	Purnea	1464	1974
27.	Santhal Pargana	1290	1499
28.	Hazaribag	1151	1314
29.	Ranchi	1362	1232
30.	Palamau	1115	1170
31.	Dhanbad	1203	1249
32.	Singhbhum	1193	1114
33.	Baleshwar	1262	1558
34.	Balangir	907	1113
35.	Cuttack	1234	1430
36.	Dhenkanal	968	1264
37.	Ganjam	1058	1280
38.	Kalahandi	1040	1113
39.	Kendujhar	1165	1389
40.	Koraput	1245	1247
41.	Mayurbhanj	1304	1321
42.	Phulbani	998	1151
43.	Puri	982	1230
44.	Sambalpur	1016	1145
45.	Sundargarh	1005	1179

Source: Orissa Agricultural Statistics, 1986-89, Bihar Statistical Handbook 1978, Statistical Abstracts of Bihar, Orissa, West Bengal, 1974-77, 1986-89

Table A.3.2 Proportion of Area Under Different Types Soils to Total Geographical Area

(in percent)

Types of soil	Bihar	Orissa	West Bengal
Younger alluvial soil	34.33	2.10	40.12
Older alluvial soil	8.54	3.50	6.54
Deltaic alluvial soil	-	5.43	16.56
Calcareous alluvial soil	7.26	-	-
Lateritic soil	0.83	7.84	9.90
Red sandy soil	20.02	33.28	0.76
Red loamy soil	1.99	31.10	0.37
Red and yellow soil	19.43	9.43	9.74
Brown hilly soil	-	-	2.80

Source: Perspective Plan for Conservation, Management and Development of Land Resources in the Eastern Zone of India, (unpublished report) Volume III, 1993 Appendix 3.4, 3.5, 3.6. Indian Institute of Management, Ahmedabad.

Table A.3.3 Cropping Intensity in Eastern India

Sl.No.	Districts	1961-64	1974-77	1986-89
1.	24 Parganas	114.8	120.1	153.0
2.	Nadia	153.8	173.1	201.3
3.	Murshidabad	143.6	166.8	142.0
4.	Barddhaman	105.6	135.3	158.2
5.	Birbhum	111.9	142.8	149.3
6.	Bankura	106.0	123.1	122.0
7.	Medinipur	108.3	125.9	137.5
8.	Hugli	119.4	153.6	185.5
9.	Howrah	122.1	132.6	183.3
10.	Jalpaiguri	110.8	138.1	163.5
11.	Darjiling	115.5	125.6	115.8
12.	Malda	129.2	162.9	236.4
13.	West Dinajpur	120.7	153.5	160.4
14.	Koch Bihar	120.6	159.8	183.2
15.	Purulia	105.9	105.7	107.7
16.	Patna	154.5	151.9	144.9
17.	Gaya	152.9	132.7	140.0
18.	Sahabad	166.1	148.8	150.0
19.	Saran	127.9	150.9	155.5
20.	Champaran	124.8	136.4	137.5
21.	Muzaffarpur	124.8	143.0	153.5
22.	Darbhanga	124.4	138.2	137.8
23.	Munger	126.2	133.5	140.7
24.	Bhagalpur	115.8	132.9	142.0
25.	Saharsha	152.4	149.4	160.1
26.	Purnea	134.8	145.2	153.1
27.	Santhal Pargana	131.8	111.6	107.6
28.	Hazaribag	118.8	117.3	123.7
29.	Ranchi	106.1	111.7	110.6
30.	Palamau	114.3	115.0	123.7
31.	Dhanbad	105.6	109.6	110.0
32.	Singhbhum	127.1	106.9	105.2
33.	Baleshwar	108.3	118.7	147.5
34.	Balangir	115.4	115.9	135.8
35.	Cuttack	134.4	149.6	178.9
36.	Dhenkanal	113.4	116.8	148.6
37.	Ganjam	129.6	144.7	175.2
38.	Kalahandi	110.8	122.3	141.8
39.	Kendujhar	107.6	111.5	138.0
40.	Koraput	109.0	108.4	138.3
41.	Mayurbhanj	107.4	112.9	126.5
42.	Phulbani	112.0	122.0	150.8
43.	Puri	134.4	150.7	170.9
44.	Sambalpur	111.0	118.9	134.4
45.	Sundargarh	106.3	111.6	135.3

Source: Indian Agricultural Statistics, Vol.II, 1961-64, 1974-77, 1986-89

Table A.3.4 Consumption of Chemical Fertilizer in Kg Per Hectare

Sl.No.	Districts	1961-64	1974-77	1986-89
1.	24 Parganas	3.69	20.01	67.75
2.	Nadia	0.96	22.98	68.10
3.	Murshidabad	2.01	20.53	60.50
4.	Barddhaman	9.27	31.69	95.00
5.	Birbhum	3.78	29.80	78.02
6.	Bankura	2.20	24.77	60.40
7.	Medinipur	2.73	14.67	59.40
8.	Hugli	13.47	51.96	170.40
9.	Howrah	9.95	47.71	204.90
10.	Jalpaiguri	0.58	1.69	35.10
11.	Darjiling	3.51	4.59	72.70
12.	Malda	0.72	13.03	67.30
13.	West Dinajpur	0.36	5.21	47.60
14.	Koch Bihar	1.25	3.26	47.30
15.	Purulia	0.79	7.19	14.90
16.	Patna	7.73	52.44	121.30
17.	Gaya	2.04	39.56	80.17
18.	Sahabad	2.92	44.00	103.96
19.	Saran	2.12	62.70	76.20
20.	Champaran	1.85	28.20	58.80
21.	Muzaffarpur	1.71	44.00	71.60
22.	Darbhanga	0.96	33.40	64.20
23.	Munger	0.94	34.70	84.80
24.	Bhagalpur	0.96	11.40	67.70
25.	Saharsha	0.12	5.60	49.60
26.	Purnea	0.13	13.40	55.16
27.	Santhal Pargana	0.47	3.70	19.10
28.	Hazaribag	1.08	2.90	13.70
29.	Ranchi	0.77	4.70	28.80
30.	Palamau	0.45	2.60	10.00
31.	Dhanbad	0.77	5.80	11.20
32.	Singhbhum	0.42	2.30	13.60
33.	Baleshwar	0.41	7.62	25.10
34.	Balangir	0.31	7.13	14.33
35.	Cuttack	1.31	10.78	20.50
36.	Dhenkanal	0.14	5.12	10.10
37.	Ganjam	4.39	14.42	25.40
38.	Kalahandi	0.08	0.60	2.60
39.	Kendujhar	0.12	1.69	8.40
40.	Koraput	0.19	2.95	7.50
41.	Mayurbhanj	0.15	2.62	8.10
42.	Phulbani	0.15	2.26	4.30
43.	Puri	1.19	8.62	28.50
44.	Sambalpur	0.87	15.12	53.90
45.	Sundargarh	0.14	5.12	16.00

Source: Statistics on Fertilizer and Agriculture in Eastern India (various volumes from 1975 to 1990).

Table A.4.1 Agricultural Density in Eastern India
(Density per sq. km)

Sl.No.	Districts	1961-64	1974-77	1986-89
1.	24 Parganas	641	836	1166
2.	Nadia	462	622	857
3.	Murshidabad	506	694	944
4.	Barddhaman	509	646	763
5.	Birbhum	385	515	638
6.	Bankura	373	511	571
7.	Medinipur	424	616	766
8.	Hugli	713	979	1235
9.	Haora	1192	1506	1829
10.	Jalpaiguri	426	525	746
11.	Darjiling	481	631	590
12.	Malda	396	583	762
13.	West Dinajpur	277	399	540
14.	Koch Bihar	382	560	716
15.	Purulia	411	443	445
16.	Patna	548	687	868
17.	Gaya	457	519	667
18.	Shahabad	411	492	617
19.	Saran	593	784	1022
20.	Champaran	426	552	755
21.	Muzaffarpur	599	816	1142
22.	Darbhanga	629	812	1103
23.	Munger	443	594	710
24.	Bhagalpur	407	562	795
25.	Saharsha	497	564	764
26.	Purnea	370	491	664
27.	Santhal Pargana	338	349	439
28.	Hazaribag	388	778	1051
29.	Ranchi	188	209	246
30.	Palamau	243	288	390
31.	Dhanbad	591	213	283
32.	Singhbhum	316	027	339
33.	Baleshwar	282	401	498
34.	Balangir	200	246	291
35.	Cuttack	408	491	648
36.	Dhenkanal	235	275	339
37.	Ganjam	358	412	521
38.	Kalahandi	206	228	232
39.	Kendujhar	199	281	311
40.	Koraput	164	213	263
41.	Mayurbhanj	246	301	368
42.	Phulbani	254	259	236
43.	Puri	380	449	544
44.	Sambalpur	163	238	301
45.	Sundargarh	160	226	277

Source: Census of India, 1961, 1971, 1981, 1991, Series 1, Part II-A (i) and Agricultural Statistics Volume 2, Table 1, 1961-64, 1974-77, 1986-89

Table A.4.2 Land-Man Ratio in Eastern India
(Per capita net sown area)

Sl.No.	Districts	1961-64	1974-77	1986-89
1.	24 Parganas	0.10	0.07	0.05
2.	Nadia	0.17	0.12	0.08
3.	Murshidabad	0.17	0.12	0.09
4.	Barddhaman	0.15	0.11	0.08
5.	Birbhum	0.22	0.17	0.13
6.	Bankura	0.20	0.17	0.14
7.	Medinipur	0.20	0.14	0.11
8.	Hugli	0.10	0.07	0.05
9.	Haora	0.04	0.03	0.02
10.	Jalpaiguri	0.20	0.16	0.11
11.	Darjiling	0.15	0.11	0.11
12.	Malda	2.22	0.16	0.10
13.	West Dinajpur	0.33	0.22	0.15
14.	Koch Bihar	0.23	0.16	0.21
15.	Purulia	0.17	0.17	0.15
16.	Patna	0.13	0.10	0.07
17.	Gaya	0.18	0.13	0.10
18.	Sahabad	0.21	0.17	0.13
19.	Saran	0.14	0.10	0.08
20.	Champaran	0.20	0.15	0.11
21.	Muzaffarpur	0.14	0.10	0.07
22.	Darbhanga	0.13	0.10	0.07
23.	Munger	0.16	0.11	0.08
24.	Bhagalpur	0.18	0.12	0.08
25.	Saharsha	0.13	0.13	0.09
26.	Purnea	0.20	0.15	0.11
27.	Santhal Pargana	0.19	0.17	0.11
28.	Hazaribag	0.15	0.05	0.03
29.	Ranchi	0.31	0.26	0.17
30.	Palamau	0.26	0.17	0.09
31.	Dhanbad	0.08	0.08	0.07
32.	Singhbhum	0.16	0.15	0.10
33.	Baleshwar	0.29	0.21	0.16
34.	Balangir	0.41	0.28	0.28
35.	Cuttack	0.21	0.16	0.13
36.	Dhenkanal	0.36	0.30	0.24
37.	Ganjam	0.20	0.19	0.15
38.	Kalahandi	0.36	0.37	0.36
39.	Kendujhar	0.35	0.26	0.24
40.	Koraput	0.52	0.36	0.26
41.	Mayurbhanj	0.32	0.26	0.24
42.	Phulbani	0.36	0.28	0.29
43.	Puri	0.22	0.17	0.13
44.	Sambalpur	0.45	0.29	0.25
45.	Sundargarh	0.35	0.24	0.20

Source: Same as for A.4.1.

Table A.4.3 Growth Rate of Rural Population in Eastern India
(Annual in percent)

Sl.No.	Districts	1974-77 over 1961-64	1986-89 over 1974-77
1.	24 Parganas	2.21	2.28
2.	Nadia	2.54	2.48
3.	Murshidabad	2.37	2.28
4.	Barddhaman	1.58	1.22
5.	Birbhum	1.84	1.73
6.	Bankura	1.80	1.56
7.	Medinipur	2.20	1.95
8.	Hugli	2.17	1.77
9.	Haora	1.45	1.44
10.	Jalpaiguri	2.23	1.95
11.	Darjiling	2.18	2.15
12.	Malda	2.56	2.30
13.	West Dinajpur	2.87	2.38
14.	Koch Bihar	2.89	2.03
15.	Purulia	1.43	1.57
16.	Patna	1.65	1.80
17.	Gaya	1.92	1.96
18.	Sahabad	1.82	1.76
19.	Saran	1.76	1.89
20.	Champaran	1.76	1.93
21.	Muzaffarpur	1.67	2.07
22.	Darbhanga	1.79	2.09
23.	Munger	1.51	1.01
24.	Bhagalpur	2.06	2.02
25.	Saharsha	2.70	2.14
26.	Purnea	2.31	2.23
27.	Santhal Pargana	1.59	1.75
28.	Hazaribag	2.01	2.33
29.	Ranchi	1.23	1.18
30.	Palamau	2.33	2.41
31.	Dhanbad	0.72	2.01
32.	Singhbhum	0.98	1.20
33.	Baleshwar	2.33	1.91
34.	Balangir	1.34	1.35
35.	Cuttack	1.93	1.56
36.	Dhenkanal	2.07	1.60
37.	Ganjam	1.50	1.38
38.	Kalahandi	1.22	1.49
39.	Kendujhar	1.79	1.31
40.	Koraput	2.33	1.76
41.	Mayurbhanj	1.32	1.20
42.	Phulbani	1.50	1.49
43.	Puri	1.84	1.51
44.	Sambalpur	1.58	1.56
45.	Sundargarh	2.09	1.36

Source: Census of India, 1961, 1971, 1981, 1991, Series 1, Part II-A (i).

Table A.4.4 Growth Rate of Urban Population in Eastern India
(Annual in percent)

Sl.No.	Districts	1974-77 over 1961-64	1986-89 over 1974-77
1.	24 Parganas	3.73	2.00
2.	Nadia	3.31	3.60
3.	Murshidabad	2.71	3.43
4.	Barddhaman	4.61	4.28
5.	Birbhum	2.54	3.01
6.	Bankura	2.01	2.17
7.	Medinipur	2.56	3.47
8.	Hugli	2.88	2.81
9.	Haora	2.30	3.01
10.	Jalpaiguri	4.15	4.87
11.	Darjiling	3.00	4.07
12.	Malda	3.13	5.20
13.	West Dinajpur	5.13	4.38
14.	Koch Bihar	2.76	2.85
15.	Purulia	3.10	2.31
16.	Patna	3.75	3.50
17.	Gaya	2.95	3.10
18.	Sahabad	3.59	3.16
19.	Saran	3.17	4.40
20.	Champaran	2.69	4.03
21.	Muzaffarpur	3.67	3.83
22.	Darbhanga	2.58	3.33
23.	Munger	2.38	6.49
24.	Bhagalpur	2.26	2.75
25.	Saharsha	4.55	4.19
26.	Purnea	3.76	3.58
27.	Santhal Pargana	2.78	2.97
28.	Hazaribag	5.16	3.94
29.	Ranchi	5.70	3.92
30.	Palamau	2.97	2.95
31.	Dhanbad	6.59	4.18
32.	Singhbhum	3.66	2.80
33.	Baleshwar	2.76	4.70
34.	Balangir	5.07	3.07
35.	Cuttack	4.01	3.93
36.	Dhenkanal	3.73	6.19
37.	Ganjam	4.61	2.87
38.	Kalahandi	5.60	2.98
39.	Kendujhar	6.98	4.33
40.	Koraput	6.78	3.32
41.	Mayurbhanj	5.09	5.00
42.	Phulbani	9.76	4.60
43.	Puri	5.70	5.54
44.	Sambalpur	5.82	3.55
45.	Sundargarh	5.52	3.75

Source: Same as for Table A.4.3.

Table A.4.5 Population Density in Eastern India, 1986-89

Sl.No.	Districts	Density per sq. km.
1.	24 Parganas	834
2.	Nadia	902
3.	Murshidabad	812
4.	Barddhaman	795
5.	Birbhum	529
6.	Bankura	386
7.	Medinipur	571
8.	Hugli	1293
9.	Haora	2377
10.	Jalpaiguri	419
11.	Darjiling	375
12.	Malda	670
13.	West Dinajpur	537
14.	Koch Bihar	591
15.	Purulia	335
16.	Patna	958
17.	Gaya	511
18.	Sahabad	475
19.	Saran	865
20.	Champaran	548
21.	Muzaffarpur	886
22.	Darbhanga	859
23.	Munger	562
24.	Bhagalpur	534
25.	Saharsha	588
26.	Purnea	547
27.	Santhal Pargana	300
28.	Hazaribag	419
29.	Ranchi	188
30.	Palamau	177
31.	Dhanbad	252
32.	Singhbhum	236
33.	Baleshwar	402
34.	Balangir	183
35.	Cuttack	477
36.	Dhenkanal	163
37.	Ganjam	243
38.	Kalahandi	129
39.	Kendujhar	149
40.	Koraput	104
41.	Mayurbhanj	170
42.	Phulbani	073
43.	Puri	319
44.	Sambalpur	145
45.	Sundargarh	151

Source: Census of India, 1981, 1991, Series 1, Part II-A(i).

Table A.4.6 Compound Growth Rate of Area Put to Non-Agricultural Uses: 1986-89 over 1974-77

Sl.No.	Districts	Growth rate in percent
1.	24 Parganas	1.23
2.	Nadia	1.95
3.	Murshidabad	1.89
4.	Barddhaman	2.75
5.	Birbhum	3.52
6.	Bankura	2.17
7.	Medinipur	2.48
8.	Hugli	1.17
9.	Haora	1.43
10.	Jalpaiguri	4.08
11.	Darjiling	0.0
12.	Malda	0.31
13.	West Dinajpur	3.53
14.	Koch Bihar	1.06
15.	Purulia	1.35
16.	Patna	0.81
17.	Gaya	0.29
18.	Sahabad	0.39
19.	Saran	2.88
20.	Champaran	0.37
21.	Muzaffarpur	0.82
22.	Darbhanga	2.94
23.	Munger	8.84
24.	Bhagalpur	1.03
25.	Saharsha	1.53
26.	Purnea	1.20
27.	Santhal Pargana	3.50
28.	Hazaribag	1.53
29.	Ranchi	1.20
30.	Palamau	1.70
31.	Dhanbad	1.03
32.	Singhbhum	1.50
33.	Baleshwar	2.33
34.	Balangir	1.97
35.	Cuttack	1.82
36.	Dhenkanal	2.40
37.	Ganjam	4.19
38.	Kalahandi	3.54
39.	Kendujhar	2.29
40.	Koraput	1.29
41.	Mayurbhanj	2.00
42.	Phulbani	0.97
43.	Puri	1.82
44.	Sambalpur	1.79
45.	Sundargarh	0.43

Source: Indian Agricultural Statistics, Volume II, Table 1, 1974-77, 1986-89