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LAND-MAN RELATIONSHIP AND DISTRIBUTION OF AGRICULTURAL LAND IN EAST SIKKIM

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ABSTRACT. The present study analyses the spatial characteristics of per capita land available and factors influencing variations in land-man ratio. The main objectives are: (1) to analyze land resources especially land use; (2) to describe population characteristics; (3) to analyze spatial characteristics of villages having varying quantity of per capita land; and (4) to evaluate spatial variations of the levels of land-man relationship. The East district of Sikkim is selected as case study. The land-man ratio is calculated as land divided by population and on the basis of required standard land (0.40 hectare) for a person to keep him fit mentally and physically, the deficit and surplus areas have been demarcated. The western and southern areas, and revenue blocks around Gangtok seem to be deficit in per capita agricultural land, while the revenue blocks situated along the higher slopes and in the upper valleys of Dik Chu, Rangpo Chu, Rangli Chu and Rora Chu are surplus. It appears that valley bottoms, flat land, and nearness to urban centres have played significant role in the differentiation of surplus and deficit land. It also appears, then, that altitude and ethnic structure seem to be closely associated with land-man ratio as well as in the scientific analysis of land use and land management.

In the past three decades, considerable changes have occured in the land-man ratio in the Himalayan region. Per capita availability of land has come down from 9.6 hectares (23.7 acres) in 1961 to 5.9 hectares (14.5 acres) in 1981 (Burmanm, 1984). Rapid increase in population is the major cause of this secular decline in land-man ratio. A study of Sikkim shows that its population increased by five times in just eight decades (1901 to 1981). The growth rate has accelerated from 1950's: 17.76 per cent in 1951-61, 29.38 per cent in 1961-71, and 50.44 per cent in 1971-81. When seen in spatial terms, the East district of Sikkim recorded much higher growth rate : 51 per cent in 1961-71 and 103.45 per cent in 1971-81 as this region has experienced considerable immigration after integration of Sikkim in India in 1975 (Karan and Iijima, 1985, 88). Rapid economic development, commercial developments in Gangtok town, and increased accessibility resulting from new roads have attracted people from neighbouring states and countries. Increased demand for food has expanded the cultivable area resulting in the removal of forests and conversion of sloping lands into arable stairs. Loss of forest has subjected the land to erosion and landslides (Karan and Iijima, 1984).

In spite of a widespread change in the land use pattern and declining land-man ratio, there is a dearth of studies on these problems. Mather and Karan's study (1978) on Bhutan advanced the concept of land support unit, that is, the unit of land needed to sustain one human being. This study is a good attempt in understanding the land-man relationship, but it has certain drawbacks too. A standard unit based on the value of land and livestock, however, cannot be static in the context of

change of technology. Secondly, forests, a primary source of support to the population have not been considered. Thirdly, the study has been conducted at the district level and not the village level. In Sikkim, every village is locationally distinct, physically contrasting, and ethnically segregating. The village located at the ridge top is different from the village in valley bottom. Therefore, village level analysis may throw better light in understanding microlevel variations in the land-man ratio and land support unit in the upper and lower parts of the watershed.

The present study analyses the spatial characteristics of per capita land available and factors influencing variations in land-man ratio, and studies the intensity of population pressure particularly suited to diversified terrain where agricultural enterprises do constitute an integral part of the occupational structure and where at the same time maximum proportion of the daily caloric intake per person is obtained from food grains. The main objectives are : (1) to analyse land resources especially land; (2) to describe population characteristics; (3) to analyse spatial characteristics of villages having varying quantity of per capita land; and (4) to evaluate spatial variations in the levels of land-man relationship.

THE STUDY AREA

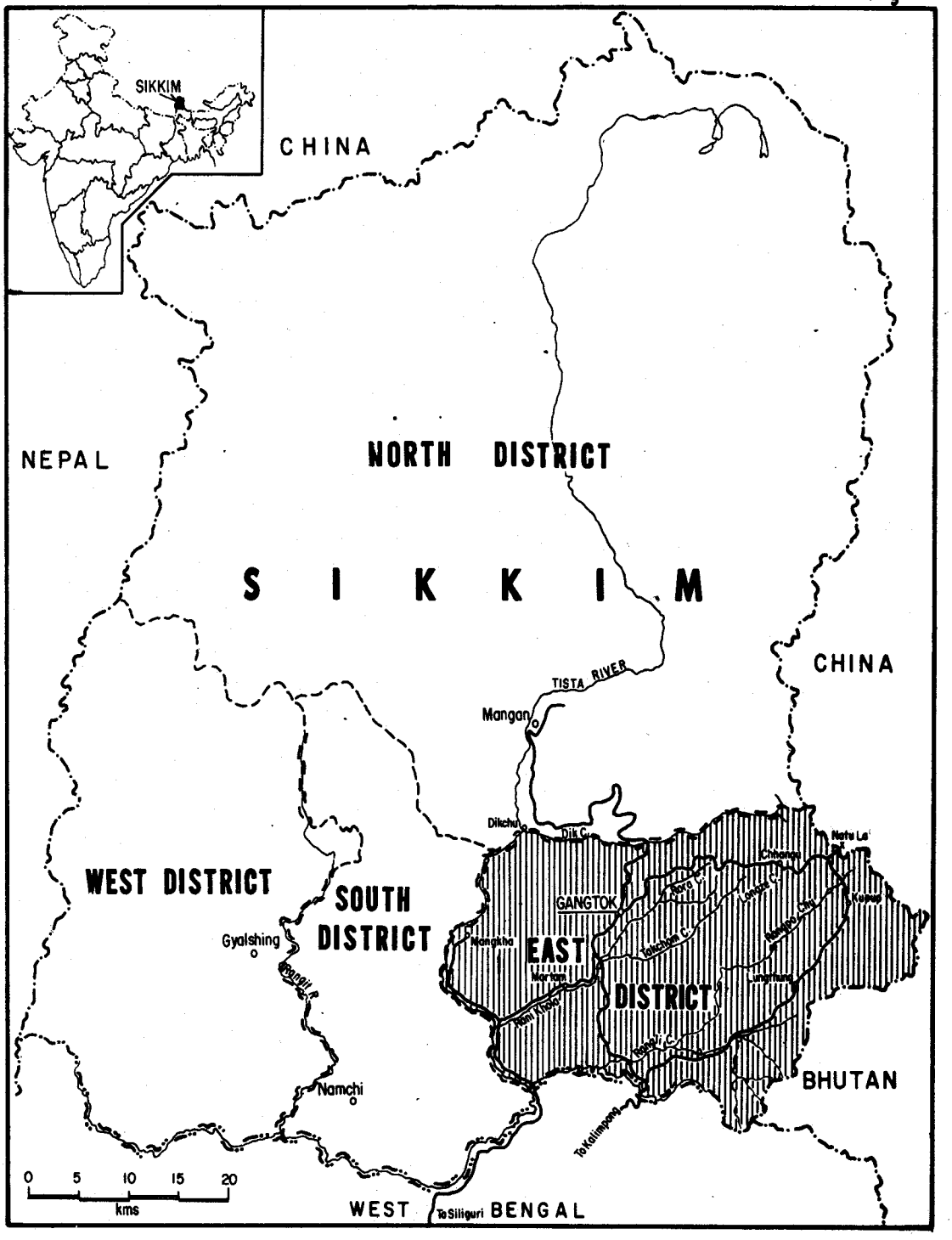
The East district of Sikkim State has been selected as case study (Fig.1). This district, with its headquarters at Gangtok, the state Capital, lies between 27°8' North and 27°25' North latitudes and 88° 23' East and 88°51' East longitudes. Its maximum stretch from east to west is about 47 kms and width from north to south is 31 kms. It occupies an area of 954 km^2 and comprises of 114 revenue blocks or villages with some forest blocks (Fig.2). The study area is girdled by physical boundaries - Dik Chuin in the north, Rangpo river and Darjeeling ridge in the souch, Tista river in the west and Donkya in the east forming the boundary between Tibet and Sikkim. The entire area is highly dissected and rugged. The elevation varies from 300 metres to 5500 metres. In fact, the Tista valley is the only area along the western border where elevations are considerably low. The elevation increases from west to east and south to north. A number of east-west flowing streams form a conspicuous sub-basin. They are Dik chu, Rongli Chu/Rani Khola and Rangpo Chu. More than 50 per cent of the total land area is forested and has a wide variety of vegetal cover. One-third of the total land area is under cultivation. This district contains the highest percentage (31.16) of urban population in the state. The main inhabitants are Lepcha, Bhotia, Nepalese and Biharis. Food and horticultural crops are predominant in the agricultural production of the district. The main food grains are rice, maize, wheat, millet and barley, and the main horticultural products are cardamom.

DATA AND METHODOLOGY

The secondary data published in various reports, statistical handbooks, administrative reports and documents have been taken as the basis of the analysis. Data on land resources have been collected from Ministry of Agriculture, Department of Animal Husbandry, Agricultural Census of Sikkim (1976-77) and District Census Handbook (1971). Data on livestock, forest and fruits have been collected from Agricultural Census of Sikkim (1976-77) published from Agricultural Census Unit, Government of Sikkim. This report provides a unified picture of agricultural pattern and the statistics of the state and the district. Data on total area of block, area under paddy (wet field), dry field, cardamon field, barren and Khasmahal land have been obtained from District Census Handbook, 1981. Data on

LOCATION OF THE STUDY AREA

Fig. I

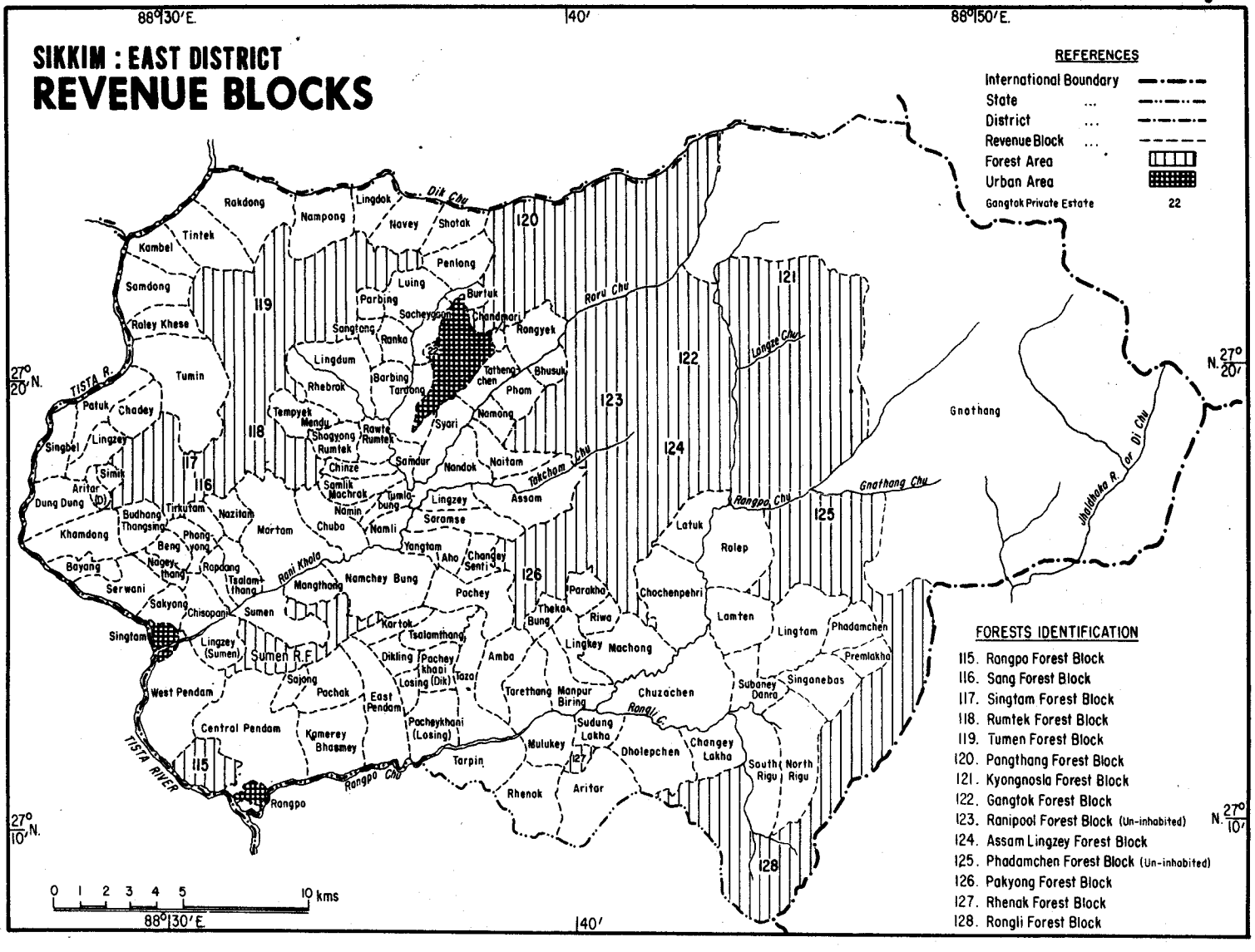


livestock and poultry products have been collected from the First Livestock Census of Sikkim (1977). 'Sixth Five Year Plan (1980-85) Draft proposals' from Government of Sikkim has been consulted to obtain general overview of agriculture land reforms, irrigation, soil and water conservation, animal husbandry, forest, power, industries etc. Report of the High Level Team for Land use Plan in Sikkim (1981) published by the Planning Commission, Govt. of India has been looked for original maps on physical setting and natural resources. Data on population characteristics have been collected from Census Population Table (1981). Data used are exclusively rural.

The smallest areal unit used is revenue block and land use and population data for 1981 have been used in the analysis. The per capita agricultural land has been calculated using the central tendency and dispersion techniques. The land-man ratio is calculated as land divided by population, which gives the land-man ratio at the revenue block level. Since the land-man ratio varies from block to block, for obtaining a conveniently comprehensible relative picture this variation is grouped by mean and standared deviation method. Following a calculation of the extent of land and population in terms of per capita land, the ratio is categorised into five groups : very high, high, moderate, low and very low. This categorisation is done keeping in view that the study area as a whole is faced with intense population pressure as well as relatively low population pressure. In the study of land-man relationship the question of how much land a man requires is one of paramount importance. it is based upon several factors, including the food requirement of each person, the productivity of the farming land, and the intensity of land use. Wherever the pressure of population on land resources is great, it has been found that one or two staple grains becomes the main source of human food. In other parts of the world, meat and milk are also supplemented to the food habits. Still, in some other parts tea and coffee are grown from the land to sustain human beings. It has also been observed that animals are raised on the land and their products are used for food, but there is a wide range of character, type and food from the animals which is difficult to calculate meaningfully (Mather and Karan, 1978). They have attempted to convert livestock into equivalent cropland unit required for human support in Bhutan for which one head of livestock equal to 0.19 acre of cropland was selected. Then the number of livestock was converted into acres of cropland. Considering cropland and animals together, the amount of land that must be put into production to supply the calories needed by Bhutanese people for each year was fixed at 0.91 acre (Mather and Karan, 1978). This figure is selected for estimating individual land need in Sikkim with minor modifications. It has been found during field survey in 1983 that in Sikkim it may take a little more land as support unit because of narrow valleys, steep slopes, dense forest, relatively low land capability and productivity.

In this study, one acre of agricultural land has been selected as required to adequately feed each person in the East district. This figure has been converted into hectare, that comes to 0.40. It is possible now to depict how far the land required to support one person in a given revenue block falls short of the standard for the district as a whole. This figure now provides a quick measure of the spatial pattern of farming efficiency as well as the degree of population pressure on land resources in a diversified terrain of the Himalayas. It must be again emphasised that these estimates are strictly relative to East district of Sikkim and to the systems employed on them. This may, however, be accepted as

.Fig. 2


SIKKIM : EAST DISTRICT
REVENUE BLOCKS
88°130'E.
140'
88°150'E.
27°20'N.
27°10'N.
REFERENCES
International Boundary
State
District
Revenue Block
Forest Area
Urban Area
Gangtok Private Estate 22
Dik Chu
Roru Chu
Langze Chu
Gnathang Chu
Rangpo Chu
Rani Khola
Takcham Chu
Jhaldhaka R. (or) Di Chu
TISTA R.
TISTA RIVER
Rongli R.
Sumen R.F.
Rakdong
Nampong
Lingdok
Navey
Shotak
Tintek
Kambel
Penlong
Samdong
Luing
Parbing
Burtuk
Chandmari
Rongyek
Raley Khese
Sangtong
Sacheydong
Ranka
Lingdum
Barbing
Tarabong
Tathengchen
Bhusuk
Pham
Rhebrok
Tumin
Tempyek
Mendu
Shogyong
Rumtek
Rawte
Rumtek
Syari
Namong
Patuk
Chadey
Singbel
Lingzey
Chinze
Samdur
Nandok
Naitam
Simik
Aritar (D)
Samlik
Machrak
Tumlo
Bung
Lingzey
Assam
Dung Dung
Budhang
Thangsing
Tirkutam
Nazitam
Namin
Seramse
Khamdong
Martam
Chuba
Namli
Beng
Phongyong
Yangtam
Aho
Changey
Senti
Bayang
Nagey
thang
Rapdang
Tsalam
thang
Mangthang
Namchey Bung
Serwani
Pachey
Sakyong
Chisopani
Sumen
Kartok
Singtam
Tsalamthang
Lingzey
(Sumen)
Dikling
Pachey
khani
Losing (Dik)
Taza
Amba
Sajong
Pachak
East
Pendam
West Pendam
Central Pendam
Kamerey
Bhasmey
Pachey khani
(Losing)
Tarpin
Rangpo
Tarethang
Manpur
Biring
Chuzachen
Mulukey
Sudung
Lakha
Dholepchen
Changey
Lakha
Rhenok
Aritar
Theka
Bung
Riwa
Parakha
Lingkey
Machong
Chochenpehri
Latuk
Rolep
Lamten
Lingtam
Phadamchen
Premlakha
Subaney
Danra
Singanebas
South
Rigu
North
Rigu
Gnathang
0 1 2 3 4 5 10 kms
FORESTS IDENTIFICATION
115. Rangpo Forest Block
116. Sang Forest Block
117. Singtam Forest Block
118. Rumtek Forest Block
119. Tumen Forest Block
120. Pangthang Forest Block
121. Kyongnosla Forest Block
122. Gangtok Forest Block
123. Ranipool Forest Block (Un-inhabited)
124. Assam Lingzey Forest Block
125. Phadamchen Forest Block (Un-inhabited)
126. Pakyong Forest Block
127. Rhenak Forest Block
128. Rongli Forest Block

probably a general estimate for a part of Sikkim where climate and types of farming vary greatly with altitude.

LAND RESOURCES

The land resource of this district is uneven though it is a very small region located in mountainous tract. being a part of the inner ranges of the Himalayan mountains. The East district is wholly a hilly region having varied elevations ranging from 600 metres to 4800 metres above sea level. The valley area below 600 metres covers 27 km^2(2.83%) of the total, mostly found along the western border (Fig.3). About 24 villages (21%) are located up to the height of 600 metres. Mountains between 600 to 1800 metres high constitute 8 per cent of the surface area covering 77 km of the total area. More than 35 villages (31%) are located eastward from the Tista river along three main tributaries - Dik Chu, Rongni Chu and Rangpo Chu. Another 22 per cent of the area between the elevations of 1800 to 2400 metres cover 214 km. This is mainly covered by the rugged mountain tract characterised by steep slopes and pierced by precipitous valleys. 92 per cent of the total settlements are up to the height of 2000 metres and only 8 per cent are up to the height of 2400 metres. The rest of the district, above 2400 metres, is more or less uninhabitable. Three ridges, running more or less parallel to each other from west to east cover an area of about 224.5 km^2 of the district. These ridges are covered with thick forests except the eastern part where moraines and cirques are seen along the border before the Chumbi Valley. The major river is the Tista which flows from north to south while its tributaries join it from the east. It is a fast flowing river and is representative of antecedent drainage in the rejuvenated Sikkim (Mukhopadhyay, 1982, 222). The Rongni Chu and Rangpo Chu, covering the entire stretch of the district, are the important sub-basins in the Tista catchment. The catchments of these rivers are fed by snow and rainfall and protected by fairly extensive cover of natural vegetation. The district is endowed with rich flora and fauna. It is a natural paradise for nature lovers, conservationists, botanists, zoologists and environmentalists. The per capita forest area is 0.02 km or 1.8 hectares.

The significant features of land utilization in the East district are : (1) more than 50 per cent of the total land area is forested and has a wide variety of vegetal cover; (2) forests cover most of the ranges and activities are concentrated in the intervening fertile riverine valley bottoms; (3) one-third of the total land area is suitable for agriculture : (4) the very small areas under pastures or grazing; and (5) on the whole there is possibility and limits of expansion of the agricultural acreage. In the remaining forest belt of the 954 km^2 of the East district, 253.54 km^2 or 26.58 per cent is devoted to agriculture (Table 1). The altitude belt which is put to agricultural use reaches approximately twice the height of that of the Alps, due to the favourable climate of its monsoon (Haffner, 1984, 115). Forest land covers 52.4 per cent of the total area, while pasture and caulturable waste cover only 1.98 per cent of the total geographical area. With more than half of the total geographical area being under forest, it is but natural that forests should play a very important role in the quality of life of local people, particularly the rural folks who live adjoining the forest area or in the midst of forest itself. Barren and unculturable land cover about 12.32 per cent of the total area. The remainder 2.32 per cent is made up of land under plantation.

Agriculture is by far the most import occupation of the people in Sikkim and hence an important land use. It provides livelihood to over 80 per cent of its population. Food and horticultural crops are predominant in the

Fig. 3

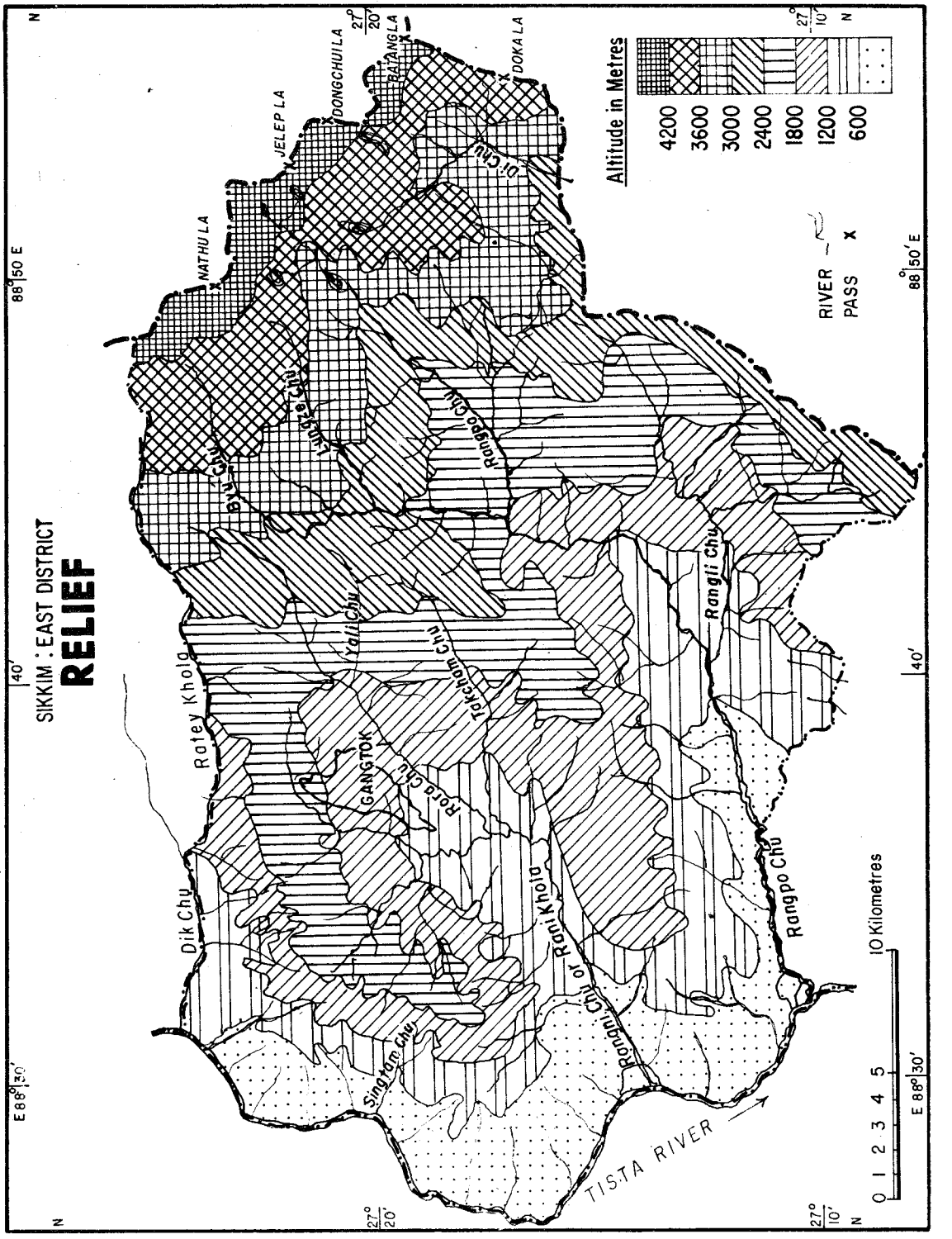

SIKKIM : EAST DISTRICT
RELIEF
Altitude in Metres
4200
3600
3000
2400
1800
1200
600
RIVER
PASS
NATHU LA
JELEP LA
DONGCHUI LA
BATANGLA
DOKA LA
Ratey Khola
Dik Chu
GANGTOK
Rongli Chu of Rani Khola
Singtam Chu
Rangpo Chu
Rangli Chu
TISTA RIVER
10 Kilometres
88°50 E
88°30' E
27°20' N
27°10' N
40'

TABLE 1 : AREA UNDER DIFFERENT LAND USE

Land Use	Area in Km^2	Percentage of Area to Total Area
Agriculture	253.54	26.58
Forest Land	500.00	52.40
Pasture and Culturable Waste	18.88	1.98
Land under Plantation	64.13	6.72
Barren Land	22.00	2.32
Unculturable Land	95.45	10.00
Total	954.00	100.00

Source : Based on agricultural data collected from the office, Ministry of Agriculture, Gangtok, 1983.

agricultural production of the district. The main food crops are rice, maize, wheat, millets and barley; and the main horticultural products are cardamom. Food crops account for about 50 per cent of the total cultivated land. Rice contributes about 22.60 per cent, maize 15.15 per cent, millets 2.40 per cent, pulses 2.55 per cent, wheat 1.85 per cent and cardamom alone contributes 17.85 per cent (Table 2). These crops are grown from an elevation of 300 to 3000 metres but most of the cultivated area is found to be concentrated below 1800 metres elevation. Also, it is common to find cultivated land on 30 to 40 per cent slope (Report of the High Level Team for Land Use Plan of Sikkim, 1981, 21). The first crop in respect of area is paddy which alone covers 23 per cent of the cropped area. Valleys and lower hills are suitable for this crop. The techniques of cultivation used for paddy relative to other crops are superior and, therefore, fairly high yields are obtained by the more progressive farmers in the lower altitudes (Karan and Bladen, 1984, 102). Maize occupies the second largest acreage under cereals and this crop contributes greatly to the economy of the rural people. The area under this crop is about 4808 hectares, i.e. 15.15 per cent of the total agricultural land. It thrives well in the hilly regions where water is not conserved and is generally sown on drier lands where it is not possible to grow rice. Cardamom is an important revenue - earning crop in this district. Sikkim is noted for the largest area and the highest production of cardamom in India. It is said that large cardamom is native of this state and from where it spread to neighbouring areas like Darjeeling, Eastern Nepal, Bhutan and Assam (Gyatso, Tshering and Basnet, 1981, 1). It occupies only a small fraction of the total cultivated area, but contributes the largest share to the national income. Cardamom with a little over 17 per cent of the total agricultural area, covering 5670 hectares, is a significant crop in the southern and western parts of the district. The production of Sikkim contributes to about 70 per cent of the total Indian production of large cardamon (Gyatso, Tshering and Basnet, 1981, 1). Other crops include banjo fields (6.35 per cent), millets (2.4 per cent), pulses (2.5 per cent), wheat (1.85 per cent), barley (0.05 per cent), potato (0.35 per cent) and orchards (1.60 per cent). It appears, therefore, that these crops are not grown sufficiently in this district.

TABLE 2 : CULTIVATED AREA UNDER MAJOR CROPS - 1980-81

Crops	Area in Hectares	Percentage of Total Agricultural Area
Paddy	7176.00	22.60
Maize	4808.00	15.15
Cardamom	5670.00	17.85
Millets	766.00	2.40
Pulse	807.00	2.55
Wheat	594.00	1.85
Barley	16.00	0.05
Potato	106.00	0.35
Orchard	502.00	1.60
Others	11322.00	35.60

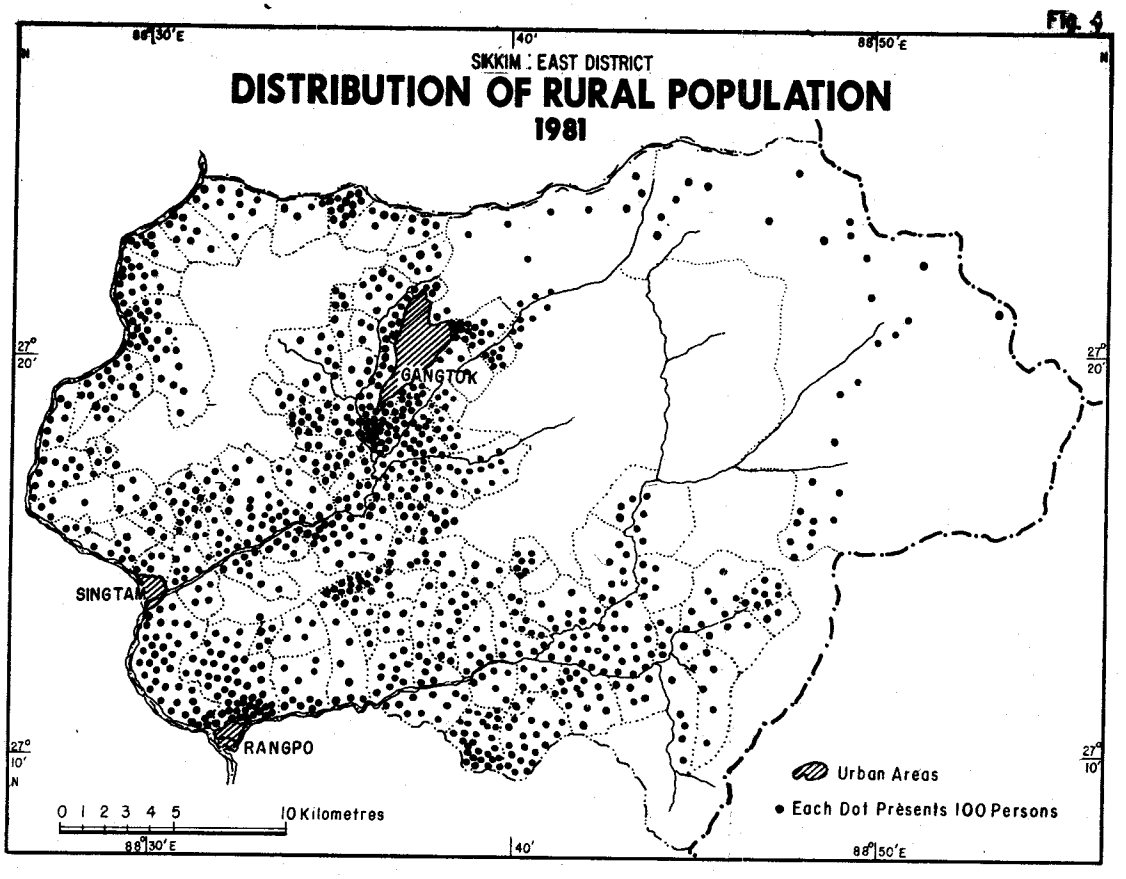
Source : Sikkim at a Glance (1981), p.6.

POPULATION CHARACTERISTICS

The growing number of people has its direct bearing on per capita land and has created problem as regards living accommodation in this diversified terrain. Ethnically, this district consists of different groups, namely, the Lepchas, the Bhotiyas, the Nepalese, Biharis and others. The Lepchas and Bhotiyas are Buddhists and the Nepalese and Biharis are Hindus. About 70 per cent of population is Nepalese, 15 per cent Bhotiyas, 13 per cent Lepchas, and 2 per cent from plains. Most of them have moved into this area from the north, west and south imprinting their cultures on Sikkim Himalayan environment. The Lepchas are the original inhabitants, while the Bhotiyas and the Nepalese are immigrants. The most startling fact is the conversion of Sikkim from a Bhotiya - Lepcha country into a predominantly Nepali one (Lall, 1981, 221). The Bhotiyas and Lepchas have practically become a single composite community, while the Nepalese preserve their separate identity. Thus, this district presents a distinct ethnic mix of two broad heterogeneous groups in which the indigenous people are being outnumbred by the immigrant Nepalese (Lall, 1981, 221). The hills, mountains and streams have Lepcha names, which indicates that the Lepchas are the original inhabitants (Rahul, 1970, 31). But Lepcha families are mostly seen in the remote valleys and forest-clad mountains. They are honest, peace loving and selflessly helpful. They have lost their best lands and most of them have now become workers in tea plantations. The Bhotiyas influenced the Lepchas deeply with their superior culture. In fact, they had come here as Tibetan traders and to spread their lamaistic cult in the fifteenth century. They are wealthy and educated. Therefore, they played an important role in establishing the kingdom of Sikkim and introducing cultural and political changes (Rahul, 1970, 31). The Bhotiyas preferred to settle on high altitude places and cultivated land. The bulk of the Nepalese is found in the

western part of the district as well as in Gangtok. They mainly consist of the Limbu and Rai immigrants from Eastern Nepal, who started migrating to Sikkim in the second quarter of the nineteenth century. They moved into the south of Sikkim, cutting down and clearing acres of forests to make space for their terraced rice paddies (Salisbury, 1972, 20). Their number has multiplied tremendously and most of the socio-economic developments of Sikkim owe their origin to the Nepalese immigrants (Chakravarti, 1984, 31). At the same time the most serious problem arising out of large-scale colonization in Sikkim by the Nepalese has been a constant threat to land resources. The energetic Nepali farmers stripped the forests and made their terraced fields everywhere they could. Added to three main ethnic groups are Biharis found mostly in town as well as densely populated villages.

The distribution of population displays close relations to physical aspects of land. They are terrain character, the proportion of sloping land, climatic variations and associated variations in land productivity (Karan, 1967, 49). The Lepchas, the Bhotiyas and the Nepalese have adapted themselves to the rugged terrain and rigorous climate; and have settled down over the narrow fertile valleys and the arable hill sides of the Tista, Rongni Chu, and Rangpo Chu and their associated tributaries. The uneven distribution of population among several small valleys is a conspicuous feature of the East district. For ex-



ample, Singtam Chu, Takchom Chu, Rora Chu, Rongli Chu are some of the valleys of population clusters (Fig.4). Generally, the river valleys are hot, steamy and somewhat malarious, and consequently, there are no houses right on the river (Spate and Learmonth, 1965, 476). It has been observed that the area 200 metres above the river bed is not suitable for habitation, and settlements are dispersed along the hillsides between 1070 and 2285 metres. Along the hillsides, not even a hundred square metres of flat ground is discernible. Most of the settlements are found on spurs within the terraced slopes. A cursory look on the map (Fig.4) reveals that population is concentrated in three valleys, while the upper part of the ridge is sparsely populated. The average density of population in 1981 was 141 persons per km^2. Since the inception of Sikkim as 22nd Indian state in 1975, the East district around Gongtok is comparatively better developed. Gangtok has become the nodal centre of Sikkim Himalaya. However, it must be indicated that the East district, by Indian standards, is one of the low density areas (India has 267 persons per km^2). But when we take the Himalaya as a whole (110 persons per km^2) then the density figure of this district is little higher. Similarly, when the density figure of the Eastern Himalayan region (16.2 persons per km^2) as a whole is considered then the East district is on much higher level (Burman, 1984, III-9).

Looking at the micro level of the density of population, we find that there is virtually an empty large tract in the eastern part. The western part, on the other hand, displays contrasts characterised by a dense scattering of population clusters around three urban centres to hamlets of two or four homesteads above the fields or even athwart the ridges. The very high density of population (more than 5 persons per hectare)is found in ten villages constituting 8.78 per cent of the total villages, centred around Gangtok and Rangpo. Those villages are central pendm and Rhenak along the Rangpo Chu; and Burtuk, Bhusuk, Syari, Tardong, Samdur, and Samlik Machrak around Gangtok. Thus, Rani Khola or Rora Chu, containing large proportion of the very high density settled villages, can be treated as the population core of the region (Fig.4). The high density of population (between 3 to persons per hectare) occurs around Gangtok, between Rangpo and Singtam towns along the Tista river, and in the upper Rongni Chu. The moderate population density (between 2 to 3 persons per hectare) including twentyseven villages constituting 23.68 per cent of the total, while forty six villages exhibit low density of population covering 40.35 per cent of the total. It is the major tract of population density concentrating mostly along the Tista valley and lower Rongni Chu and Rangpo Chu. The lowest density of population less than 1 person per hectare), covering 12.28 per cent of the total, is found in the south eastern part along the upper Chhuba Khola in Alpine type of environment.

SPATIAL CHARACTERISTICS OF PER CAPITA LAND :

This part looks into spatial variations in land-man relationship under different headings, viz., per capita land, per capita agricultural land, per capita banjo land and per capita Khasmahal-Kabile-abad and pasture land. This is based on statistical analysis and mapping of 1980-81 data for all the 114 revenue blocks of the district.

PER CAPITA LAND :

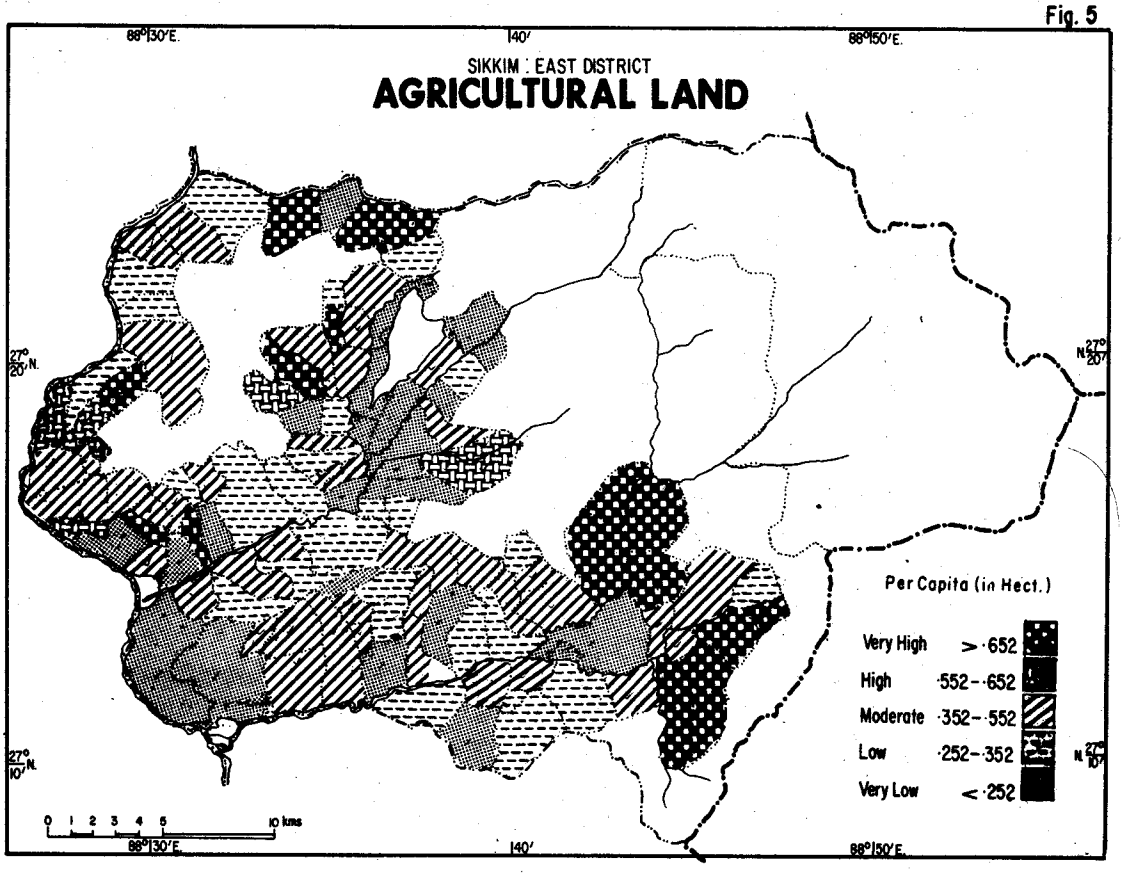
The total per capita land in the district is 6.2 hectares including forest area and there is about 3.5 hectares without forest area. Thus, about half of the total per capita land is uninhabited. The revenue block having the highest per capita land is Mulukey which

contains 2.79 hectares of land and the lowest per capita is in Nangeythang containing .07 hectare of land. It indicates high imbalance of land-man ratio in this district. The very high per capita land (over 1.06 hectares) is found in the marginal land at the boundary of arable and forested land. It comprises of four belts, viz., upper Dik Chu Valley, West of Gangtok, upper Rangpo Chu and upper Rongli Chu. Five revenue blocks fall in high category located on the escarpments where human habitation is not easy. The number of revenue blocks having moderate per capita land are more than half of the total, i.e. 55.26 per cent. The revenue blocks falling under this category are generally away from the state capital and are still well linked. The one side of these blocks is flanked by forest area, which is the cause of low population and the other extremity is surrounded by the river, the cause of increasing population. As many as 28 revenue blocks fall in low category, distributed unevenly between the Tista river and Gangtok town. Here there is land shortage because the per capita land available is 0.14 to 0.37 hectare only. The very low per capita land is available in the seven revenue blocks around Gangtok town continuously along Rora Chu presumably due to proximity to the town and suitable environmental conditions for settlement.

PER CAPITA AGRICULTURAL LAND :

A look at the map of agricultural land (Fig.5) shows much discrepancy in the spatial

Fig. 5



pattern with the per capita land discussed earlier. The per capita agricultural land in this area is 0.45 hectare. Revenue blocks having more than 0.65 hectare are generally situated in the upper river valleys, such as, Latuk (1.7 hectare), followed by Nampong (1.71), Premlakha (1.43), Rolep (1.35) and South Rigu (1.34) are larger in size and smaller in population. Revenue blocks with moderate per capita agricultural land are fortytwo in number and vary from 0.35 to 0.55 hectare. They are widely scattered along the valleys and escarpments forming a small belt between low and high per capita belt. It will be seen from the map (Fig.5) that three large belts of very low per capita agricultural land are clearly recognised. They are around Gangtok, between Rangpo and Singtam town, and near the junction of the rongli Chu and Rangpo Chu. This is the densely populated land unit as it has exceptionally good agricultural land and has attracted settlers because of the presence of cool climate, and where rainfall is adequate for growing of maize and rice.

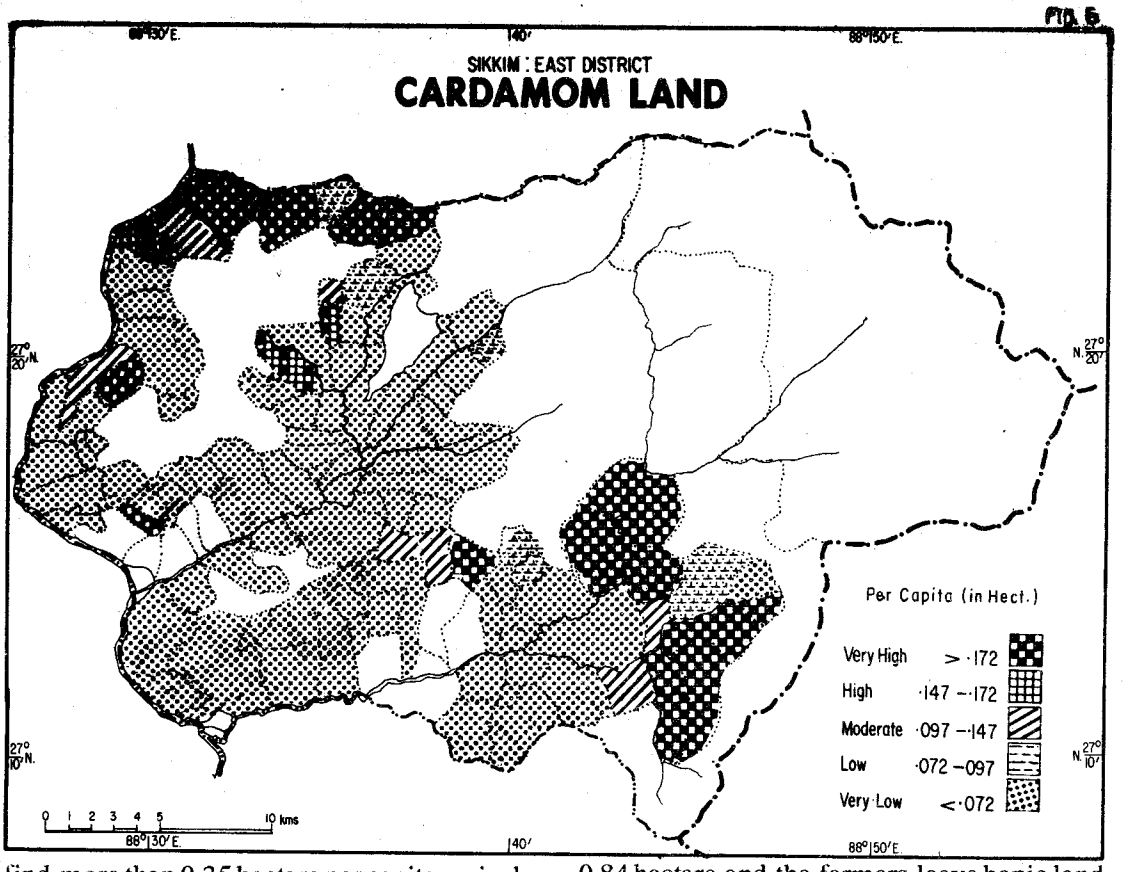
PER CAPITA IRRIGATED LAND :

The spatial pattern in the distribution of per capita irrigated land is quite contrasting. About 92 per cent of the total revenue blocks fall either in very high or in very low categories. It is because of their location in the mountain areas and pressure of population. Most of the revenue blocks having very high per capita irrigated land are in the river valleys of Tista, Dik Chu, Rongli Chu and Rangpo Chu where the increase in irrigated cultivation has taken place in the last thirty years. The farmers have been tapping the jhora or kholsa from the stream at a higher level and then diverting the water for irrigating their paddy fields which are on terraces. But, conversely, as many as 59 revenue blocks come under very low category of per capita irrigated land. In fact, these revenue blocks form a continuous belt in southern and eastern parts of the district. Although the Govt. of Sikkim has initiated some diversion schemes through the Panchayats and Rural Works Department, they are still to be implemented (Report of the High Level Team, 1981, 15). There is considerable excess water in the hilly areas during the rainy season and such water must be drained, collected and reused as far as possible either below the site of collection by flow irrigation or pumped to higher levels.

PER CAPITA CARDAMOM LAND :

The per capita cardamom land is 0.14 hectare only. It is not a significant crop in southern and western parts of the district. The number of revenue blocks having per capita cardamon land below 0.07 are 83, i.e. about 72 per cent of the total. Figure 6 shows that most of these revenue blocks are south of Gangtok town along Rani Khola, Rongli Chu and Rangpo Chu. Out of these, sixteen revenue blocks have no cardamom cultivation. The revenue blocks falling under very low category contain terraced fertile soil, suited more to the cultivation of paddy, maize and ginger. Secondly, in these revenue blocks due to high concentration of population, the demand for food crops is more for general sustenance. Thirdly, the slope of the land is quite favourable for paddy and maize cultivation. Contrary to it, more distinct, contrasting and striking natural settings are the fields of cardamom cultivation covering about sixteen revenue blocks. Figure 7 presents three main patches of this category: (a) the first patch runs along the Dik Chu covering Rakdong, Nampong, Navey and Shotak revenue blocks; (b) along the Rangpo Chu surrounded by forests; and (c) along the Rongli Chu surrounded by Rongli Forest Block. Cardamom, which is a traditional cash crop of this district, is mostly grown at 1000-2000 metre elevation and in the above mentioned

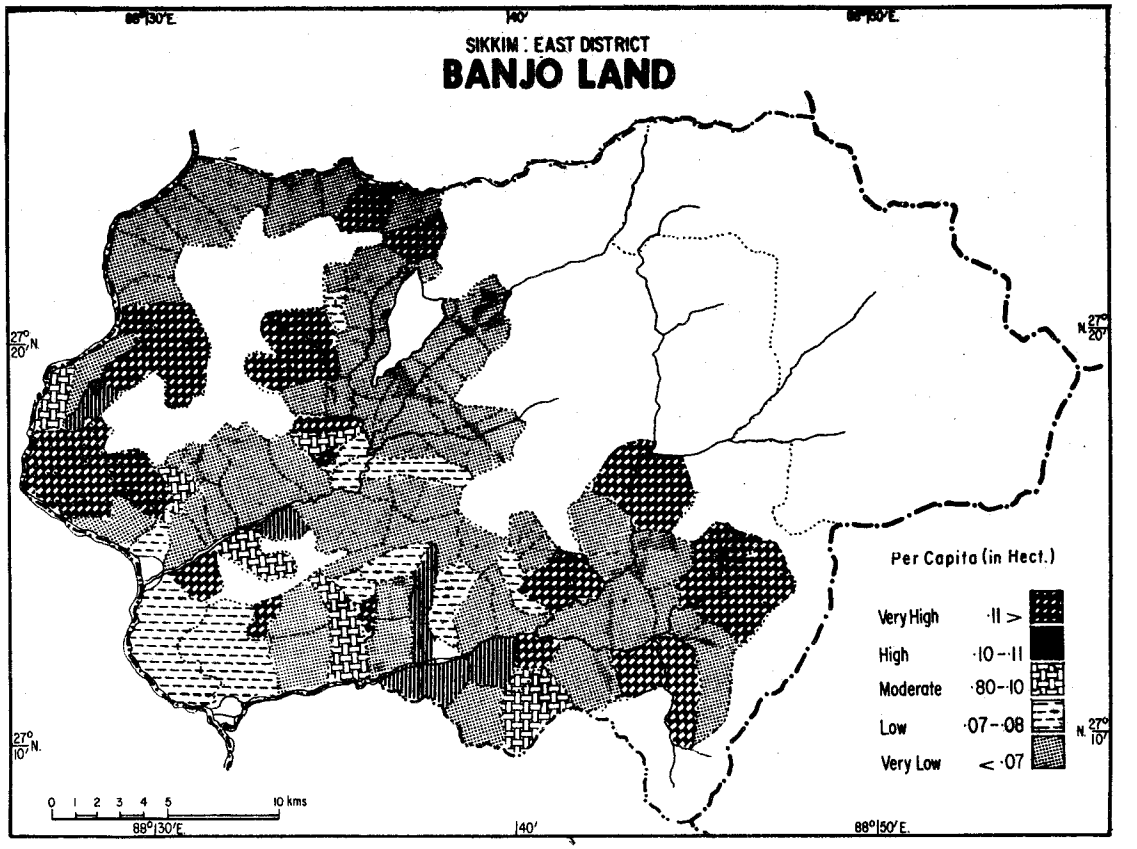
patches are found favourable shade, humid environment and soils rich in organic matter content. These revenue blocks have low density of population resulting into very high per capita cardamom land. Consequently, here we find more than 0.35 hectare per capita agricultural land.



PER CAPITA BANJO LAND :

It is well known concept in India that increasing population pressure on land resources leads to more frequent use of land and consequent shortening of banjo land (fallow) (Dayal, 1984, 361). In other words, the amount of land left fallow is an indication of agricultural intensity in a theoretical framework. When we examine the per capita figures for agricultural land and land under fallow or banjo, then we find a close positive relationship between them. It shows that as the agricultural land-man ratio deteriorates owing to increasing population pressure, the amount of banjo land declines. The highest per capita banjo land is 0.84 hectare and the farmers leave banjo land for a variety of reasons. For example, population pressure, amount of rainfall received in a given year, availability and non-availability of irrigation are some of the factors affecting the spatial variations of the proportions of banjo land (Dayal, 1984, 362). It is generally found that in the areas of high rainfall variability, farmers may be encouraged to leave more banjo land because of the uncertainty involved in the farm business (Dayal, 1984, 362). However, in the irrigated areas the farmers generally leave less banjo

land. Figure 7 indicates that about 63 per cent of revenue blocks contain very low per capita banjo land. the distributional pattern shows that these revenue blocks are away from the forest blocks and are confined to the lower and mid hill slopes. On the other hand, very high per capita banjo land is found at the margin of forest block, where, the low population pressure and nearness of forest are probably the affecting factors.



PER CAPITA KHASMAHAL KABILE ABAD LAND :

The local meaning of the term 'khasmahal kabile abad land' is cultivable land and 'khasmahal kabile abad' also includes pasture land. This means future expansion of the agricultural acreage is from the grasslands unutilized today. The pasture or the grazing lands have good tree but no grass (Report of the High Level Team, 1981, 24). In the case of few khas lands or village lands, where people have the right to cut the trees, trees have been completely removed (Report of the High Level Team, 1981, 24). therefore, like other states in India, Sikkim has the same problem of managing the common lands for which no one feels responsible (Report of the High Level Team 1981, 24). The effective utilization of pasture and grassland resources forms the key aim before the Government. However, the extent of good and a palatable

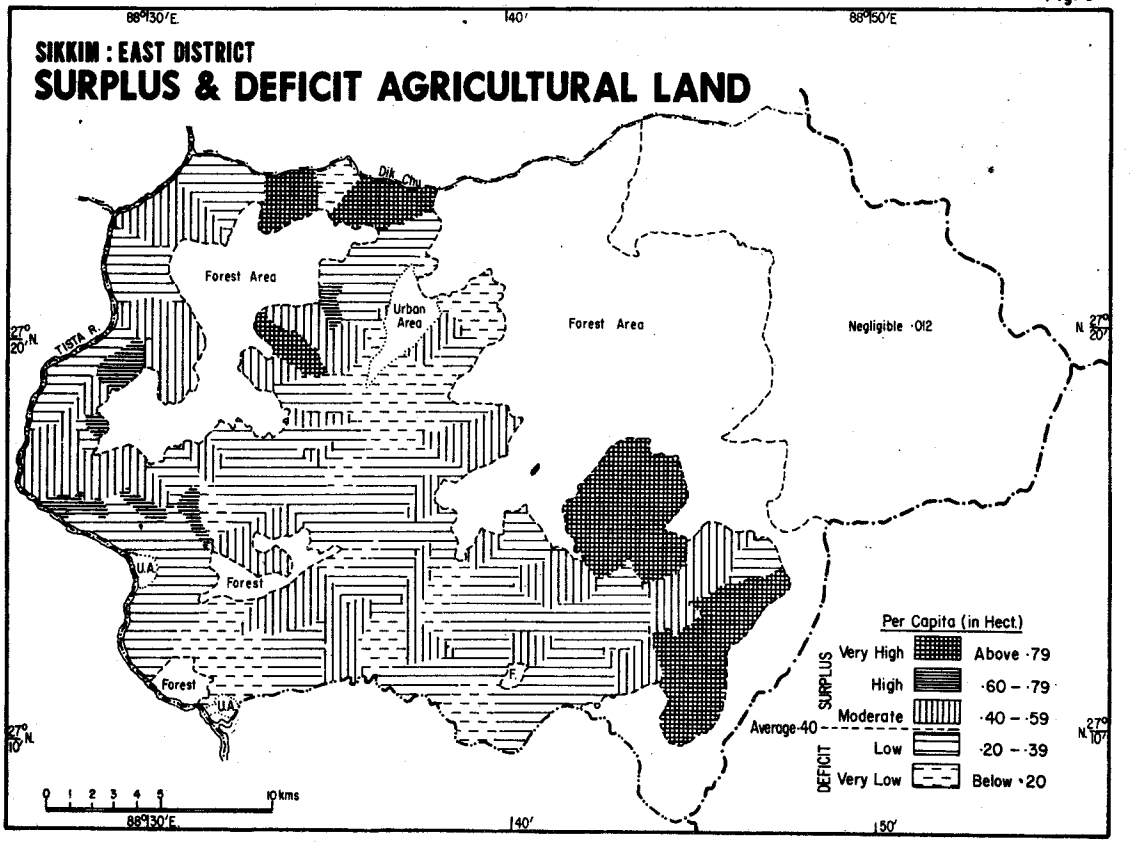
grasslands is patchy and irregular, Revenue blocks having low and very low per capita khasmahal kabile abad land are ninetyfour which invite the attention of the government seriously.

DISTRIBUTION OF SURPLUS AND DEFICIT LAND :

According to the estimate, the average carrying capacity of land in the East district is calculated as 2.50 persons/hectare. In the similar vein, the standard land support unit (LSU) for Bhutan is 2.70 persons/hectare which is little higher as discussed earlier. The average carrying capacity of land in Andhra Pradesh is estimated to be 3.77 persons/hectare (Ramanaih and Reddy, 1983). Thus, it shows that there exists a wide regional disparity in the carrying capacity of land in the country caused by the presence of wide diversity of physical and socio-economic conditions. Under more favourable climatic conditions, and where there are extensive areas of fertile soils, land carrying capacities are, no doubt, considerably higher.

Taking the figure 0.40 hectare as the average agricultural land to support one person, the surplus and deficit nature of 114 revenue blocks is calculated and presented in Table 3. It provides where, in which revenue block, the agricultural land is surplus and deficit. Following a calculation of the extent of

Fig. 8



agricultural land in terms of variation from 0.40 hectare, the pressure of population on the land has been categorised into five surplus and deficit groups (Fig.8): (a) Very high (above .79), (b) high (.60-.79), (c) moderate (.40-.59), (d) low (.20-.39) and (e) very low (below.20). Very high, high and moderate groups are surplus in nature; and low, and very low are deficit.

TABLE 3 : SURPLUS AND DEFICIT AGRICULTURAL LAND

Sl. No.	Name of Revenue Block	Per Capita Agricultural Land (in Hectares)	Surplus/ Deficit Land
1.	Latuk	1.778	+ 1.378
2.	Nampong	1.710	+ 1.310
3.	Premlakha	1.434	+ 1.034
4.	Rolep	1.356	+ .956
5.	South Rhegoh	1.343	+ .943
6.	North Rhegoh	1.217	+ .817
7.	Navey	1.120	+ .720
8.	Lamaten	1.019	+ .619
9.	Singaneybas	.939	+ .539
10.	Shotak	.896	+ .496
11.	Chochenphery	.809	+ .409
12.	Rey	.804	+ .404
13.	Sangtong	.763	+ .363
14.	Chadey	.729	+ .329
15.	Rapdang	.691	+ .291
16.	Namgeythang	.667	+ .267
17.	Simik	.628	+ .228
18.	Byang	.602	+ .202
19.	Tephyak-Mendu	.582	+ .182
20.	Lingzey	.576	+ .176
21.	Assam	.572	+ .172
22.	Thekbung	.549	+ .149
23.	Khamdong	.545	+ .145
24.	Sumen	.532	+ .132
25.	Lingtam	.532	+ .132
26.	Changeylakha	.532	+ .132
27.	Tumen	.528	+ .128
28.	Change Senti	.520	+ .120
29.	Namin	.518	+ .118
30.	Subanedara	.513	+ .113
31.	Lingdum	.510	+ .110
32.	Beng	.505	+ .105
33.	Barbing	.503	+ .103
34.	Machong	496	+ .096
35.	Pachak	.487	+ .087
36.	Taza	.486	+ .086
37.	Nazitam	.483	+ .083
38.	Budang Thangsing	.481	+ .081
39.	Sajong	.463	+ .063
40.	Dung Dung	.459	+ .059
41.	Kambal	.451	+ .051
42.	Gangtok Pvt. Est.	.451	+ .051
43.	Mangthang	.448	+ .048
44.	Chinze	.444	+ .044
45.	Sudunglakha	.444	+ .044
46.	Tintek	.440	+ .040
47.	Losing	.434	+ .034
48.	Tathangchen	.420	+ .020
49.	East Pendam	.417	+ .017
50.	Phengyong	.397	- .003

51.	Sakyong	.396	- .004
52.	Mulukey	.394	- .006
53.	Liyung	.393	- .007
54.	Aritar	.390	- .010
55.	Biring	.390	- .010
56.	Riwa	.385	- .015
57.	Dikling	385	- .015.
58.	Pachey	.381	- .019
59.	Tumlabund	.377	- .023
60.	Singbel	.368	- .032
61.	Lingzey	.367	- .033
62.	Naitam	.361	- .039
63.	Kammare Bhamse	.360	- .040
64.	Ranka	.359	- .041
65.	Rakdong	.353	- .047
66.	Raleykhese	.353	- .047
67.	Pacheykhani	.347	- .053
68.	Phadamchen	.339	- .061
69.	Tsalumthang	.338	- .062
70.	Patuk	.336	- .064
71.	Linkey	.333	- .067
72.	Namchey Bung	.331	- .069
73.	Tirkutam	.330	- .070
74.	Aritar	.321	- .079
75.	Chuba	.315	- .085
76.	Martam	.314	- .086
77.	Tarethang	.313	- .087
78.	Aho	.312	- .088
79.	Tarpin	.311	- .089
80.	Parkha	.308	- .092
81.	Samilk Marchak	.305	- .095
82.	Sumdong	.300	- .100
83.	Dholepchen	.297	- .103
84.	Parbing	.291	- .109
85.	Rawate-Rumten	.273	- .127
86.	Penlong	.262	- .138
87.	Pam	.250	- .150
88.	West Pendam	.237	- .163
89.	Yangtam	.227	- .173
90.	Sangyong Rumtek	.218	- .182
91.	Chujachen	.218	- .182
92.	Chisopani	.215	- .185
93.	Sherwani	.213	- .187
94.	Sicheygaon	.209	- .191
95.	Saramse	.208	- .192
96.	Tsalumthang	.199	- .201
97.	Amba	.198	- .202
98.	Pacheykhani	.198	- .202
99.	Kartok	.197	- .203
100.	Lingdok	.181	- .219
101.	Lingzey	.181	- .219
102.	Chandmari	.180	- .220
103.	Rongyek	.174	- .226
104.	Central Pendam	.157	- .243
105.	Wandok	.153	- .247
106.	Namli	.137	- .263
107.	Rhenak	.102	- .298
108.	Burtuk	.100	- .300

SURPLUS LAND :

Table 3 shows that out of 114 revenue blocks, fortynine contain surplus land. These revenue blocks present distinguishing spatial patterns in the study area. they are basically located along the higher slopes of the ridges and in the upper valleys of Dik Chu, Rangpo, Rongli Chu and Rora Chu. It is also interesting to find those blocks near the big forest blocks characterised by low agricultural population resulting into low density of population. they are mostly settled by Lepcha and Bhotia communities. Here the population concentration is comparatively low due to its remoteness and long distance from urban areas. Based on the estimates, it is assumed that in these revenue blocks further migrant people can be accommodated twice or thrice the present number of population.

DEFICIT LAND :

Sixtyfive Revenue Blocks are included in this category. These revenue blocks are basically located either in the lower course of the rivers or near the urban areas. Lingdok is the only exception which is surrounded by the revenue blocks with very high per capita agricultural land. It is because of the little more flat valley part along with Dik Chu. It is also interesting to find that most of the revenue blocks in this category are along the national highways (Siliguri Gangtok) or the state highway (Kalimpong-Gangtok). They have high agricultural population resulting into high density of population. These revenue blocks are inhabited generally by the Nepalese and the cause of low per capita agricultural land is due to migration from the different neighbouring states also.

CONCLUSIONS :

The following results have been obtained from the foregoing analysis : (1) Agriculture is by far the most important occupation of the people of east sikkim and an important land use. On an average, the agricultural land accounts for one-third of the total area of the district. More than 50 per cent of the total land area is forested and has a wide variety of vegetal cover. (2) The density of population has been found to be 145 persons per km^2 and it is highly concentrated around three urban centres, along the tista river and in the valley bottoms of other rivers. (3) The total per capita land is 6.2 hectares including forest area and it is about 3.5 hectares per head without forest area. Taking the 1981 rural population at 95,520 the per capita agricultural land amounts to 0.45 hectare. At this level, the average availability of land is higher in this district than in other states of India. However, the cultivated area is mostly terraced. The western and southern parts which are densely populated have the lowest cultivated land, while the eastern and south-central parts, having low density of population, have the highest cultivated land. The spatial variations in the quality of per capita land are largely determined by topographical and climatic conditions as well as ethnic characteristics. (4) when the proportion of surplus and deficit land is considered, the western and southern areas, and revenue blocks around Gangtok seem to be deficit in character, while the revenue blocks situated along the higher slopes and in the upper valleys of Dik Chu, Rangpo, Rongli and Rora Chu are surplus in character. It appears that valley bottoms, flat land and nearness to urban centres have played significant role in the differentiation of surplus and deficit land. It also appears, then, that altitude and ethnic structure seem to be closely associated with land-man ratio as well as in the scientific analysis of land use and land management in this part of the Himalayas.

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