"SPATIO-TEMPORAL ANALYSIS OF AGRICULTURAL LANDUSE IN THANE DISTRICT"

A Thesis Submitted To
Faculty of Moral And Social Sciences,
Department of Geography
Tilak Maharashtra Vidyapeeth,
Pune

For The Degree of Vidyvachaspati
(Doctor of Philosophy)

By

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Year- 2011

CERTIFICATE

This is to certify that the Dissertation entitled **"SPATIO-TEMPORAL ANALYSIS OF AGRICULTURAL LANDUSE IN THANE DISTRICT"** which is being submitted herewith for the Degree of Vidyavachaspati (Ph.D.) in Geography of Tilak Maharashtra Vidyapeeth, Pune is the result of original research work completed by ***Shri. Balasaheb B. Rahane*** under my supervision and guidance. To the best of my knowledge and belief the work incorporated in this thesis has not formed the basis for the award of any Degree or similar title of this or any other University or examining body.

Research Guide

Dr. Hemant M. Pednekar

Place: Pune

Date: 1st August, 2011

DECLARATION

I here by declare that the Thesis entitled **"SPATIO-TEMPORAL ANALYSIS OF AGRICULTURAL LANDUSE IN THANE DISTRICT"** completed and written by me has not previously formed the basis for the award of any Degree or other similar title of this or any other University or examining body.

Research Student

Shri. Balasaheb B. Rahane

Place : Pune

Date : 1ST August, 2011

DECLARATION

I here by declare that the Thesis entitled **"SPATIO-TEMPORAL ANALYSIS OF AGRICULTURAL LANDUSE INTHANE DISTRICT"** is an extended topic of my M. Phil. Dissertation entitled **"SPATIO-TEMPORAL ANALYSIS OF AGRICULTURAL LANDUSE IN WESTERN COASTAL PLAIN OF PALGHAR TAHSIL".**

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CONTENT

ACKNOWLEDGEMENT

There are many people who helped in successful completion of this research work. I have had the benefit of guidance by Dr.Hemant Pednekar, my guide, who carefully read each and every line of this thesis and his valuable criticism helped me a good deal in putting my thoughts into the form in which they are presented now. I am further indebted to him for his frequent suggestions with regards to the works on the subject by various authors and his readiness to help me in referring to them.

I owe special thanks to Principal Dr. A. M. Padhye, for extending required facilities in Geography Department and Library of Sonopant Dandekar College, Palghar. I am grateful to Dr.J. Suri Madom, Bhugol GIS, IIT Powai, Mumbai, for data processing and cartographic assistance.

I received excellent co-operation from my colleagues in the Sonopant Dandeker College, particularly from Vivek Puranik, Sanjay Deshpande, Kiran Save, Mahesh Deshmukh, and Subhash Patil who have always been source of inspiration in this honest pursuit they deserve special thanks.

I wish to extend my sincere thanks to Prof. Mrs. Bharati Unni and Dr. Yargop, for the keen interest shown in my research work.

I received admiration, appreciation and support from my family and friends. There are many well wishers who helped me and although they are not mentioned here by name, I thank them sincerely.

- B.B. Rahane

ABSTRACT

Agriculture continues to sustain millions of people in India. This is despite the rapid industrialization which has acquired significant proportion in many regions of the country. Agriculture still forms the backbone of Indian economy. The twin processes of industrialization and urbanization are transforming the traditional economic relations between the rural and the urban segments. Agriculture geography is not concerned simply with describing the nature of farming in a region, in its broad sense; it includes aspects of farm operations and transport and marketing of agricultural commodities.

Thane is one of the districts in North Konkan situated to the north of Mumbai. Complemented by fertile soil and market due to high connectivity of railway and highway ensuring access to the market of Mumbai, Surat and Ahmedabad. The study region has significant location in respect to the 'Sahyadri' (Western Ghats) in eastern side, relatively broad coastal plain i.e. western coast, is a fair coast-line (about 100 kilometers long), plateaus between the coastal range, the hills of Sahyadri and the western steep slope of the Sahyadri, lies between $72^0$37'and $73^0$45' East longitudes and between $18^0$42' and $20^0$20' North latitudes.

This study is concerned with the spatial analysis of agricultural landuse. To assess and analyse geographically. To describe and interpret the patterns of agricultural landuse in a selected area. Thus the study of agricultural pattern and its spatial variation form the central idea of the study. With respect to investigations certain physical and socio-economic variables involved in landuse patterns provide meaningful results for proper and efficient landuse. This is useful in meeting demand of food for the increasing population and to describing and interpreting the variation in agricultural landuse patterns with crop combination, crop diversification, correlation and time series analysis.

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Chapter – I

INTRODUCTION

Agriculture is considered as one of the oldest and most important of all the economic activities of man. Agriculture is related to domesticated plants and animals as activity to satisfy man's needs. Now a days agriculture has become the worlds most important industry. Agricultural geography has thus become a unique branch of geography in which the physical environment and man's response to it have become cardinal points of research and regionalization.

The credit of introducing this pioneering approach in agricultural geography goes to L.D.Stamp (1962), several landuse studies followed by this, In India Chatterjee (1941) drew the attention of geographers to undertake a land use survey. M.Shafi (1951) focused attention on needs of land utilization survey. The influence of physical factors, especially, morphological factors on landuse was emphasized by Deshpande, Bhat and Mavinkurve (1959). The importance of landuse surveys has been explained in detail by Ganguli (1964). A number of attempts have been made in regard to case studies, regionalization and evaluation of landuse problems. Karimi (1950) and Lahiri (1950) have carried out micro-studies to highlight the need of proper utilization of land and the connected agricultural problems. Shafi (1960) carried out extensive fieldwork in eastern Uttar Pradesh and came up with actual landuse maps at micro or even nano levels. Noor Mohamad (1971), A.R.Kumbhare (1976), S.D.Shinde(1980), Indra Pal and Lakshmi Shukla (1981), Karmarkar P.R. (1981), Datye V.S. (1983), Vaidya B.C.(1996) have focused their attention on the landuse of specific regions. All

these studies also suggest ways and means of improving the landuse for the ultimate good of human welfare.

Geographers have recently turned their attention to asses quantitatively the changes which have been in place in the utilization of land. In this connection, Chakerborthy (109,1962) has given a statistical method to analyse land use pattern of any region. M.Shafi(114,1965) has selected Ganga-Yamuna Doab, in the most fertile and thickly populated part of Uttar Pradesh, for his intensive study of patterns of crop landuse.

The significance of spatio-temporal analysis of agricultural landuse in a predominantly agricultural country like India can never be overstated. In the context of the alarming increase of population and relatively slow rate of economic growth, it is increasingly being accepted that the proper and efficient utilization of land resources could be the answer to the problems faced by the country. This is particularly significant even from the modern theoretical view that considers landuse patterns as dynamic and not static. “Man,s main purpose for using land is to gain some sort of satisfaction, such as earning an income or providing recreation rather than ‘blending with nature’ moreover farmers viewed as income optimizers behave like ‘economic men’ and therefore their decision depend ultimately on two things : productions functions and the prices of inputs and outputs” (Found-1971), Due attention should also be paid by researcher to the preservation and care of the ecosystem when the farmers degradation have damaged it in both the developed and developing countries.

Agriculture also has been the source of raw materials to India’s leading industries. The importance of agriculture in the national economy is also indicated by many other facts e.g. agriculture is the main support of Indian transport system since railways and

roadways secure bulk of their business from the movement of agricultural goods. Further, the failure on agriculture front upsets the whole system of planning. Thus, the problem of providing food to ever increasing population is the most important one. Therefore it is pertinent that this vital economic activity and its spatial distribution be described properly, explained and understood.

Agriculture in a way is the result of human efforts applied in exploitation of land resources, towards the satisfaction of one of mans basic needs 'food'. It is a kind of permanent or cyclic human intervention to satisfy human needs from the complex of natural resources i.e. land. The nature and level of human efforts applied and the quality of physical environment give rise to spatial variation in the agricultural patterns. In order to explain this spatio-temporal variation in the agricultural patterns one has to explain the nature of relationship between them and the physical, socio-economic and technological factors.

OBJECTIVE AND OUTLINE OF THE WORK

This study is concerned with the spatio-temporal analysis of agricultural landuse in a selected district viz. Thane district in the state of Maharashtra. Thus, the study of agricultural patterns and their spatial variation form the core of the study undertaken. It is proposed to consider the spatial variation in the agriculture landuse in Thane district with a view to evaluate the influence of certain physical environmental and economic factors on the distribution pattern. The currently evolving and changing agricultural landuse patterns in the district with special reference to changes that have taken place since the end of the 20th century are investigated. An attempt is also made to represent the various patterns of landuse and socio-economic phenomena and the resulting agricultural location in a model form. The work has its limitations imposed by

choice of region and other factors. Several aspects are omitted and author is fully aware of such omissions which result from lack of data and other resources including time to be devoted for such work.

The spatio-temporal analysis of agricultural landuse in Thane district has been organized into following chapters followed by conclusion and bibliography.

Chapter I: The first chapter begins with the introduction to the area under study, Chapter II: The description of physiography through a general study of geology, relief, and drainage. Some important aspects of climate and the distribution of weather elements are also considered along with the spatial distribution of soils and natural vegetation studied in chapter two.

Chapter three is devoted to the discussion of selected socio-economic factors and their aerial distribution in the district. Further, different aspects of population with a special emphasis on the persons engaged in the agricultural activity are studied along with other elements of agricultural organization like land tenure, land holding, farm elements, marketing, and the role of transportation and irrigation in the development of agriculture in the district.

Spatial and temporal distribution of general landuse forms the core of chapter IV. General land utilization and agricultural land utilization are described in chapter four and five respectively. The association between the agricultural and landuse and the various related factors are examined in sixth chapter followed by a temporal analysis of trends in the production of various agricultural commodities.

Chapter seven delineates the composite crop regions with the help of quantitative techniques used in the identification of crop combinations for the individual village in the district. This discussion

helps to form agricultural regionalization in chapter seven where, an attempt is made to explain the crop combination and diversification regions and landuse patterns resulting from the interaction of various physio-cultural phenomena.

Sample villages from each of the crop combination and diversification regions, are studied at micro level in the eighth chapter. This helps to evaluate the interactions of various elements and the resulting landuse patterns.

An attempt is made to bring together the main findings and to arrive at some conclusion, apart from providing a brief summary of the entire work, includes a discussion of the problems and prospects of agriculture in Thane district. The work it is hoped will have served its purpose if it can at least provide a basis for planning changes in agricultural landuse for the optimum utilization of the regions resources. The regional frame developed and the model agricultural location may together be useful for making policy decisions, especially for the allocation of resources with respect to the potential and problem regions, delineated in terms of the existing agricultural patterns.

Choice of the Region

The scale problem is fundamental in geographical studies. In agricultural geography, data is collected and observations are generalized. A district level study would provide us with frame at micro level on which further research can be based. Keeping this in mind, The Thane district (Maharashtra) was chosen as an area of investigation. The choice is influenced by several considerations. Firstly, little work has been done to asses the significance of various physio-socio-economic factors with respect to agriculture in North Konkan (Maharashtra)). It is felt that such study at micro level would

provide a useful approach to obtain a more complete understanding of the problems of agriculture in the region.

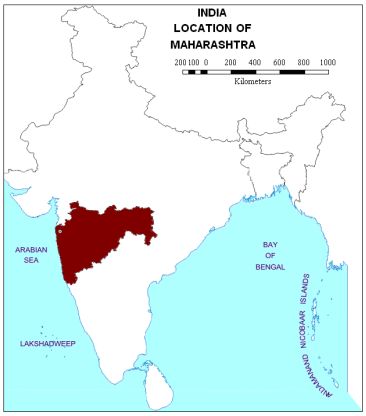
Secondly, Thane district has significant location in respect to the 'Sahyadri' (Western Ghats) in eastern side. The district is a good representation of Konkan area in many respects viz. geology, physiography, climate, drainage, natural vegetation, soils and other socio-economic phenomena. Therefore, the study of the agricultural landuse of Thane district will help to a certain extent to understand agricultural geography of North Konkan. Thirdly, the district has varied physical base i.e. it represents large variations in topography. Thus it is possible to evaluate the influence of various physical elements upon the agricultural landuse.

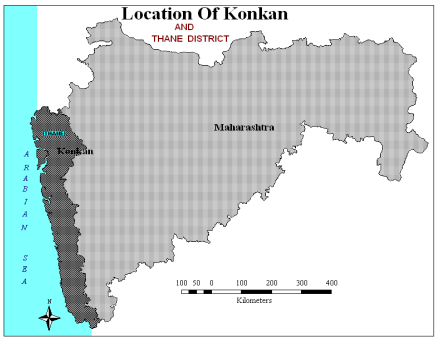
All these considerations have led to the choice of Thane district as the region for this study in order to understand the agricultural landuse of the region in a time-space perspective.

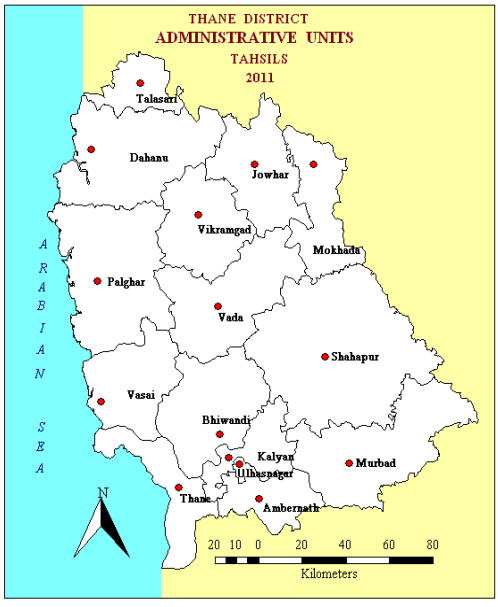
LOCATION MAP

AND

ADMINISTRATIVE UNITS OF THANE DISTRICT







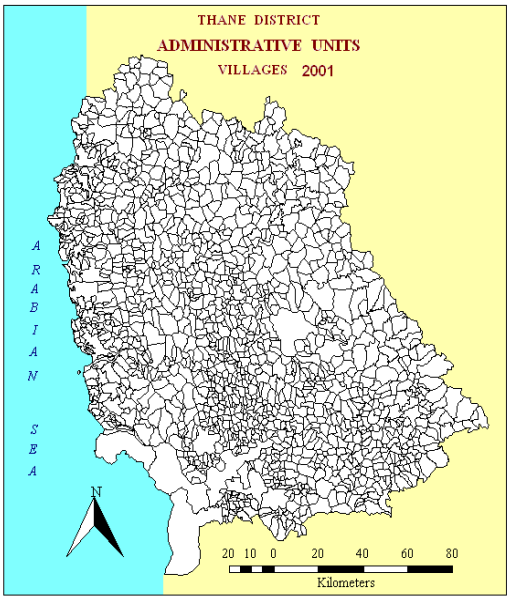


Fig. - 1.1

Sources of Data in The Present Study

The study is based on the use of village as a unit of observation to understand the spatial variation in the agricultural landuse. The temporal aspects are studied at the district level to appreciate the overall picture of changes in agricultural patterns. The investigation excludes the Thane city tahsil being predominantly urban area.

Season and crop reports published by the Government of Maharashtra , formed a major source of data on landuse and cropping patterns at district level.

Data regarding village level agriculture was collected from the Revenue Records at each of the tahsil headquarters.

Annual socio-economic review and district socio-economic abstracts of Thane districts were the sources of data on landuse, cropping patterns, irrigation, population and other economic activities at tahsil level.

District census handbook of Thane district, compiled by the census office Maharashtra, were the other important sources of data on village level population, occupational classes and general land utilization.

Data on some aspects of agriculture, irrigation and transport was collected from the Agricultural Department, Government of Maharashtra, Thane office.

The Grampanchayat offices in the villages and the offices of Talathi provided information regarding distribution of crops, land holding, irrigation wells, general land utilization, population distribution and settlements at village level.

The information relating to the cultivation of crops, crop weather calendar, agricultural practices and farmers input –output budget etc. was collected by the author through interviews with local farmers during his field work in the region.

Other sources of information used in the compilation of the maps are-

i. Census of India 1991, 2001.Census Atlas of Maharashtra.
ii. Maps of Thane District published by the Government of Maharashtra.
iii. Village maps on scale 10cm to 1km (1:10,00,000) prepared by Land Survey and Record office, Thane.
iv. Thane District Planning Map on scale 1cm to 2.5km(1:250000)

Field Work-

In the initial stages of the work, in order to collect the data relating to village level agricultural landuse, all the tahsil headquarters were visited in the year 2009-10. Information was also collected and observations noted while traveling.

In the advanced stages of the research work, sample villages from different crop regions were selected for micro level analysis. These villages were visited by making several trips, to collect and update data and relevant information.

Chapter -II

THE PHYSICAL ENVIRONMENT

A Profile of The Region

The Thane district forms a part of the traditional 'Konkan Plain', lies between $18^0$42' and $20^0$20' North latitudes and between $72^0$37'and $73^0$45' East longitudes, forms a distinct unit covering 9,558 sq. km area and a population of 8,131,849 persons (2001). It accounts for 3.11 per cent of the total area of the state and 8.39 per cent of the total population of the state. It is second most populous district of the state. The district includes 1727 inhabited villages, 21 uninhabited villages and 37 towns. The district occupies the northern-most position of Konkan, lies adjoining the Arabian Sea in the north-west part of Maharashtra state. It's northern limit adjoins the Union territories of Dadra, Nagar Haveli and the state of Gujrat, while the districts Nasik and Ahmadnagar are to its east, Pune to the south-east, Mumbai sub-urban district to the south. (Fig.2.1)

Historical Background:

The available Documentary evidence reveals that 'Thane' was formerly known as Shreesthanak and in ancient times it was an excellent port and commercial centre. From prehistoric times, Thane coast had relations with Egypt, Babylon, Greece and Persia. The carving Ashokas edicts (225 BC) remain the earliest known fact in the history of Thane. An inscription discovered at Kanheri caves, shows that King Rudraman ruled North Konkan i.e. Thane and Coloba during the second century AD. This area was ruled by Mushervan (531-578), and then by Shilaharas for more than 400 years. The Muslims ruled during the period 1300-1500 AD. After them came the Portuguese, the Marathas and then the British.

Since First May, 1960, the district forms a part of Maharashtra state.

Administrative Units :

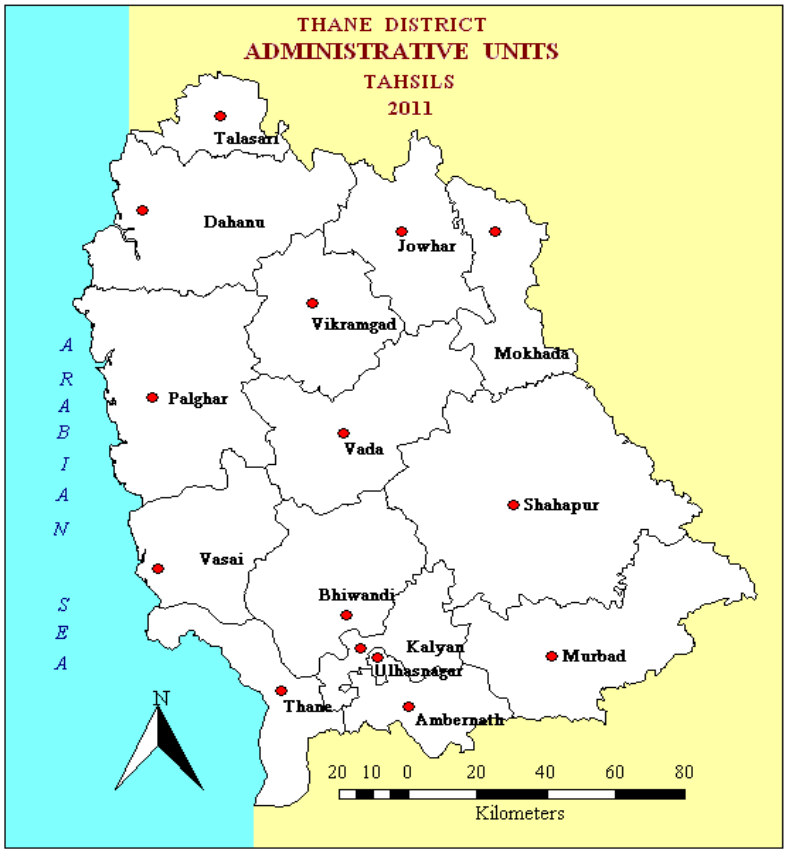
The district has been divided into fifteen tahsils. According to the 2001 population census, there are 37 towns (including Thane city) and 1727 inhabited villages in the district. Out of the district total of 8,131,849 persons, about 72.58 per cent live in the urban areas and 27.42 per cent (2229753 persons) in the rural areas. Detailed information regarding the administrative units i.e. tahsils is given in Table-2.1.

Administrative Units Of Thane District:

Sr.No.	Name of The Tahsil's	Area	Population (2001)
1	Ambarnath		366501
2	Bhivandi		945582
3	Dahanu		331829
4	Javhar		111039
5	Kalyan		1276614
6	Mokhada		67319
7	Murbad		170267
8	Palghar		454635
9	Shahapur		273304
10	Talasari		121217
11	Thane		2486941
12	Vada		142753
13	Vasai		795863
14	Vikramgad		114254
15	Ulhasnagar		473731
Thane District Total			**8131849**

Source: Thane District Census, 2001 Table -2.1

ADMINISTRATIVE UNITS



Map - 2.1

GEOLOGY

The region is underlain by basaltic rocks. Basalt flow forms the predominant formation capped at a few places by laterite at higher levels. A number of hot springs occur in Thane district which have positive relation with the geology of the area. The hill ranges in the area are predominantly aligned north-south and have more or less escarpments.

Basalt flows, popularly known as Deccan traps, forms the predominant formation. It is capped by laterite on a few high plateaus and covered by shore sands along the coast.

A general geological sequence is as follows:

Shore sand- Recent, Laterite-Pleistocene and Basalt-Eocene.

Deccan Traps:

The Deccan trap has been divided into three major groups, i.e. upper, middle and lower. The Bombay basalt flows have been grouped into upper traps on the basis of the inter-trappean and ash beds present in them (Krishnan, 1968). Being in the contiguous area, the Deccan traps in the district can also be grouped with the upper flows.

There are number of dykes criss-crossing the area. The general trend is however, north-northwest south-southeast and north-northeast south-southwest, dipping steeply to the east. The thickness seldom exceeds six meters. The dykes send out off-shoots of different sizes, at places enclosing lenticular wedges of country rock. Chilled margins are seen along dykes flow contact. The dykes vary from coarse dolerite to fine grained basalts. Most of the dykes are porphyritic of feldspars.

Laterite: Few high basalt plateaus of the district are capped by laterites. These are Boundongri ($19^0$10'N: $75^0$57'E) and Bombassadongri ($19^0$11'N: $75^0$57'E) 430 meters, Kanheri ($19^0$13'N: $72^0$58'E) 510 meters, and Tungar ($19^0$26'N: $72^0$55'E) 665 meters hills. The Kanheri and Tungar laterites have conspicuous development of bauxite.

Shore Sands: The sea coast of the district stretching several kilometers along the western boundary is covered by sands.

Thermal Springs: There are about thirty three hot springs which are described under five groups based on their location.

1. ***Vajreshwari Group*****:** i) Ganeshpuri area ($19^0$29'N: $73^0$01'E)-There are thermal springs, most of these occurring on medium to coarse grained dykes.

ii) Akloli area ($19^0$29'N: $73^0$02'E)-Ther is linear cluster of six thermal springs near the left bank of Tansa river. They occur at the eastern margins of fine grained dolerite dykes trending towards east.

2. Sativli Group**:** ($19^0$38'N: $72^0$55'E) There are about six springs in this group. They occur at about a kilometer west of sativli village, near Vadvali.

3. *Haloli group* : ($19^0$40'30"N: $72^0$51'30"E) There are four hot springs at Haloli occurring in a paddy field 0.1 km west of the new highway.

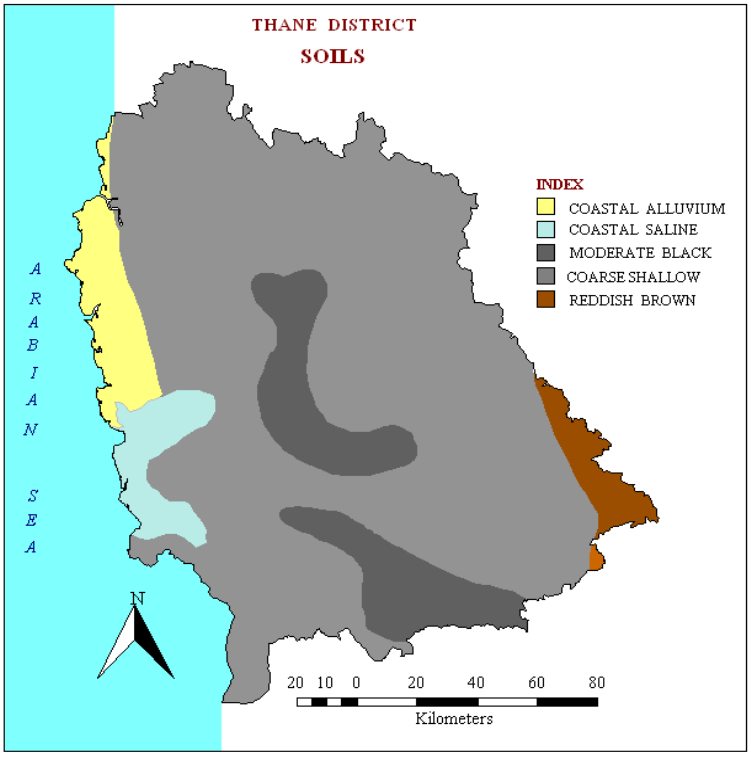
4. *Paduspada springs***:** ($19^0$41'30"N: $72^0$55'30"E) The four springs in this group are seen in the soil covered left bank of Vaitarna river.

5. *Kokner springs* ($19^0$43'N: $72^0$51'E)**:** The three Kokner springs are seen at the right bank of the alluvial embankment six to eight meters high in the dry bed of Surya river.

Most of the thermal springs are seen on the fringe of dykes. The temperatures of the spring vary from 30^0 C to 70^0 C. Most of the springs are of sodium chloride. These waters are proved to have therapeutic values. Most of the springs give out gases from the orifice of the springs at periodic intervals.

Economic Mineral Deposits: i) ***Bauxite Deposits***: Tungar plateau is the most promising of all the aluminous laterites reported in the district. The plateau rises to an elevation of about 665 meters and is situated about 14.5 kilometers north-west of Bassein ($19^0$20'N: $72^0$48'E).

ii) *Common Salt*: Common salt is collected in artificial evaporation pans along the coast. It is thriving industry.



Map - 2.2

PHYSIOGRAPHY / RELIEF FEATURES

The relief features of the region presents the steep scarps of the Sahydri in the east, the land of the district falls through a succession of plateaus in the north and centre of the district to the Ulhas valley in the south centre. These lowlands are separated from the coastal flats by a fairly well defined narrow ridge of hills that runs north-south to the east of the Thane creek, maintaining a remarkable parallelism to the shore at a distance of about six to ten kilometers from the shores. A number of isolated hills and spurs dot the entire district area, so much so that the district as a whole in its aspects is hilly.

The Sahyadri **:** The western steep slope of the Sahyadri, falling from the crestal plateaus and high peaks, as well as the foothills lie within the limits of the district.

Passes **:** From the northern limits, adjoining the Gujrat border, till reaching the Thal Ghat, the Sahyadri is subdued in relief, and nowhere, elevations exceed 600 meters. There is no well marked physical barrier between Nasik and Mokhada taluka of this district and a number of ghat passes have been traditionally used as routes between villages in the plateau and this district.

Off-shoots **:** A number of spurs shoot off from the Sahyadri west-wards into Thane lowlands and plateau. Most of them are narrow, rarely more than two kilometers wide, with steep slopes on either side and often rising to considerable levels, rather abruptly, above the floor level of the plateau. Many of them carry on their crests, small plateaus, often forest clad and of difficult access. This type of a hill, range country, with intervening deep gorges of stream valleys, is at its best seen in the central part of Wada and Jawhar talukas ; it presents a memorable picturesque landscape clothed in green soon after the monsoon.

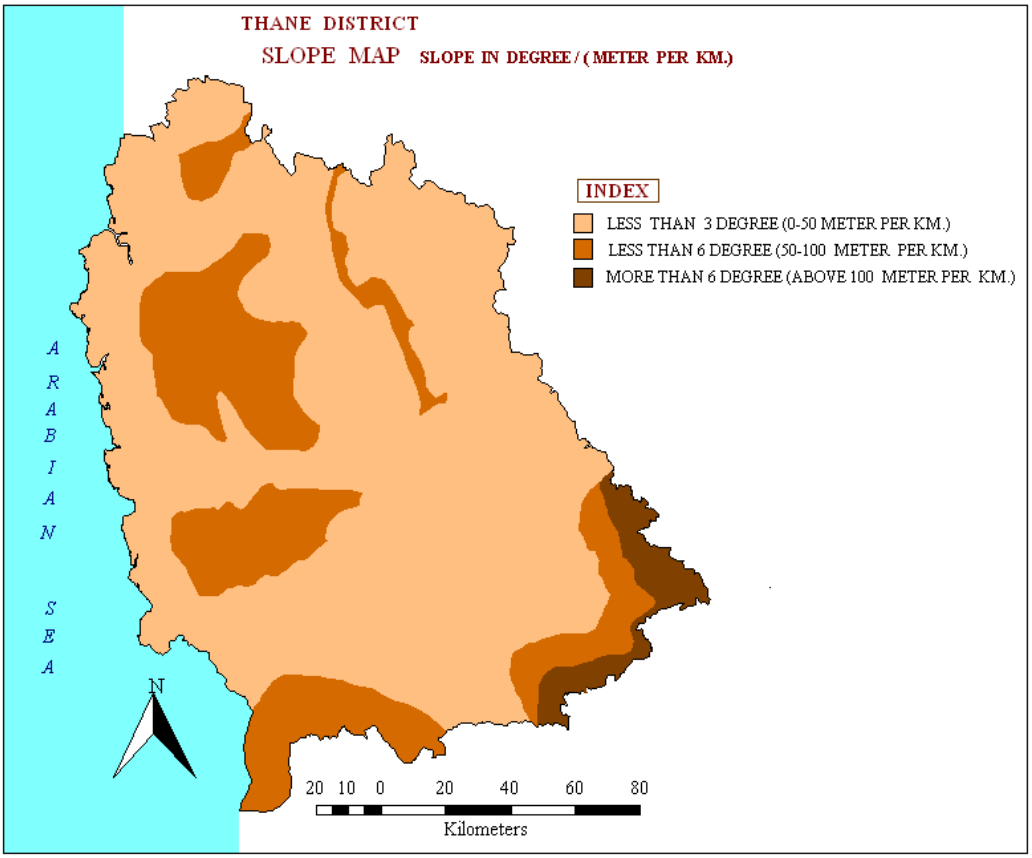
Coastal Ranges **:** The most rugged terrain of the district is a belt about 15-25 kilometers broad that runs parallel to the coast at a distance of 15-20 kilometers from the shore. In the south of these tracts are the hills of the Salsette island that form the core and rise to the highest elevation of 462 kilometers at Kanheri and Avaghad and further north in Kamandurg and Tungar hills of Bassein.

Interior Hills **:** Further inland to the north east of the Manor is the semi-circular hill of Pola with its peaks Adkilla and Asheri. About thirteen kilometers south of Manor, across the Vaitarna from Keltan

and Takmak stands the solitary fortified hill of Kohoj rising abruptly from the plains and visible over considerable distances from all around.

Between this rugged terrain and the Sahyadri in the east, the country is comparatively level, broken by few hills. Of these, the western-most hill in Wada is Davja with its two spurs. Smaller hills in Wada are Kapri in the east, Indagaon hills in the north-west, and Ikna and Domkavla hills in the south-east border. About seven kilometers north-east of Shahapur the long flat-topped mass of Mahuli (849 meters) rises like a great block of masonry. The sides of the hills are richly wooded but the laterite-capped top has only a poor stunted vegetation mostly of hirda (Terminalia chebula). North of this, Bhopatgad is crowned with a fort which overlooks Kurlod on the north of the Pinjal river and rises about 170 meters above the general level of the neighboring high country. From the east, the ascent is about 170 meters from the west; it is about 500 meters for its slopes form the face of the Mokhada tableland.

The Southern Hills: In the south, the country is far from level. On the west, the Parsik range runs from Panvel creek northwards and ends abruptly with a cliff face overlooking the Ulhas near Mumbra. Its highest elevation is Dophora peak (405 meters). The curved range of Chanderi stretches from the long level back of Matheran, west to the quaintly cut peaks Tavli and Bava Malang (791 meters) along southern limits of the district. About every twenty kilometers to the north-east, near Bablapur is Muldongri hills.



Map - 2.3

The Plateaus **:** Between the coastal range, the hills and Sahyadri scarp the whole country is a succession of plateaus descending from the sahyadri, step by step and separated from the next lower down with a well-defined scarp face. In the north-east at an elevation of about 300-400 meters is the Jawahar-Mokhada plateau that descends down further west to the Wada plateau at an elevation of about 150-300 meters. The Wada plateau is separated from the coastal lowlands of Palghar and Dahanu by the double range of hills that runs about 15-25 kilometers from the coast, enclosing within it the Surya and the Vaitarna valleys. South-east of the Wada plateau is the Shahapur upland at an average elevation of 300 meters which in the west falls to the Bhiwandi lowland and in the south to the narrowly entrenched Bhatsai-Kalu valleys. In the

south-east of the district is the Murbad plateau at an elevation of less than100 meters.

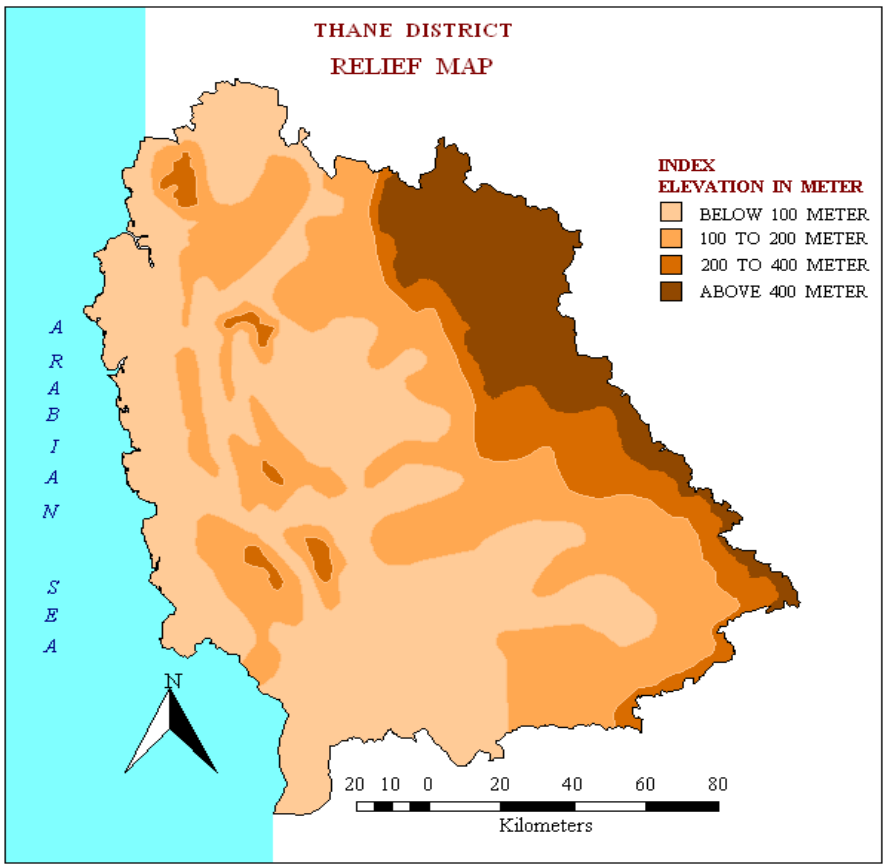
The plateau country locally is dotted with low mounds and ladges that are best seen along the railway line from Kalyan to Kasara.

The Coast **:** To the west, the district of Thane has a fair coast-line, about 100 kilometers long. The coast naturally falls into two sections to the north and south of Vaitarna estuary. Then the south, the great gulf that runs from the north of Kolaba to Bassein, must in recent time have stretched far further inland than it now stretches. Idrisi description of Thane (1153 A.D.) that it stands on a great gulf where vessels anchor and from which they set sail, may have been adequately deep when sea filled the marsh through which the Thane creek now runs towards Bhivandi and Kalyan and where the wide tracts are now half dry. As late as the beginning of the 19th century, Salsette comprised a number of islands. Within three to five kilometers of the Vaitarana estuary formed the islands of Basssein. The backwater that separated this strip of coast from the mainland opened south-westward into the Bassein creek forming the Sopari creek on which stood the celebrated fort of Sopara Ptolemy. In-between the Vaitarana and Ulhas mouths, island were formed once by the branches of the Bassein creek that ran up to Bhivandi. In the south, the Thane creek was once a broad belt of sea with a number of islands like the Gharapuri, Butcher islands and Karanja, dotting it. Many of these islands have now become a continuous mass of land extending as peninsulas from the mainlands. On the whole, the coast here presents the appearance of considerable submergence. However, geologically the coast is not without its variety. The present coast from Bandra to Dahanu is a constant alternation of bays and rocky headlands with sand spits, dunes and bars in protected reaches behind headlands. Along the

coast, in the neighbourhood of Manori and further north, as far as Dahanu, raised beaches made of littoral concrete have been recognized, running north-south close to the present shores and not very high above the present sea level.

North of the Vaitarana estuary, the shores are flat, with long sandy beaches and spits running into muddy shallows; the creeks and streams are at best small inlets divided by wide wastes of salt marshes tracts of slightly rising ground in-between covered by palms, fruit orchards and casurina. This landscape stretches to the foot of the hills that lie a few kilometers away and rise abruptly to sufficiently high elevations to mask off the flatness of the low ground. All along the coast, the dreary salt marshes are being steadily reclaimed as salt pans and rice flats.

Islands **:** There are number of islands along the sea-margins of the district. The most important of these is the group of Mumbai islands, overlooking Uran and Panvel of Kolaba district on the mainland. In the Bassein tahsil, at the entrance to the Vaitarana estuary lies the island of the Arnala containing a well preserved fort.



Map - 2.4

Rivers :

The rivers of the districts mainly belong to two river streams of North Konkan, namely the Ulhas and the Vaitrana, both draining the rainy western slopes of Sahyadri that lie between the Bhor and the Thal Ghats. There is much similarity in their courses. Dashing over the black scarp of the Sahyadri,.

The Vaitarana **:** The Vaitarana, the largest of Konkan rivers, rises in the Tryambak hills in the Nasik district., opposite the source of the river Godavari, and enters Thane at Vihigaon near Kasara, after passing through a deep gorge while descending the plateau top to the Konkan lowland. For about forty kilometers the Vaitarana flows west through a deep defile among high hills. From Kalambhai at the eastern border of Vada, the river flows for about thirty kilometers west across a more or less level country, till near the ancient

settlement of Gorha , the great spurs of the great Takmak range drives its course north-west for about sixteen kilometers till it flows past settlement of Manor. Within three kilometers of Manor, the stream meets the tidal wave and is navigable for small crafts. Near Manor, the river after skirting the northern spur from Takmak, flows initially south-west for about ten kilometers and then to the south for twenty kilometers before sharply turning to the right, and for the last twelve kilometers west to enter the sea through wide estuary off Arnala. In the last stretch of thirty kilometers the Vaitarana passes through a country of great beauty in-between two ranges and has a fine broad river which in many places has a good depth of water and a fairly flat-bottomed valley with meander terraces on either side.

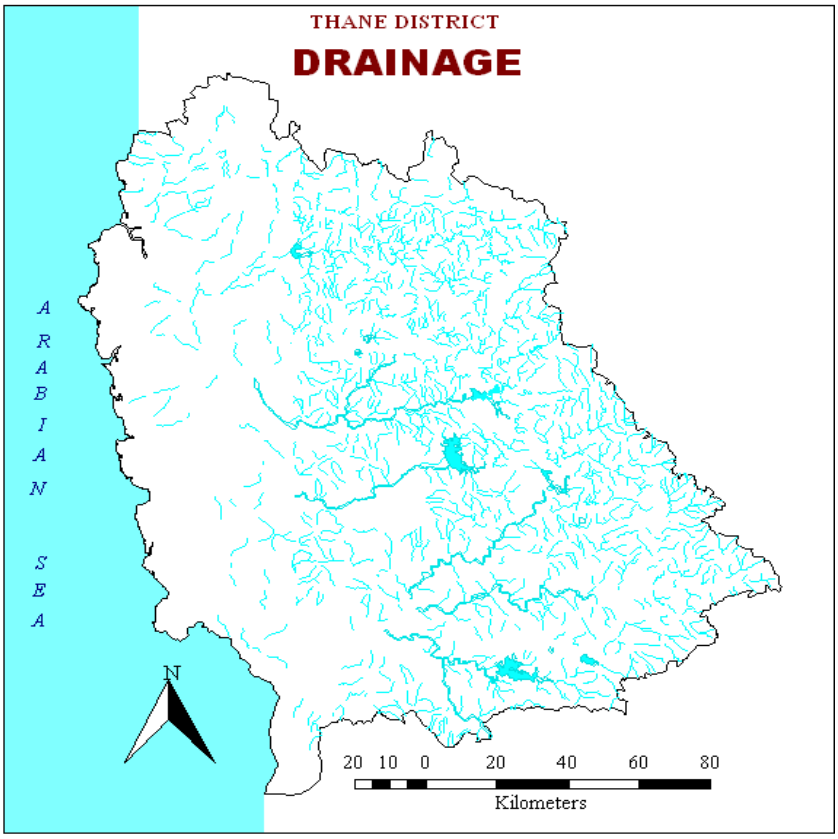
The Vaitarana is 154 kilometers long and has a drainage area that practically covers the northern sections of the district. It has a number of tributaries, the most important of which are the Pinjal, the Surya and the Tansa.

The Ulhas : The Ulhas rises north of Tungarli near Lonavala, has initially a southerly flow and then west for a short distance before it descends the scarp slopes of the Sahyadri near Bhor Ghat through a succession of two leaps of water-falls each about 80-90 meters in height. Then a short distance of about ten kilometers it flows north through a deep gorge that is picturesque and extremely well wooded with sheer cliff walls that in many sections fall through a height of 300 meters. Then it has a gentle northerly flow and enters this district at the southern border near Vangani railway station. In this district, the river has a northerly course skirting the Matheran ridge initially through Ulhasnagar tahsil until near Kalyan it is joined by the combined flow of the Kalu and the Bhatsai and the river turns west to enter through a gap to the north of Parsik range into

the Thane creek. In this section between Thane and Bassein, the river flows through a highly varied hill and forest country and is known as the Bassein creek. Ptolemy knew this as the Binda river, probably from the name Bhivandi.

The river has many tributaries, the two most important of them being the Kalu and the Bhatsai. It has practically no tributary joining it on the left bank, as it skirts the edge of the Matheran range over most of its course.

***Creeks* :** All along the coast are found many small creeks, in which tidal water flood upstream and inundate much low ground; human interference in many cases has helped in converting them into mud flats. Of these, mention can be made of the Bhivandi, Chinchani, and Dahanu creeks. The Sopara creek in the bygone days was an important artery of sea-traffic bringing Arab dhows and Greek sailing vessels to the now forgotten Sopara, that was a celebrated port. The Thane creek is not a creek in the true sense, but a depression engulfed by the sea. Its shallowest point is just south of Thane where a ridge of rocks affords the foundation for the railway bridge.



Map - 2.5

CLIMATE

The climate of this district is charecterised by high humidity nearly all the year round, an oppressive summer season, and well distributed and heavy rainfall during the south-west monsoon season. The year may be divided into four seasons. The cold season from December to February is followed by the summer season from March to June. The south-west monsoon is from June to September. October and November constitute the post-monsoon season.

Thane District Annual Rainfall and Total Rainy Days

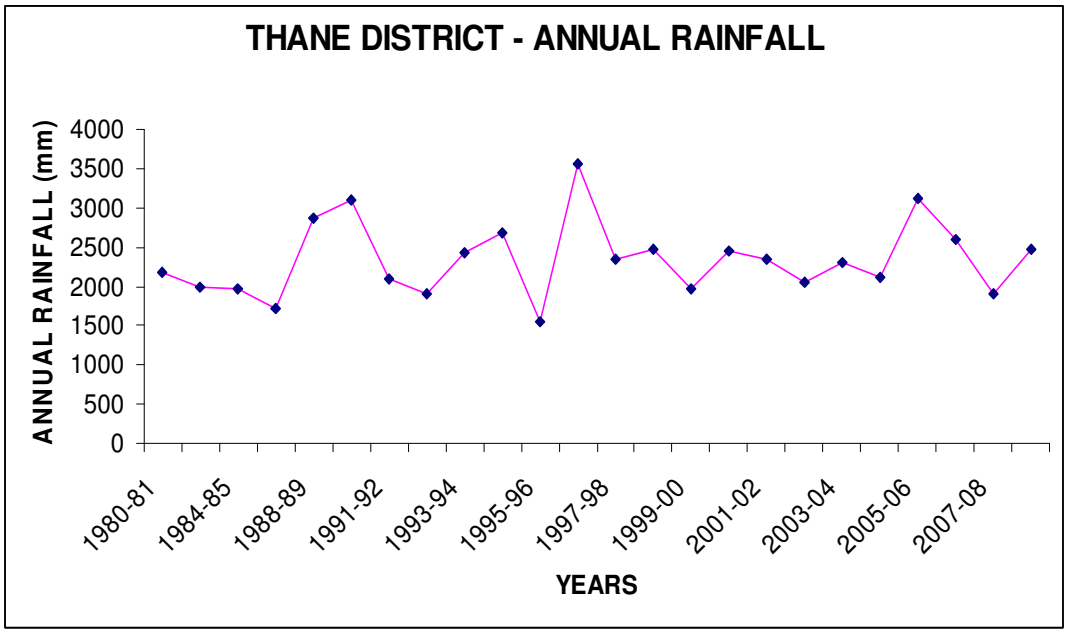


Fig. 2.1

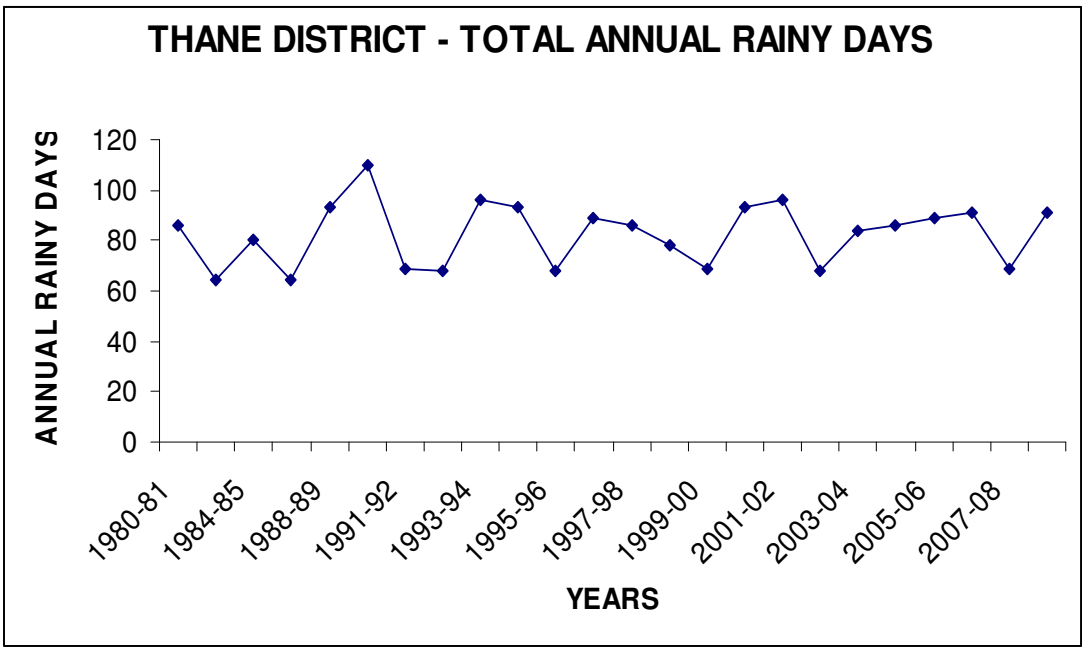
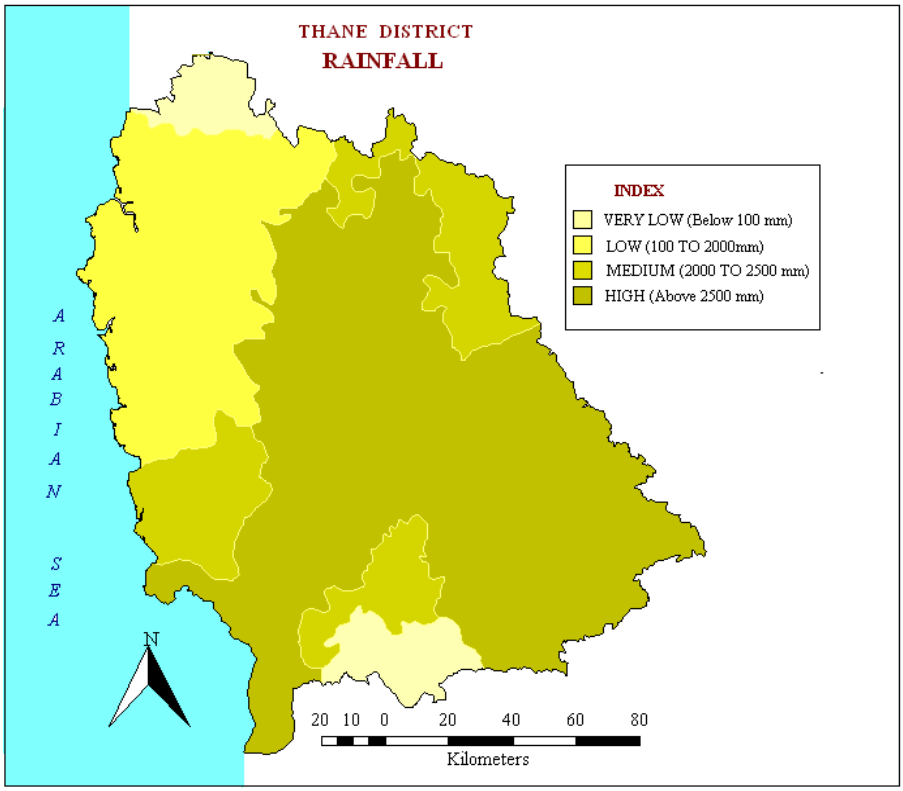


Fig.2.2

Source: Season and Crop Reports for the respective years Commissionerat of Agriculture, Pune, Government of Maharashtra. And Agricultural Research Centre, Palgher, Dist. Thane, Govt. of Maharashtra.



Map - 2.6

***Rainfall*:**

Records of the rainfall in the district are available for ten stations for periods ranging from fifty years. The details of the rainfall at these stations for the district as a whole are given in table No. 2.2. The average annual rainfall in the district is 2293.4mm . The rainfall in the district increases from the coast towards the interior. The rainfall varies from 1730.5mm at Mahim at the coast to 2588.7mm at Shahapur in the interior. The rainfall during the south-west monsoon season, June to September, constitutes about 94 per cent of the annual rainfall. July is rainiest month with a rainfall about 40 per cent of the annual total. The variation of the annual rainfall from year to year in the district is not large. In the fifty year period, 1901 to1950, the highest annual rainfall in the district amounting to 142 per cent of the normal occurred in1931, while 1905 was the year with the lowest annual rainfall which was only 56 per cent of the

normal. In the same fifty year period the annual rainfall in the district was less than 80 per cent of the normal in seven years, two being consecutive. Considering the rainfall at the individual stations, two or three consecutive years of such low rainfall occurred once at eight out of the ten stations during this fifty year period. It will be seen from table - 2.2 that the annual in the district was between 1800 and 2800mm in thirty eight years out of fifty.

On the average there are 83 rainy days (i.e., days with rainfall of 2.5mm or more) in a year in the district. The number varies from 67 at Mahim on the coast to 92 at Thane. The heaviest rainfall recorded in 24 hours at any station in the district was 481.1mm at Dahanu on 1st September1958.

Temperature **:** There is a meteorological observatory in the district at Dahanu. The records of this observatory may be taken as fairly representative of the meteorological conditions in the district. But in the interior parts of the district, temperatures are likely to be slightly lower in the cold season and higher in the hot season than at Dahanu. Being a coastal district the variation of temperature during the day and between the three seasons is not large. After February temperature progressively increase till May which is the hottest month with the mean daily maximum temperature at 32.9^{0}C. In the summer season and in June before the onset of the monsoon day temperature may sometimes go above 37^{0}C in the coastal parts while in the interior it may be a couple of degree higher. The oppressive heat is on most days relieved by cool sea breezes particularly in the coastal regions. The afternoon thunder-showers on some days during the hot season also bring welcome relief. On the onset of the south-west monsoon by about the first or second week of June the temperature decreases a little. From about beginning of October when the south-west monsoon withdraws day

temperature increases, and in October and November days are nearly as hot as in the summer, while nights become progressively cooler. After November, temperature decreases and in January which is the coldest month, the mean daily maximum temperature is 27.7^{0}C and the mean daily minimum 16.8^{0}C. In the cold season cold wave sometimes affect the district when the night temperature may go down to less than 10^{0}C.

The highest maximum temperature recorded at Dahanu was 40.6^{0}C on 19th April 1955 and lowest minimum was 8.3^{0}C on 8th January 1945.

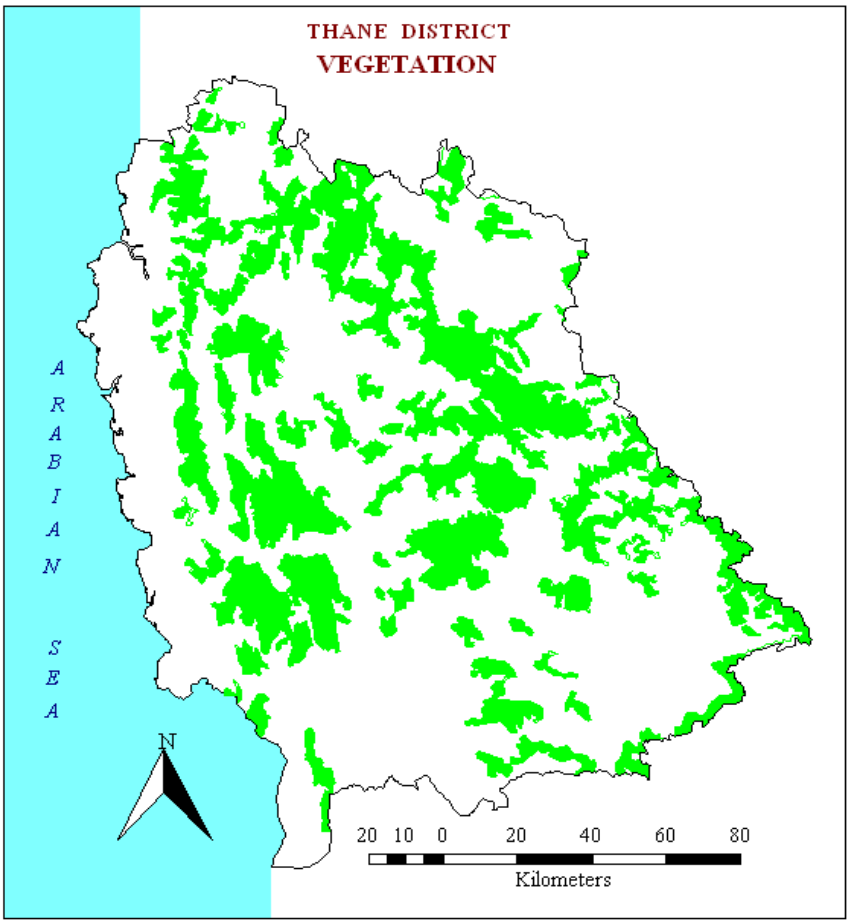
Humidity **:** Owing to the proximity of the sea the district is on the whole very humid nearly all the year round.

Cloudiness **:** During the south-west monsoon season the skies are heavily clouded to overcast. In the rest of the year skies are clear or lightly clouded.

VEGETATION :

The Thane forests are one of the valuable and well-preserved forests in Maharashtra. The forest area occurring in the district does not consist of single block, but are scattered all over the district. They are mainly situated on the steep Western Ghats on the spurs, ridges and out layers extending from the ghats.

For the purpose of administration, the district forest area is divided into four divisions, viz., I) Thane, II) Dahanu III) Shahapur and IV) National Park, Borivali.


THANE DISTRICT
VEGETATION
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Kilometers

Map - 2.7

Rainfall in Thane District

Year	Jan	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total Rain Fall	Total Rainy Days
1980-81	-	-	1.5	2.3	25.1	536.1	722.7	694.31	172.4	17.3	4.4	-	2176.11	86
1982-83	-	-	-	-	11.2	334.3	931	559.2	85.5	-	67.5	-	1988.7	64
1984-85	-	-	-	-	-	506.1	994.5	212.3	240.6	10.4	-	-	1963.9	80
1986-87	-	-	-	-	-	734.7	409.6	473.9	80.1	6	12.7	7.4	1724.4	64
1988-89	-	-	-	1.7	-	413.9	1410.2	464.3	540.5	46.8	-	-	2877.4	93
1990-91	-	-	-	-	112.9	928.4	558.6	1017.6	400.6	71.1	-	-	3089.2	110
1991-92	-	-	-	-	-	790.6	930.1	323.9	47.5	-	-	-	2092.1	69
1992-93	-	-	-	-	-	110.9	510.3	967.4	313	-	-	-	1901.6	68
1993-94	-	-	-	-	-	378.4	901.5	434.3	596.6	114.4	-	-	2425.2	96
1994-95	-	-	-	--	-	418.4	1207.8	595	415.6	21	15.1	-	2672.9	93
1995-96	-	-	-	-	-	58.6	805.6	350.9	265.8	63	-	-	1543.9	68
1996-97	-	-	-	-	-	476	1668	849	304	265	-	-	3562	89
1997-98	-	-	-	-	-	468.21	901.47	547.21	386.9	-	52.2		2355.99	86
1998-99	-	-	-	-	-	330.1	697.2	629.9	575.21	212	21.3	-	2465.71	78
1999-00	-	-	-	-	16.5	473.9	722.7	241.5	320.8	189.4	-	-	1964.8	69
2000-01	2.3	-	-	-	11.8	597.31	655.91	859.21	260.6	61.1	-	2.3	2450.53	93
2001-02	0	1.1	0.1	-	0.4	664.8	772.8	647.1	200.5	67.2	1	-	2355	96
2002-03	-	-	-	-	-	1002.76	139.97	856.8	47.37	-	-	-	2046.9	68
2003-04	-	-	-	-	-	605.6	934.2	451.6	305	11.4	-	-	2307.8	84
2004-05	-	-	-	-	12	261	703.2	1022.1	85	39.9	0.6	-	2123.8	86
2005-06	-	-	11	-	-	498.6	1169.9	1077.2	278.6	88.2	-	-	3123.5	89
2006-07	-	-	-	-	-	402.11	994.6	746.8	379	81.2	-	-	2603.71	91
2007-08	-	-	-	-	-	399.8	681.4	485.2	322.8	-	10.4	-	1899.6	69
2008-09	-	-	-	-	-	569.2	997.24	754.1	97.2	40.12	12.89	-	2470.75	91

Source: Season and Crop Reports for the respective years Commissionerate of Agriculture, Pune, Government of Maharashtra. And Agricultural Research Centre, Palgher, Dist. Thane, Govt. of Maharashtra.

Table - 2.2

Physical Regions

While studying the spatial variations in agriculture, one must pay particular attention to two basic sets of relationships; those between physical environment and agricultural patterns, and those between cultural environment and agricultural patterns. In order to analyze the influence of physical environment upon the agricultural patterns, the areal unit of study has to be a physical region. The administrative units like tahsil can not be considered for various reasons. Firstly, the data collected and published by the Government and other bodies are confined to the administrative units, the statistics for such units are generally averages. Secondly, the limits of agricultural practices and crop distributions may not necessarily correspond with the limits of administrative units like tahsil. Therefore a scheme of village based data on all the important physical and socio-economic elements. Initially the district is divided in to four physical regions according to relative relief map. In the second stage of regionalization, a soil map of the district, depicting five broad soil types (coastal alluvium, coastal saline, coarse shallow soils, moderate black and reddish brown) was superimposed on the relative relief.

These physical regions provided a basic frame used for the analysis and evaluation of the different parameters of physical and cultural environment along with their influence upon the agricultural landuse in the district.

CHAPTER-III

SOCIO-ECONOMIC SETTING

After unfolding the background of physical setting of the Thane District in earlier chapter pertaining to climate, soils, and relief structure, it would be relevant to understand the role of socio-economic aspects in shaping agricultural landuse pattern in area under study. Both the physical and socio-economic variables exert their impact on agriculture practice and its production. Jasbir Singh and S. Dhillon (1987) have rightly stressed the necessity for the evaluation of socio-economic variables in terms of inputs involved in agriculture sector that have been ultimately forming landuse pattern and yield per hectare. The present study, therefore, is significant in this respect.

The data related to population in 1991 and 2001 have been collected from Thane District Census Handbook. Area under irrigation has been obtained from Land Records of taluka. The elaboration of land holding is entirely based on sample surveys during the field work.

POPULATION:

Agricultural landuse is the end product of human response to physio-socio-economic as well as technical and organizational factors. The landuse is constantly modified by man according to his requirements. These modifications must be studied with the various aspects of population; its distribution, growth, demographic characteristics and occupational structure. The population is an important resource from economic point of view for the regional development of agriculture as it influences the economic activity and determines the level of consumption and agriculture force. It also forms the workforce, namely, cultivators, agricultural laborers. The

relation between population and landuse is reciprocal, e.g. the changes in land utilization. Population pattern influences the utilization of the land and the latter with changes in the agricultural controls to a great degree also determines the pattern of farm population (Singh 1974)

The population of Thane District is 8131849 persons (2001 census). It accounts for 8.40 percent population of the Maharashtra state. The average density of population in the area under study is 442 persons per sq. kms.

The variation in the population is largely resource oriented, varying with the productivity of land, urbanization, and the degree of the industrial development. The region has shown consistent growth of population from the year 1931 to 2001.

The population data pertaining to growth is not readily available for Thane district. Therefore, investigator has obtained the population data from Thane District Census Handbook and Thane District Gazetteer. The table 3.1 shows the population since 1951 with its decadal variations and percentage of growth.

Population Growth and Decade Variations:

Years	Population	Decade variation	Growth (In percent)
1901	665326	-	-
1911	721323	55997	+8.42
1921	713228	-8095	-1.12
1931	787664	74436	+10.44
1941	882321	34657	+12.02
1951	1282572	400251	+45.36
1961	1652676	370104	+ 28.86
1971	2281664	628988	+ 38.06
1981	3351561	1069897	+ 46.89
1991	5249126	1897565	+ 56.62
2001	8131849	2882723	+ 54.92
From 1901 - 2001		7466523	+1222.23

Source: District Census Handbook. Table - 3.1

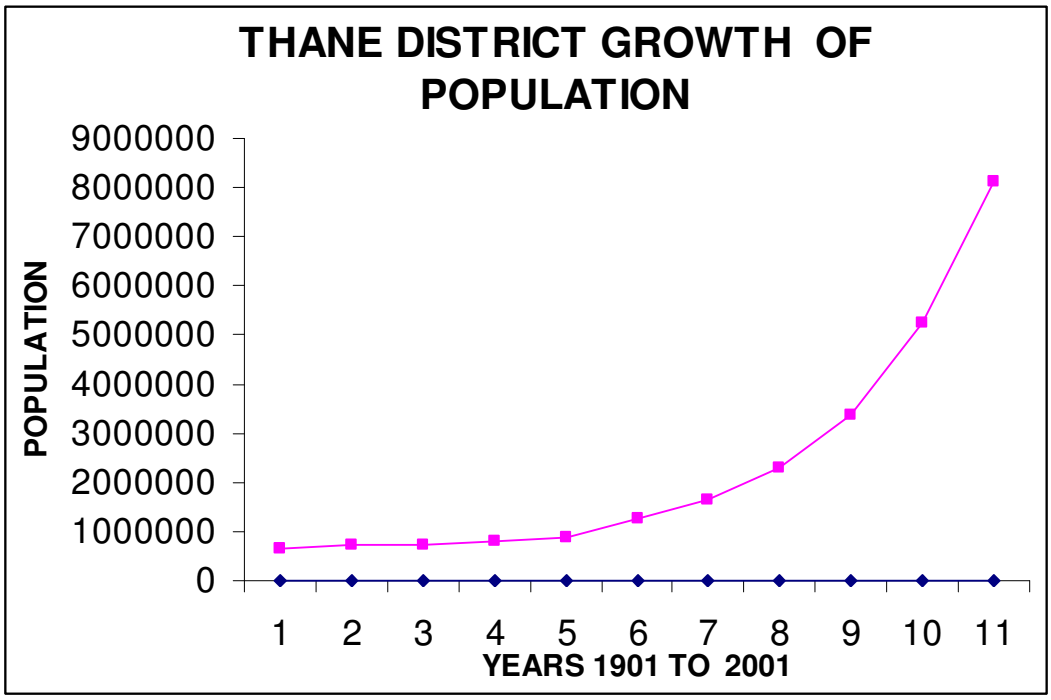


Fig. - 3.1

It is observed from the above table the population of Thane district has been steadily increasing from 1931 to 2001. The population in the district in 1931 was 665326 persons which increased to 8131849 persons in 2001. The total increase in population during the above period is 7466523 persons.

However from 1951 onwards the population increased at a high rate. It has increased by 45.36 per cent in 1951 and 54.92 percent in 2001.

DENSITY OF POPULATION:

This aspect has been studied in order to understand the regional variations in the population density and its influence on agricultural landuse. The population density values were calculated as ratio of total population to total area.

THANE DISTRICT DENSITY OF POPULATION (1901 – 2001)

Years	Population	Area in hectares	Density (Persons per Hundred hectare)
1901	665326	918469	72
1911	721323	918469	78
1921	713228	918469	77
1931	787664	918469	85
1941	882321	918469	96
1951	1282572	918469	139
1961	1652676	918469	180
1971	2281664	918469	249
1981	3351561	918469	365
1991	5249126	918469	571
2001	8131849	918469	885

Source: Compiled by Author. Table -3.2

The population density value was calculated as ratio of total population to the total area from 1901 to 2001 and is shown in Table. 3.2

The above table indicates that the density of population in the region has been increasing since 1901 from 72 persons per hundred hectares to 885 persons per hundred hectares in 2001. The density of population increased threefold during ninety years. During the period from 1901 to 1941 the density shows low rate of increase (less than 10 persons per hundred hectare), while highest density observed in the decade 1991 to 2001 (more than 800 persons per hundred hectare in the district).

Rural Population

According to the 2001 Census, there are thirty seven towns and 1748 villages in the district. About 22.29 million people live in rural areas and 59.02 million in the towns. In rural areas most of the population is observed to be concentrated in the villages of population size from 500 to 10000 (table 3.3), while the proportion of population living in the villages of sizes below 200 and above 10000 is insignificant. Percentage of population living in villages of various population sizes groups with reference to total Rural Population is shown in Table No. 3.3.

Population Size	Per cent of Population
Less than 200	1.11
200 – 500	6.87
501 – 1000	15.21
1001 – 2000	24.56
2001 – 5000	29.81
5001 – 10000	14.33
Above 10,000	8.11

Table 3.3

THE SPATIAL DISTRIBUTION OF POPULATION DENSITY

Population density values were calculated as ratio of total population to total area (hectare) and which is represented in the choropleth map.

(Fig.3.1). In 1991, the density of population was low (below ten persons per hundred hectare) along the eastern margins of the district. The lowest density (ten persons per hundred hectares) is recorded in the extreme eastern part and north eastern corner of Thane District. Low density also recorded at the south eastern part and middle hilly region. This entire belt comprises hills, plateaus, narrow valleys and has very heavy rainfall (over 2000 mm).

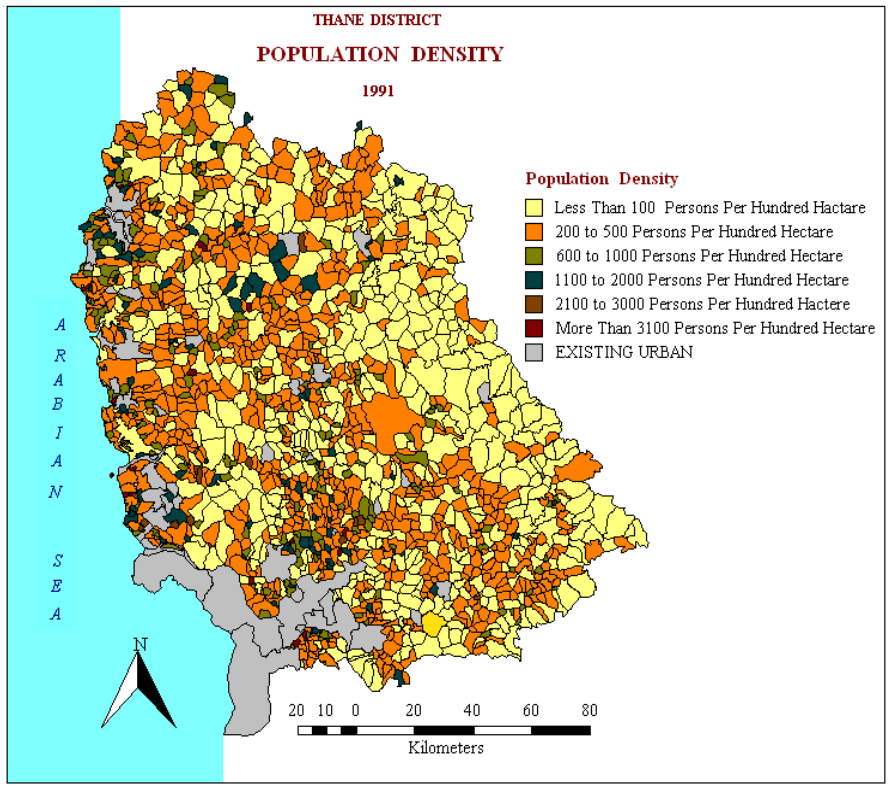
On the western side of this low density zone, population density is increasing gradually. Density of 200 to 500 persons per hundred hectares is observed over most of the remaining part of the district. Comparatively higher density values (above 600 persons per hundred hectare) are observed near urban centers and Thane city. Highest density (more than 1000 persons per hundred hectares) is observed in the south western and western part of the district. These high density areas reveal the influence of major central places and that of the important administrative and industrial centres like Thane. A third belt of high population density is observed along the western margin of the district i.e. along the coast of the Arabian Sea. Location of high density belt in this area is mainly the result of availability of irrigation to the rich agricultural lands along the coast.

The pattern of population density distribution in 2001 is similar to that of 1991. In 2001 the low density belt (lowest is 100 persons per hundred hectare) has retreated to middle region and is now located

in the area of east and north east. The area between the west coast and eastern margins of hilly tracts show medium density (100-200 persons per hundred hectares). A southern and south western transitional zone displays high density of population. The highest density of population (more than 300 persons per hundred hectares) is observed along the western coast.

The population density pattern in 2001 shows much deviation from that of the 1991. The growth of large and medium sized central places (North West and north east of Thane and those along the Arabian Sea coast) Along with the industrial growth of Mumbai Metropolitan region has been responsible for the overall increase in population density. Highest population density (300 persons per hundred hectares) is observed along the west coast and lowest density (100 persons per hundred hectare) in the eastern hilly regions where the continuous low density belt of 1991 and 2001 has broken into three patches.

The density of population in relation to the total cultivated area was calculated for the year 2001. It varies from west to east (Fig 3.2). At the western coast some places close to urban areas the values are above 1000 persons per hundred hectares of cultivated area. The transitional zone and the western coast have medium density values between 20 to 50 persons per hundred hectare whereas the middle plateau region shows lower density values (below 10 persons per hundred hectare). The spatial variation in the density pattern is closely related to the availability of land for cultivation.


THANE DISTRICT
POPULATION DENSITY
1991
Population Density
Less Than 100 Persons Per Hundred Hactare
200 to 500 Persons Per Hundred Hectare
600 to 1000 Persons Per Hundred Hectare
1100 to 2000 Persons Per Hundred Hectare
2100 to 3000 Persons Per Hundred Hactere
More Than 3100 Persons Per Hundred Hectare
EXISTING URBAN
ARABIAN SEA
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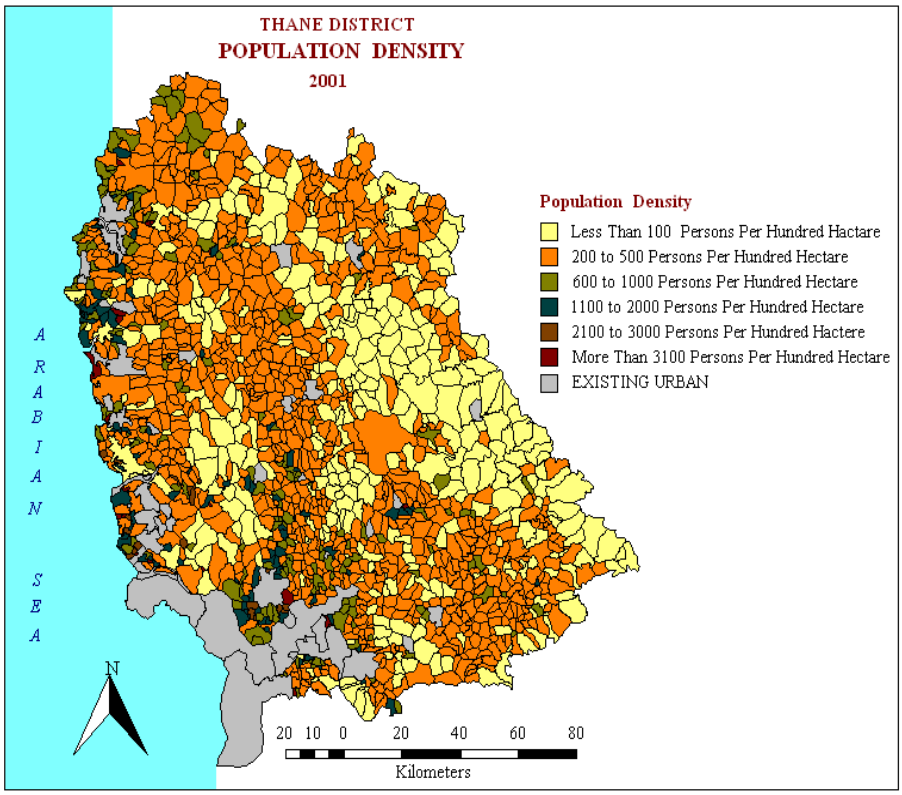
20 10 0 20 40 60 80
Kilometers

Map - 3.1


THANE DISTRICT
POPULATION DENSITY
2001
Population Density
Less Than 100 Persons Per Hundred Hactare
200 to 500 Persons Per Hundred Hectare
600 to 1000 Persons Per Hundred Hectare
1100 to 2000 Persons Per Hundred Hectare
2100 to 3000 Persons Per Hundred Hactere
More Than 3100 Persons Per Hundred Hectare
EXISTING URBAN
ARABIAN SEA
N
20 10 0 20 40 60 80
Kilometers

Map - 3.2

OCCUPATIONAL STRUCTURE:

In a developing country like India, the total availability of labours (as a human resource) and its division over different economic activities can be considered as a measure of the overall economic development. The availability of labour resources and its involvement in various activities in agriculture represent the scenario of development of the region. The district has engaging 39.10 percent population as working force (2001). The population can generally, be grouped into two groups a) Working population and b) Non-working population.

The working population owes special significance as it is directly involved in economic productive activity. The proportion of population, demographic characteristics and economic composition has a bearing on the landuse pattern (Forasat Ali Siddiqui, 1988).

As per definition main workers are those who are engaged in economic productive activity for a major part of the preceding year (at least six months or 180 days), while marginal workers means, those who worked for some time but not for the entire year.(census of India,2001).

The planning commission organization has suggested two types of working population.

I) Main workers and

II) Marginal workers.

The main workers have been again grouped into four sub groups as follows:

1) Cultivators
2) Agricultural labourers
3) Workers engaged in household industry, and

4) Other workers who are engaged in other activities such as trade and transport.

In the Thane district total number of workers is 3179981 (39.10 percent to total population). The main workers and marginal workers account for 76.31 per cent and 23.69 per cent to total workers (2001) respectively. Table 3.2 shows the population structure and Table 3.4 exhibits in occupational structure for 1991 and 2001 in the Thane district.

The occupational structure in the district has been studied under four groups as follows.

1. Percentage of total workers to total population.
2. Farm workers to total workers.
3. Percentage of cultivators to farm workers and
4. Percentage of agricultural labourers to farm workers.

OCCUPATIONAL STRUCTURE

(1991 And 2001)

Sr. No.	Categories	1991	% of total population	2001	% of total population
1.	Total population	5249126	100.00	8131849	100.00
2.	Total workers	1961704	37.37	3179981	39.10
3.	Cultivators	402934	7.67	388645	4.77
4.	Agricultural Laborers	200327	3.81	306643	3.77
5.	Farm workers	603261	11.49	695288	8.55

Source: Compiled by Author Table - 3.4

VARIATION IN THE OCCUPATIONAL STRUCTURE

(Year 1991 and 2001)

Sr. No.	Categories	Years		Increase/ Decrease
		1991	2001	
1.	Percentage of total workers to total population.	37.37	39.10	+1.73
2.	Percentage of cultivators to farm workers.	66.79	55.89	-10.90
3.	Percentage of Agricultural labourers to farm workers.	33.20	44.10	+10.90
4.	Percentage of farm workers to total workers.	11.49	21.96	+10.47

Source: Compiled by Author. Table - 3.5

The temporal variation in the ratio of working force to total population thus reveals the gravity of the problem of ever growing population pressure on land causing unemployment and under employment.

Besides agriculture, the next important economic activity in the district is manufacturing, employing 22.22 percent of the work force (Maharashtra 26 per cent), followed by other services, like trade and commerce, transport and communication, livestock, forestry and mining and quarrying. The rural areas exhibit similar trend but in the urban Thane district, other services like, (33.32 per cent), trade and commerce (14.25 per cent) transport and communication, construction, agriculture, livestock forestry and mining and quarrying are more important.

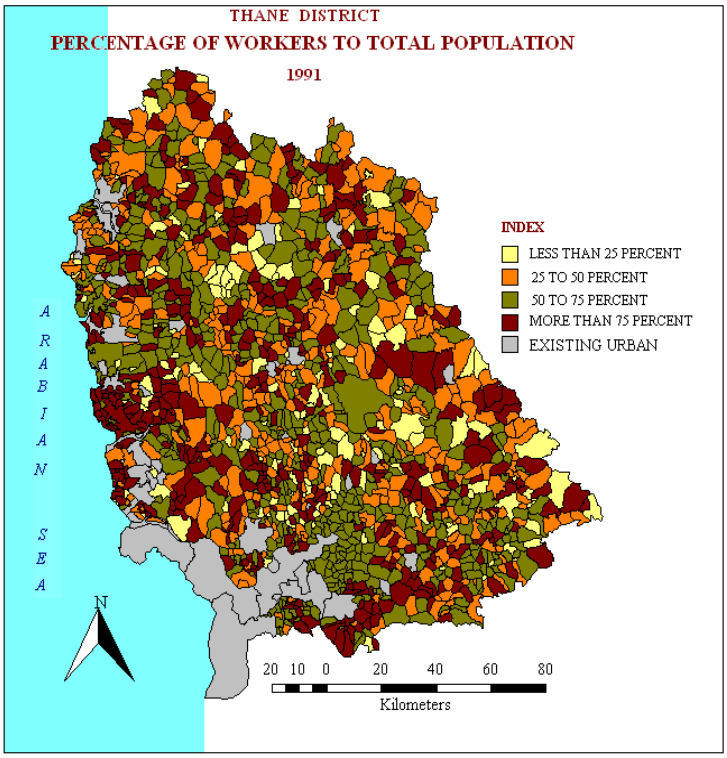
PERCENTAGEOF TOTAL WORKERS TO TOTAL POPULATION

The spatial distribution of percentage of total workers to total population in the study area for 1991 and 2001 is shown in Map-3.3 and Map- 3.4.

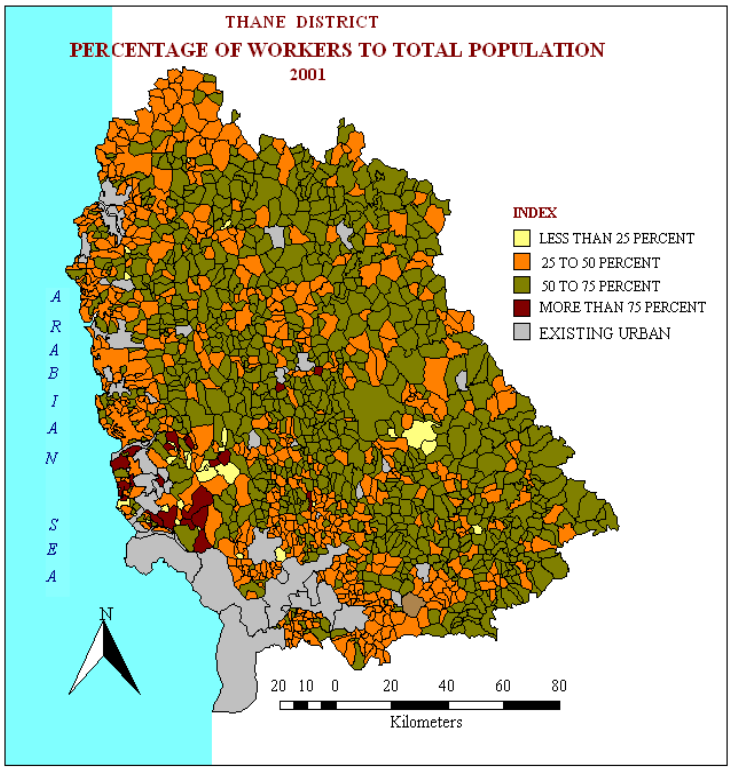
In 1991, 1961704 persons were in the category of working population (37.37 percent to total population) in the region. Map 3.3 shows the spatial distribution of workers to total population in 1991. It is observed that the total working population increases towards the northwest part and other patches in the central, south west part in the area under study. The northwestern and western part has more than 50 percent workers to total population in the region in 1991. In four hundred and twenty villages more than 75 percent workers to total population, most of the villages have workers between 50 to 75 percent. (In 199 there were 566 villages and 2001 the number increased to 891villages). Moreover, it is shown by Map 3.3 and 3.4 that northwestern part has comparatively less percentage of workers and they are involved in agriculture in the study region.

The working population in 1991 was 1961704 workers (37.37 percent to total population) in the region and it increased by 2.55 percent after decade (1991 to 2001). Map 3.3 and 3.4 show spatial distribution of working population for 1991 and 2001 in the area under study. It is obvious from the above exhibit that the structure of working population has changed considerably in the study period (1991-2001). The remarkable increase in working population from 25-50 percent to 51-75 percent in the region after decade. Another noteworthy change occurred in the region in 2001 is that; pockets of more than 75 percent workers have decrease from four hundred twenty (in 1991) to twenty one (in 2001). The pockets of above 75

percent (2001) working population are found in the south western and southern part of study region.



Map - 3.3



Map - 3.4

THE PERCENTAGE OF CULTIVATORS TO FARM WORKERS:

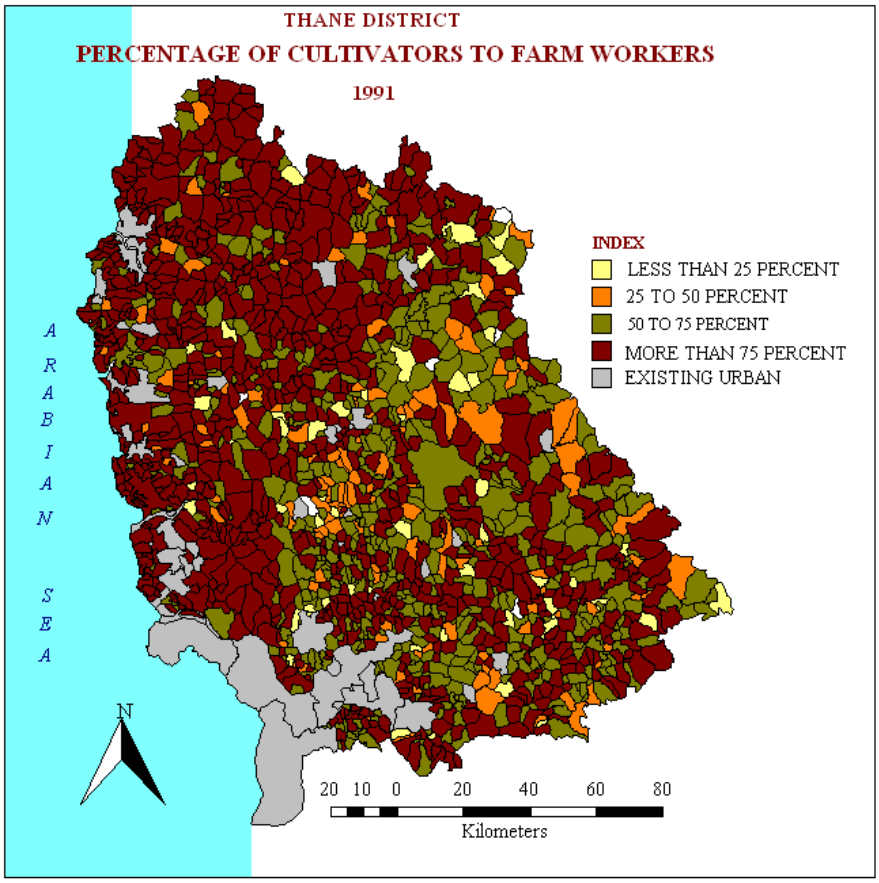
The cultivators include both tenant and owner of farm workers, whereas, farm workers refer to cultivators and agricultural labourers (Census of India, 1991). The involvement of farm workers in agriculture in the region has significance as it is a major coastal plain of North Konkan. The Maps -3.5 and 3.6 gives comparative exposition of spatial distribution of cultivators to farm workers for 1991 and 2001 in the area under study. The total cultivators are 23907 persons (57.67 percent) in 1991 and 18245 persons 50.41 percent in 2001 that shows decline in cultivators by 7.26 percent in the area under study.

The spatial distribution of cultivators to farm workers in 1991 is shown in Map -3.5. In the eastern part owing to low fertility of soil and lack of irrigation facilities, seventy nine villages have cultivators less than 25 percent. The central parts have 25 to 50 percent cultivators to farm workers and some patches in the south east and northwest part. The high percent of cultivators in northern and western part of the region. About 862 villages have more than 75 percent of cultivators to farm workers. It is clear from the Map -3.5 that percent of cultivators to farm workers declines towards central part of the region i.e. from south to north and north to south or west to east. The cultivator to farm workers are more than 75 percent in 862 villages. The highest concentration occurred in the western costal plain, in the northern part and in the southeastern part of the area under study.

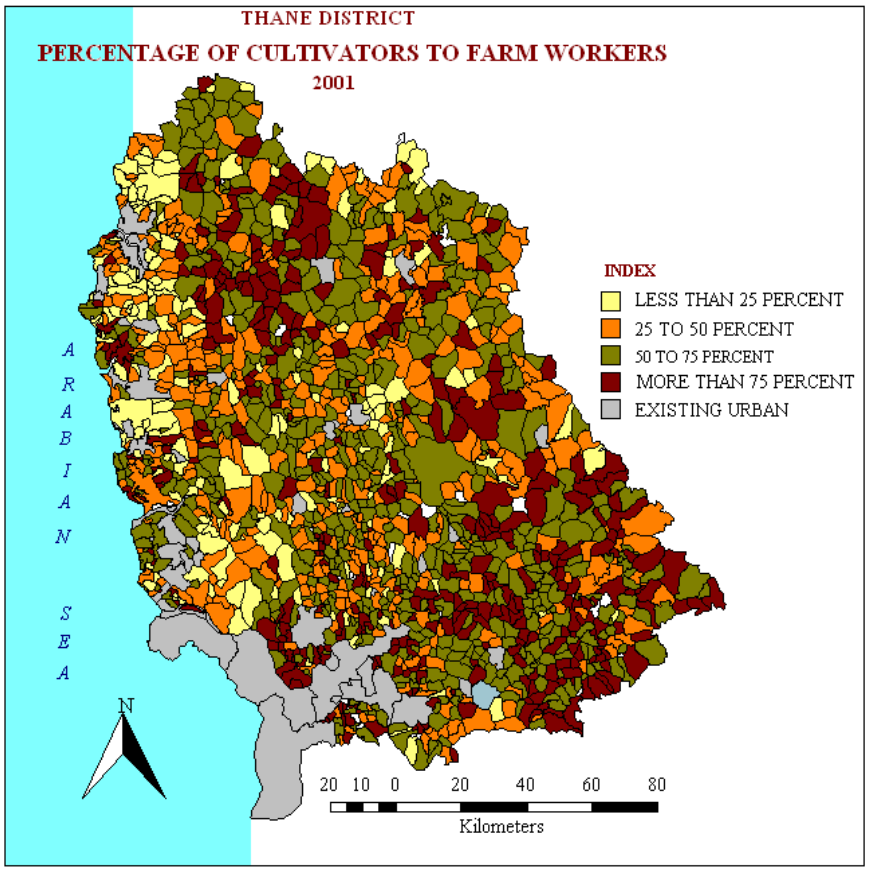
The spatial distribution of cultivators to farm workers in 2001 is represented in Map -3.6. 18245 cultivators (50.41 percent to farm workers) in agriculture. It is seen from the exhibit that the overall percent of cultivators has decreased by 7.26 percent to farm

workers in the region. In the western and northern parts, the number of cultivators have decreased considerably (more than 25 percent). This ascribed to the fact that the people engaged in agriculture sector shifted towards industrial sector. The highest percent of cultivators to farm workers (more than 75 percent to total farm workers) observed in 360 villages, most of them are concentrated in the southeastern and northwestern part of the area under study. While lowest was found in the western part of the region.

In the year 2001, the percentage of cultivators have not increased due to infertile land and lack of irrigation facilities. More than 75 percent cultivators were found in the village of northeastern and southeastern part of the study area.



Map - 3.5

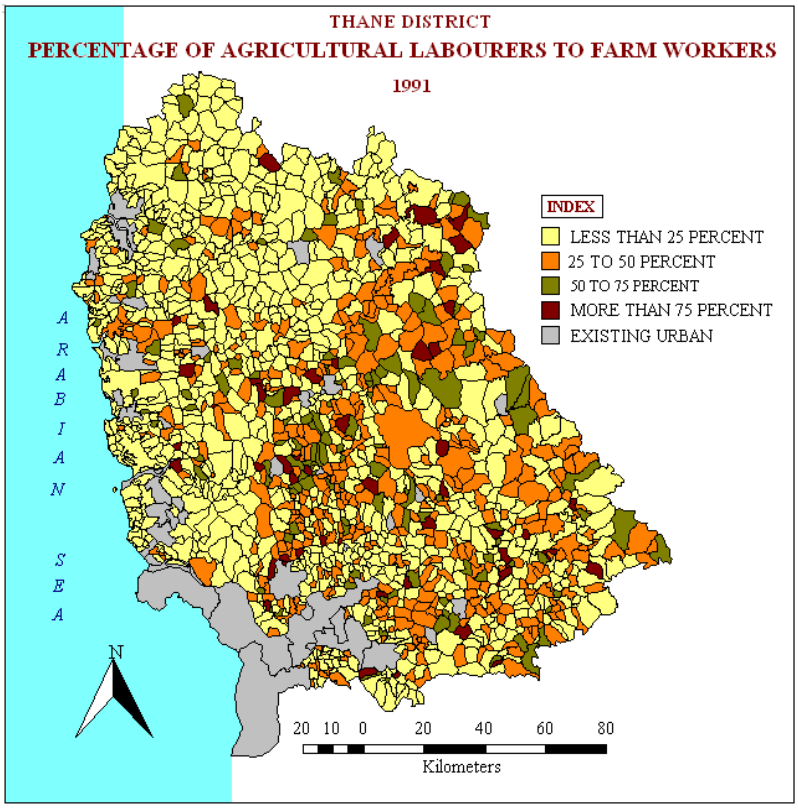


Map - 3.6

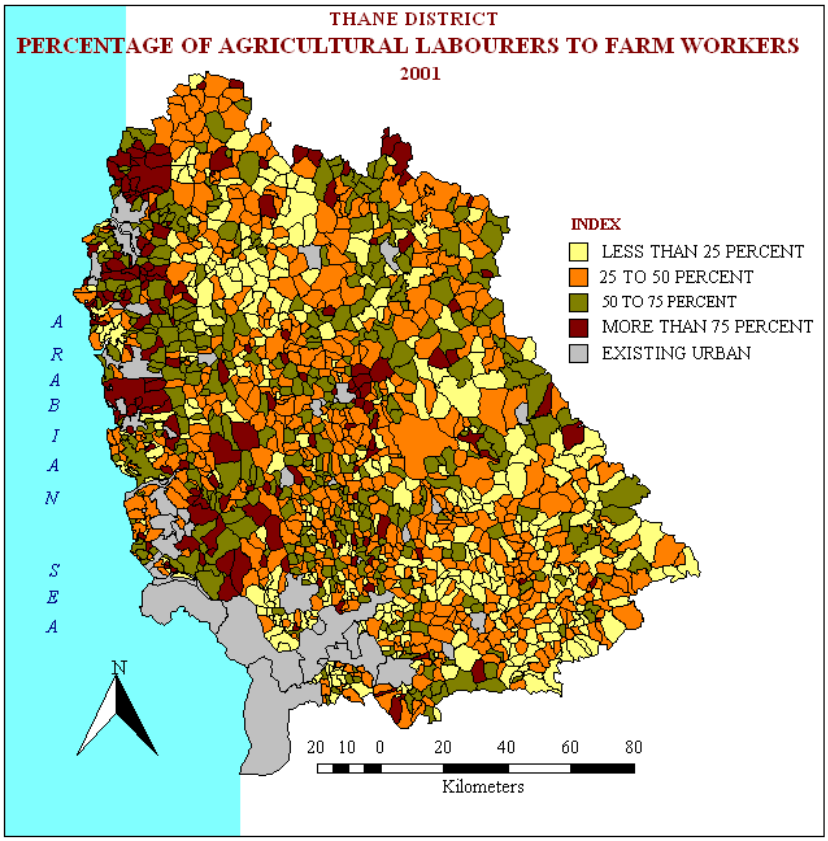
THE PERCENTAGE OF AGRICULTURE LABOURERS TO FARM WORKERS

The Map 3.7 and 3.8 give comparative exposition of spatial distribution, the percent of agricultural labourers to farm workers for the year 1991 and 2001. The percentage of agriculture labourers has increased considerably during study period by 10.47 percent in the study area. The spatial distribution of agricultural labourers to farm workers is shown in Map -3.7 for 1991. It is clear from this exhibit that the high concentration of agriculture labourers was found in the fifty two villages only. Which are located in the central and eastern part of Thane district.

The number of agricultural labourers increased considerably during study period (10.47 percent). Map-3.8 shows the spatial distribution of agriculture labourers to farm workers in the Thane district (2001). The region has 17942 agriculture labourers accounting 49.58 percent of the farm workers in 2001. It is observed that the proportion of agriculture labourers to farm workers has changed the nature of spatial distribution pattern than that of 1991. More than 50 percent agriculture labourers were found predominantly in the central and western part of the region. (Map - 3.8). The western part has concentration of agriculture labourers in five hundred seventy nine villages. These villages have shown significant changes in the number of agricultural labourers. The percentage of agricultural labourers has changed between 25-50 percent in northwest part and central part of the district.



Map – 3.7



Map – 3.8

THE PERCENTAGE OF FARM WORKERS TO TOTAL WORKERS

The Thane district is predominantly agricultural region of north Konkan. Nearly forty percent working force is engaged in agricultural activity (census of India, Thane District Handbook 2001). The spatial distribution of farm workers to total workers is shown in Maps -3.9 and 3.10 for 1991 and 2001 respectively.

The farm workers include the cultivators and agriculture labourers, where as, workers refer to participation in economically productive activity (mental and physical) as well as supervision and direct work.

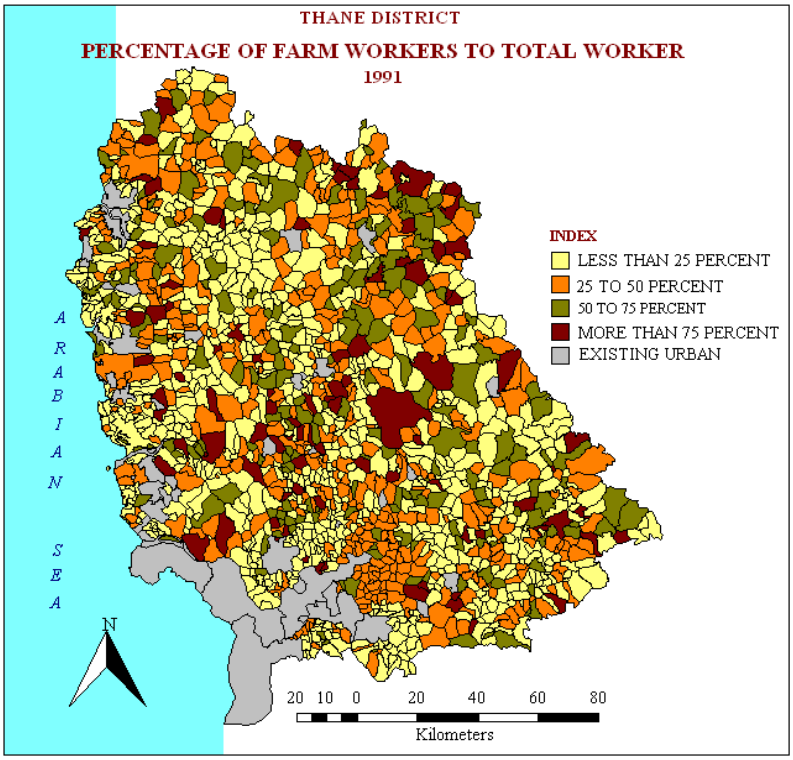
The spatial distribution of farm workers to total workers for 1991 in the area under study is shown in Map-3.9. The region has 603261 farm workers (11.49 percent to total workers).

The percent of farm workers to total workers has been worked out at village level and it was then mapped and is shown in Maps - 3.9 and 3.10. It is observed from this exhibit that the majority of farm workers concentrated in eastern and south west parts (more than 75 percent to total workers) of the district and are involved agriculture practice. About 94 villages have more than 75 percent farm worker to total workers (1991). About 50-75 percent farm workers were observed in 185 villages. 25-50 percent farm workers were found in 453 villages. And less than 25 percent farm workers to total workers in 848 villages, these villages mainly concentrated in the western part and some patches are found in the eastern and southern part of area under study. The highest percentage of farm workers to total workers is found in ninety four villages.

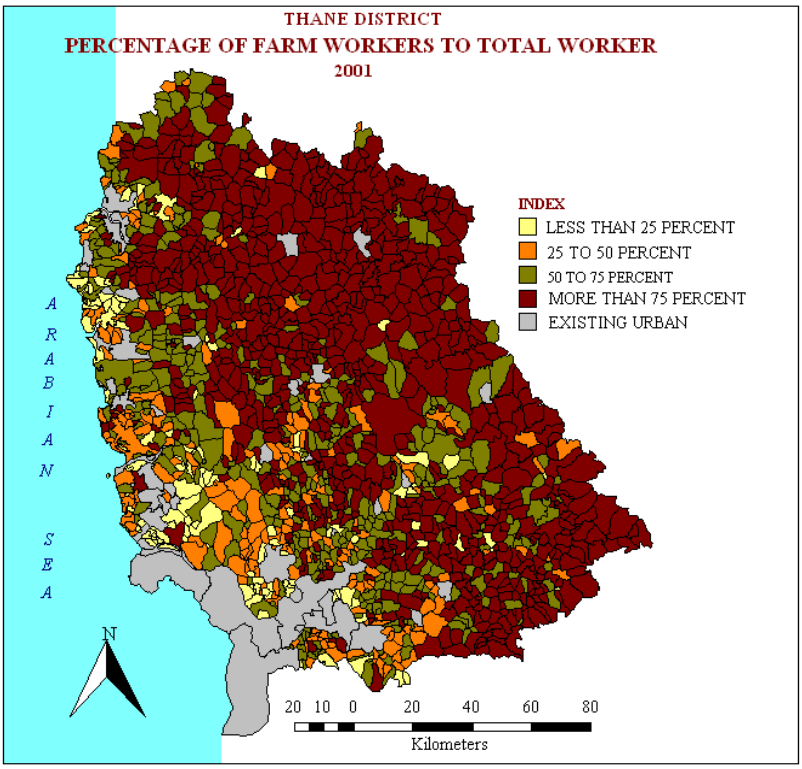
The spatial distribution of farm workers to total workers is shown in Map -3.10 for the area under study in 2001. The region has 695288 farm workers (8.55 percent to total workers).

The percent of farm worker has decreased by 2.94 percent in the region. More than 75 percent farm workers to total workers found in 816 villages, these villages are concentrated along the eastern margins of the tahsil. Four hundred three villages have 50 to 75 percent farm workers, mainly concentrated in coastal plain and low valley region southern and northwest parts in the district. About 213 villages have more than 25 percent farm worker to total workers. About 25-50 percent farm workers were observed in two hundred thirteen villages. Less than 25 percent farm workers to total workers were found in one hundred six villages. These villages mainly concentrated in the western part and very few patches are

found in south of the area under study. The highest percent of farm workers to total workers found along the eastern margin of the district.



Map - 3.9



Map - 3.10

LAND HOLDING:

The size of land holding is an important factor in determining the efficient use of the resources available to farmers. The application of various proportions of inputs to the land their efficient utilization depends upon the size of farm. Besides physical environment, the socio-economic conditions such as the farmers, resources, capacity, attitude, crop pattern and the type of farming practiced together fix the size of land holding in an area.

With the ever increasing population the pressure on land increases leading to the fragmentation of large size farm holdings. A major cause of low agriculture efficiency in India is fragmentation and subdivisions of holdings. Apart from population pressure, the small size of farm could be attributed to laws of inheritance, decline of joint family system, absence of alternative employment opportunities lack of capital investment and attachment to land as a valuable property. The result is the existence of numerous small size farms which are widely scattered pieces of land and hence are uneconomic to cultivate. These uneconomic farms give rise to wasteful method of farm operations, (Datye V. S., 1984)

The disadvantages of fragmentation and scattered holdings are well known. It puts a large proportion of land out side the possibility of effective cultivations involving wastage of time and the need to supervise, it makes capital duplication necessary. The small plots are difficult to work with tractor, weeding and pest control is also difficult and it limits mechanization and experimentation. On the whole it is a serious impediment to the agriculture progress and acts as a deterrent to a full utilization of land and farm force (Sing Jasbir-1974)

The Thane district like others regions has heavy pressure of growing population which results in subdividing agricultural plot into

small holdings. During the field work and interview with farmers, the fact uncovered that the land of small size creating numerous difficulties, such as proper supervision accessibility of easy inputs, wastage of time, use of improved implements and limitations for mechanization, and thus, small size of land holdings has adverse effect on efficient land utilization.

Moreover it is observed that the average size of land holding in the region is 1.12.00 hectares which is comparatively low than the average land holding in Maharashtra (4.00). The unequal and uneconomic small size land holdings are observed in the region i.e. a large number of small holders occupying a smaller area. It is therefore needed to consolidate the land for efficient landuse in entire region.

AGRICULTURE LAND HOLDING IN THE STUDY AREA

Land holding	No. of Land Holders	% of Land Holders	% of Land
Less than 2.023 hectare	18785	98.13	85.67
More than 2.023 hectare	358	1.87	14.33

Source: Tahsil revenue record – 2001. Table No. -3.6

IRRIGATION:

The importance of irrigation to the predominantly agriculture economy of the country cannot be over-emphasized. Rainfall in most parts of the country is confined to the four rainy months June to September. While crops need moisture throughout the period of growth particularly during crucial stages. The Thane district entirely depends on monsoon rainfall for its crop growth. From this point of view, the study of irrigation aspect is essential. Out of the various irrigation sources such as tanks, wells, rivers, canals, lake and reservoirs are used. The study area has only two sources of

irrigation, namely well irrigation and tank irrigation. Most of the villages in the region have well irrigation.

There are two main sources of irrigation:

Surface Water :

Rivers, tank, ponds, lakes and artificial reservoirs provide surface water for irrigation. Canals are drawn from dams constructed across the rivers and if the dam is high enough to form a large reservoirs, water is available through out the year. Tanks which form an important source of irrigation are mostly rain fed. The water from the artificial sources is carried to the fields by flow due to gravity.

Ground Water

The nature of topography and the characteristics of geological formations influence the amount of underground water available. The subterranean water is tapped by digging or drilling wells. The depth of these wells depends upon the nature of underlying beds and the level of permanent water table.

This is a zone of slightly saltish, sandy soils, a shallow water table and rice-coconut fish culture. Well irrigation with pumps is of widely used and this rapid expansion of pump irrigation in the area is liable to face water famine with exhaustion of the top layer of fresh water of the water-table, which will be replaced by the sea water and hence that water will become useless. The better watered lands are devoted to the cultivation of vegetables, flowers and chili.

Further inland is a flat alluvial low-land, with fairly productive black soils, rice is the predominant crop during the rains, but after that the rains a quick succession of winter and summer

vegetables are raised making heavy use of pump during the rains, but in the post

monsoon vegetables are raised making heavy use of pump irrigation, manures and artificial fertilizers.

The district has a total gross area of 21100 hector (2001) under irrigation. It means about 5.58 per cent of the NSA is under irrigation. Among the different sources of irrigation wells occupy a very significant position.

Area Irrigated ('00'Hectare)

Year	Total Net Area irrigated (ha. '00')		Total Net irrigated Area ha. '00'	% of Net Area irrigated to Net sown Area	Total Grossed Cropped irrigated Area (ha. '00')	% of total area irrigated to total cropped Area
	Surface irrigation	Well irrigation				
1980-81	4	36	40	1.6	45	1.6
1982-83	24	19	43	1.7	56	2.0
1984-85	39	10	49	1.8	54	1.9
1986-87	27	18	45	1.5	49	1.6
1988-89	28	35	63	2.1	71	2.3
1990-91	31	30	61	1.7	69	1.9
1991-92	27	58	85	2.3	98	2.6
1992-93	30	59	89	2.4	103	2.7
1993-94	40	87	91	2.4	106	2.7
1994-95	41	86	127	3.4	146	3.7
1995-96	41	99	140	3.7	160	4.1
1996-97	12	160	172	4.6	192	4.9
1997-98	2	165	167	4.6	190	4.8
1998-99	2	186	188	5.1	208	5.1
1999-00	10	180	190	5.3	208	5.3
2000-01	54	138	192	5.3	213	5.3
2001-02	54	136	190	5.3	211	5.4

Source : Season And Crop Reports for Respective Years

Table - 3.7

Major and Medium Irrigation Projects

Name of the Project			
	Bhatsa (Shahapur)	**Surya (Vikramgad)**	**Wandri (Palghar)**
Height of the Dam	**89.00 meter**	**58.08 meter**	**28.27 meter**
Max. Capacity (million cubic meters)	**942.10**	**166.52**	**35.94**
Total Beneficial Area	**47860 ha.**	**30547 ha.**	**4088 ha.**
Total Land Fusible for Irrigation	**23000 ha.**	**14696 ha.**	**2044 ha.**
Total land under irrigation (2005-06)	**1012 ha.**	**2478 ha.**	**789 ha.**

Source : Season And Crop Reports for Respective Years Table - 3.8

TRANSPORTATION:

The role of means of transport in the economic development is significant in agricultural regions. It acts as a main vehicle for bringing different raw materials, seeds, fertilizers, implements and distributes the product within the region. The improvement in transport network extends the hinterland of markets and brings isolated productions area into light (V.S. Datye, 1984). Such improvement and change in frequency, speed and capacity indicate the changes in traditional agricultural pattern. From this point of view, it would be necessary to examine the existing means of transport in the region. The western coastal plain has two types of transport namely, roadways and railways. Both covering transport network in the region.

The area under study has 286 kilometers of l railway track which is (broad gauge) part of western railway and Central railway. And road ways have dense linkages than railways. The roadway plays a significant role in collecting and distributing agricultural products. Total road length is 6350 kms. Three types of road ways are found in the region namely, National highways of 226 kms, The state highway with length of 1205 kms ,Major District Roads of 1980 kms in length. Other District Roads and village Roads or Kacchya roads. These District Roads, State highways and other village roads are linked with Railways and National Highway No.8, Mumbai–Ahamedabad and Mumbai Agra shows a wide network of transportation within the study area. These roadways are linked to distance villages, either by metaled or unmetalled roads. The unmetalled roads are maintained by Zila Parishad (Public Works Department). The total length of Major district roadways is 1980 kms and village roadway is 2939 kms.

The entire product grown in this region finds its way to the city market through trucks and rail. Nearness to the Mumabi market is of vital importance in determining the market produce raised in the region. It is observed that most villages are linked by bus services. This bus service is owned by State Transport Service, Government of Maharashtra.

The western railway network of Mumbai – Surat – Ahamadabad – State of Rajsthan – Delhi operates significantly. The Mumbai suburban local train from Virar and Dahanu road to Virar Shuttle services are significant from agricultural point of view as well as it is used for public travel. And the central railway network of Mumbai-Nasik-Bhusaval-Nagpur-States of Madhya Pradesh-West Bengal and Delhi operates significantly. The Mumbai suburban

local trains from Mumbai CST to Kasara area significant from all dimensions of mankind.

Route length of Thane District.

(Length in kms)

Sr. No.	Types	Thane District (Length in kms)
1.	Roads Total Length =	6350
	i) National highway	226
	ii) State highway	1205
	iii) Major District Roads	1980
	iv) Village Roads	2939
2.	Railway- Broad Gauge	286

Table No.3.9

Source – Socio-Economic abstract,Thane District. (Palghar)

Economic factors were very pronounced in the structure , spatial distribution and lay out of railways. Initially the railways were constructed with an idea to connect Thane with Mumbai and after that other important cities like Ahmadabad, Surat, Ajmer, Agra, Delhi, Kolkata etc. One cannot compare the diffusion of road system with that of the railways in the district because both these means of transport have an altogether different basic structure. As a result, railways serve smaller area as compared to roads in the district.

We may conclude that the entire development and efforts to increase accessibility are mostly linked with the extension of road system. The extension of roadways in the present inaccessible areas will bring a large portion of area and population in the main stream of economic growth of the district. With the increase in accessibility, frequency, speed and capacity of the modes of transport, one may anticipate a change in the agricultural patterns of the areas which have remained isolated for a long time. Besides the commodity transport, movement of a farmer from his home to the

fields is also important. This problem is closely related to the agricultural productivity and partly could be solved with the consolidation of farms.

Marketing:

Agricultural geography studies spatial variations in agriculture and now a day the definition is extended to cover all the activities from sowing and harvesting to marketing. Surplus and exchange are two important aspects of modern commercial economy. It is essential, therefore to understand the spatial distribution market centres, their functional integration and the areas served. In an agricultural economy in developing rural areas, agricultural commodities dominate the gods traded at market centres. The goods offered for sale at the market reflect the surplus and deficiencies of the total agricultural production in the area served by the market.

Weekly Markets

A weekly market is the central economic institution in most rural areas particularly in the developing economies (Diddee, 1978). In the countryside where most settlements are purely agricultural, the weekly markets perform important economic and social functions. Weekly markets essentially are distributing rather than collecting centres for significant volume of agricultural produce flow only through the largest weekly markets and regulated markets.

Distribution of Weekly Markets

The spatial distribution of weekly markets is influenced by physiography, population density, agricultural productivity and accessibility. In the Eastern mountainous area market centres are

absent on account of low marketable surplus, low population density, poor accessibility and low purchasing power of a farmer. In the irrigated tracts an increase in the number and size of weekly markets is observed. Most weekly markets are found in the villages below five thousand population. The number of weekly markets declines in the urbanized areas. Weekly markets in such areas are replaced by daily markets.

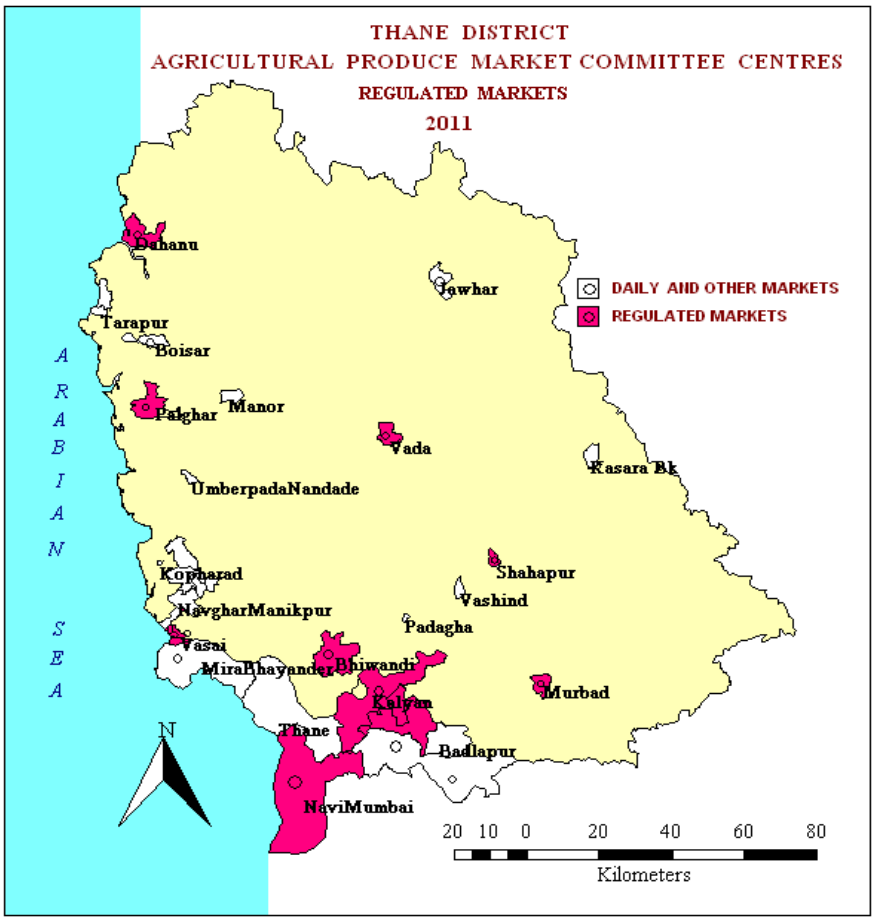
Regulated Markets

Weekly markets are of local importance and serve a smaller area as compared to the regulated markets which functions as a collection centres for large volume of agricultural produce. In India, market regulation was introduced as a measure to protect the farmer from exploitation and also to introduce an element of stability to the price structure. The first regulated markets were introduced in 1927 preliminary in the cotton growing areas. Subsequently, gur, potatoes, groundnuts, and chilies, in addition to cotton were brought under regulation. The regulated markets have extended considerable additional assistance for warehousing and storage space for traders and farmers. Most of the regulated markets are located at tahsil headquarters where a substantial agricultural surplus in the hinterland exists. The eastern hilly tahsils of Mokhada have no regulated markets. The market yards specialize in the sale of different commodities in different areas.

Tahsilwise Distribution of Market Centres in Thane District

Tahsil	Sub Markets	No.of regulated Markets
Ambarnath	1	-
Bhivandi	3	1
Dahanu	1	1
Javhar	1	-
Kalyan	1	1
Mokhada	1	-
Murbad	2	1
Palghar	1	1
Shahapur	3	1
Talasari	-	-
Thane	-	-
Vada	1	1
Vasai	8	1
Vikramgad	-	-
Ulhasnagar	-	1

Source: Agricultural Produce Market Committee, Table - 3.10



Map - 3.11

RESUME:

The discussion on socio-economic aspects in this chapter has brought out the nature and major features of various aspects namely, population, occupational structure, irrigation, transportation and market centers in the Thane district. The region like other area, has witnessed a steady growth of population with its upward trend. In the decade 1991 to 2001 the percentage of growth rate had been 54.92 percent. The average density of population is 885 persons per hundred hectares in the district (2001). From the spatial point of view the density increases towards west. Of the total population 11.49 percent working force is engaged in agricultural pursuits. The negligible area is under irrigation, i.e. 5.40 percent to net sown area in the region. The total network of roads and rails has been estimated to be adequate for circulation of goods and people. Bus service is available for the villages in the remote areas.

CHAPTER - IV

GENERAL LANDUSE

The concept of landuse is related to the use of land which is used for certain activity for a given period of time. The man has fundamental utility of land in satisfying the human need of food, habitation and housing materials. In order to meet the need, it is essential to choose proper mode of landuse planning and allocation to various ingredients of optimum landuse. Kellong (1980) has rightly pointed out that this calls for a clear understanding of land classification for successful planning and development. Landuse studies are important as they are important as they are aimed at explaining the occurrences of different uses in different areas. The growing pressure of population coupled with an increasing variety of demand on land resources has brought extra pressure on available resources. In order to deal with these and to plan for optimum utilization of land, it is necessary to have accurate and up to date information in all possible details on landuse (Vaidya B.C. 1997).

Landuse thus is an expression of permanent struggle in which human efforts are applied to the land resources for the satisfaction of human needs. The competition between various types of uses is the results of scarcity of land for a specific use depending on physical, economic and cultural characteristics of land to which its suitability for a particular use is related. Therefore in agricultural geography it is essential to understand the variations in the land use as a human reaction towards the satisfaction of human wants. The environmental factors influence upon the use to which land is put. This is true especially in the case of rural landuse such as agriculture, forestry etc. The urban landuse to a large extent reflects cultural responses. The agriculture landuse dominates the rural landuse patterns. As a result of ever increasing population pressure

on land, the land resources are depleting fast. In such a situation even the marginal lands are brought under cultivation and further extension being impossible, efforts are made towards optimum utilization of land through more intensive methods of cultivation. Though the basic land resources are more or less permanent, the application of technology and changing social and economic conditions introduce changes in the landuse patterns.

The objective of this chapter to the study of general land utilization in Thane district. First the temporal variations in the landuse are examined analyzing the data at Tahsil level. This study enables one to identify the temporal changes in the significance of various uses of land from 1981 to 2009.

The spatial variations in the land utilization are then studied with respect to the physical regions. Village level data obtained from the district census hand book (1991, 2001) and data from Tahsil head quarters for the year 2009 is then compiled to understand the spatial variations in the landuse types as well as temporal landuse and suggest possible ways and means to improve existing landuse in the Thane district in the light of physio – socio – economic conditions.

The general landuse categories are:

1) Net sown area (NSA)
2) Cultivable waste
3) Area not available for cultivation (ANC)
4) Forest
5) Fallow land

The area of net sown area (NSA), cultivable waste, area not available for cultivation (ANC), fallow land and forest cover have been converted into percentage to total geographical area. Further,

these have been used for showing the spatial distribution of land classification with suitable cartographic maps.

The description of each land classification has been supplemented by numerous spot – inquiries besides information embodied in the relative District census Hand book, District Gazetteer and District Socio – Economic Review of Thane District.

LAND CLASSIFICATION:

The land classification aimed at dividing into different categories according to a single factor or a set of factors. Therefore, land classification may be of many types depending upon the factors taken into consideration. The land classification has a direct bearing on climatic factors, soil characteristics, and slope of land, degree of erosion, water supply, drainage and similar environmental conditions. The landuse capabilities of land to produce over a long period of time for selected uses which can provide land operation with a basis for actual practice of land (Stamp, 1968).

TEMPORAL VARIATIONS IN THE LAND UTILIZATION:

The temporal variations in landuse pattern in the Thane district have been studied for a period of about three decades (i.e. 1981 to 2009) and possible causes of changing landuse are interpreted. The investigator could not succeed in uncovering temporal variations of landuse for consecutive years due to paucity of data for the years concerned. However, census year has been taken into considerations for showing temporal variations in landuse pattern in the area under study.

Five major categories of landuse are noted for the temporal variations in the study area:

1. Forest cover (FC)
2. Area not available for cultivation (ANC)
3. Cultivable waste (CW)
4. Fallow land (FL)
5. Net Sown Area (NSA)

The salient features in the temporal variation can be summed up as follows:

I) FOREST COVER :

1) Area under forest in the study area of Thane district –

The forests are classified in the area into three categories –

i) Reserved ii) Protected and iii) Village forest.

All forested area in the villages classed or administered as forest under any legal enactment dealing with forest, whether state owned or private are included in this category. Forests, their types and species have already been described in chapter – II. The highest concentration of forests, above 45 percent of the total area is observed in the areas of hill slope, mountainous ridge and parallel to the coastal plain. The forests occupied about 35.37 percent of the total area (2001) Table - 4.1 (Map - 4.1)

In the study area forest cover indicates decline during 1981 and 2009. In 1981 about 39.61 percent area under forest cover in 2001 (35.37 percent) and decline by 4.24 percent. This fact suggests that forest land has been brought under cultivation. Moreover, there is loss of forest by various human interference.

II) Area not available for cultivation:

This category of land includes barren lands, uncultivable land and land put to non agricultural uses. The land put to non agricultural use also includes land occupied by buildings, roads and railways or under water (Non-Agricultural Uses and Barren and Uncultivable land). The area under non-agricultural uses has

increased from 1981 to 2009 (6.68 to 10.29 per cent) in the study region. The total increase during the study period is 3.61 per cent (Table 4.1). There is slight increase due to the decrease in the land under forest cover and cultivable waste. (Map - 4.2 and Table- 4.1) The Map - 4.2 reveals the temporal variation in land out of non-agricultural uses and barren and uncultivated land. Non agricultural land has been substantially increased the period from 1981 to 2009. The barren and uncultivated land steadily decreased for the period of 1981-92 to 2009 (8.73 to 4.14 percent).

Land put to non agricultural uses has notably increased by 3.61 percent during two decades period. The land put to non-agricultural uses has been steadily increasing because day by day more land brought under non-agricultural uses such as for construction of buildings and expansion of towns, industrialization etc.

3) **CULTIVABLE WASTE** :

Other cultivated land excluding fallow has been subdivided into three types:

i) Cultivable waste

ii) Permanent pastures and other grazing land.

iii) Land under miscellaneous trees not included into net sown area.

Cultivable waste land includes all land available for cultivation or taken up for cultivation once, but not cultivated during the current year and the preceding five years or more in succession. In 1981 the proportion of cultivable waste was high (14.35 percent) which has decreased to 10.40 percent in 2009.

The proportion of cultivable waste is declined as shown in Map - 4.3. The total decline is 2.36 percent. There was decline in miscellaneous trees and groves due to notable awareness increase

among farmers. This category covers all grazing lands and common grazing lands of village within forest areas. The permanent pastures and other grazing land in 1981 (9.33 percent) has also steadily decreased by 3.59 percent (5.74 percent in 2009). Miscellaneous trees and groves increased by 2.00 percent and cultivable waste decline by 2.36 percent. There were more declines in permanent pasture and other grazing land due to land brought under cultivation.

4) FALLOW LAND :

Fallow lands are divided into two sub types, current fallow and other fallow. Current fallow are the lands which are kept fallow during the current years, for regaining fertility of soil and other purposes during the agricultural year. Other fallow included all lands which were taken up for cultivation but are temporarily out of cultivation for period not less than one year and not more than five years. Other fallows due to various reasons i.e. non availability of capital or lack of agricultural know how. The proportion of current fallows fluctuated from 1.83 percent of total area in 1981 to 0.97 percent in 1987 and 2.31 percent in 1991. Again in 1997 it has dropped to 0.77 percent of the total area. In 2001 it was 1.00 percent and there was not much difference in the proportion of areas under current fallow for the district (1.00 percent in 2009). In the study area both current fallow and other fallow land show decrease during two decades period i.e. 3.64 percent and 2.27 percent respectively in 1981 and 2009. Proportion of area under other fallows also indicates fluctuations as 1.81, 0.54, 2.32, 1.11 and 1.26 percent of the years 1981, 1987, 1991, 2001 and 2009 respectively. This fact suggests that land under current fallow and other fallow is fluctuated through the study period.

5) NET SOWN AREA:

Net sown area consists of net area sown with crops and orchards excluding the area sown more than once. Net sown area denotes the extent of the cultivated area actually sown during the agricultural year.

The net sown area to total area in the district has changed considerably since 1981 to 1991 (26.97 to 38.37 percent of the total area respectively). Surprisingly, in spite of progress made in other aspects of agriculture the net sown area in the district has not changed at all since 1991 (38.37 percent) to 2009 (39.59 percent). As against this, area sown more than once has increased from 1991 (1.01 percent) to 2001 (4.01 percent). There was a slight decrease in 2009 (3.96 percent). It is seen from Plate No-4.5 that 26.98 percent area was under cultivation in 1981 and it has been stepped to 39.59 percent area under cultivation in 2009, registering an increase by 12.61 percent.

There is 12.61 percent increase in net sown area within two decades. This increase in net sown area may be due to more land under trees and shrubs were brought subsequently under cultivation. Therefore, other types of land have declined i.e. forest cover and cultivable waste from 1981 to 2001 (Map - 4.5 and Table 4.1). Other types of land previously considered cultivable waste is being used by the farmers for cultivation for growing crops. Moreover, increasing awareness about arable land and mounting pressure of population on landuse pattern has brought this land under cultivation.

Temporal analysis of general landuse indicates clearly that on the whole landuse pattern has remained the same since 1981. Net sown area, Land under forest, and area not available for cultivation account for a major share of the total area, and Land under forest

and area not available for cultivation do not display any fluctuations. The significant changes are observed related to the areas under net sown area, cultivable waste, pastures and grazing lands, fallows and areas sown more than once. These fluctuations could be attributed to the variations in the human responses to the various aspects of land. Though the environmental factors like physiography, geology, climate and soil could be identified as constants which have not undergone much change in the course of time.

Remarkable changes in the area sown more than once and increasing net sown area can be attributed to the human efforts in the direction of intensification of agriculture. This indicates the socio-economic and technological changes that took place during last two or three decades. This aspect of agriculture has been discussed more precisely in other chapter.

Temporal Variation in The Landuse (Percentage of The Total Geographic Area)

Year	Forest	Area Not Available For Cultivation			Other Uncultivated Land				Fallow Land			Net Sown Area	Area Sown More than Once	Gross Cropped Area
		Non-Agri. Uses	Barren And Uncultivable	**Total**	Cultivable Waste	Permanent Pasture And Other Grazing Land	Miscellaneous Trees	**Total**	Current Fallow	Other Fallow	**Total**			
1980-81	39.60	6.68	8.73	15.42	4.35	9.33	0.65	14.35	1.83	1.81	3.64	26.98	2.58	29.56
1982-83	39.60	6.68	8.73	15.42	4.35	9.33	0.65	14.35	0.73	1.84	2.57	28.05	1.70	29.75
1984-85	37.37	7.71	8.05	15.77	5.06	8.30	1.20	14.57	0.91	2.38	3.29	29.00	0.69	29.70
1986-87	37.22	7.73	7.87	15.60	4.93	7.92	0.77	13.63	0.97	0.55	1.52	32.01	0.56	32.58
1988-89	35.12	8.77	5.98	14.76	3.74	5.26	0.75	9.77	3.17	3.82	6.99	33.35	1.27	34.63
1990-91	34.83	7.87	5.62	13.49	2.66	5.30	1.29	9.25	2.31	2.32	4.64	37.77	1.01	38.79
1991-92	37.06	8.25	3.94	12.19	2.57	4.89	2.37	9.85	1.46	1.06	2.52	38.38	0.85	39.24
1992-93	35.38	8.43	4.35	12.80	2.37	4.89	2.59	9.86	0.80	0.71	1.51	40.44	0.98	41.43
1993-94	35.35	9.24	4.35	13.60	2.00	4.88	2.59	9.48	0.61	0.82	1.44	40.13	1.63	41.77
1994-95	35.37	9.30	4.15	13.46	1.99	4.92	2.57	9.49	0.46	0.79	1.25	40.42	1.39	41.81
1995-96	35.37	9.43	4.16	13.60	2.05	4.92	2.57	9.55	0.32	0.47	0.79	40.68	1.51	42.19
1996-97	35.37	9.52	4.17	13.70	2.00	4.92	2.57	9.50	0.77	0.91	1.68	39.75	2.47	42.22
1997-98	35.33	9.51	4.17	13.68	2.00	4.92	2.42	9.34	1.21	1.28	2.49	39.15	3.10	42.25
1998-99	35.35	9.57	4.17	13.75	2.00	4.92	2.61	9.54	0.56	1.05	1.61	39.75	3.76	43.52
1999-00	35.25	9.58	4.16	13.75	1.99	4.90	2.60	9.51	2.02	1.54	3.55	37.94	3.97	41.91
2000-01	35.46	9.67	4.18	13.86	1.99	4.93	2.62	9.56	1.01	1.12	2.13	39.00	4.01	43.01
2001-02	35.50	10.17	4.19	14.36	2.06	4.94	2.62	9.63	1.01	1.28	2.29	38.20	3.93	42.14
2002-03	35.88	10.16	4.16	14.33	2.00	5.80	2.67	10.48	1.01	1.28	2.29	37.01	3.78	40.79
2003-04	35.41	10.14	4.17	14.31	1.99	5.78	2.67	10.45	1.01	1.55	2.56	37.26	3.92	41.18
2004-05	35.56	10.06	4.15	14.22	2.04	5.74	2.65	10.44	1.00	1.53	2.53	37.24	3.96	41.20
2005-06	35.26	10.10	4.16	14.27	1.99	5.76	2.66	10.42	1.00	1.55	2.55	37.49	3.75	41.25
2006-07	35.32	9.57	4.17	13.74	2.00	5.76	2.60	10.36	1.01	1.54	2.55	38.03	3.97	42.00
2007-08	34.76	9.59	4.13	13.73	1.98	5.75	2.65	10.39	1.00	1.30	2.30	38.82	3.89	42.71
2008-09	33.28	10.29	4.14	14.45	1.99	5.75	2.65	10.41	1.00	1.27	2.27	39.59	3.96	43.56

Source: Season and Crop Reports for the respective years Commissionerate of Agriculture, Pune, Government of Maharashtra. **Table – 4.1**

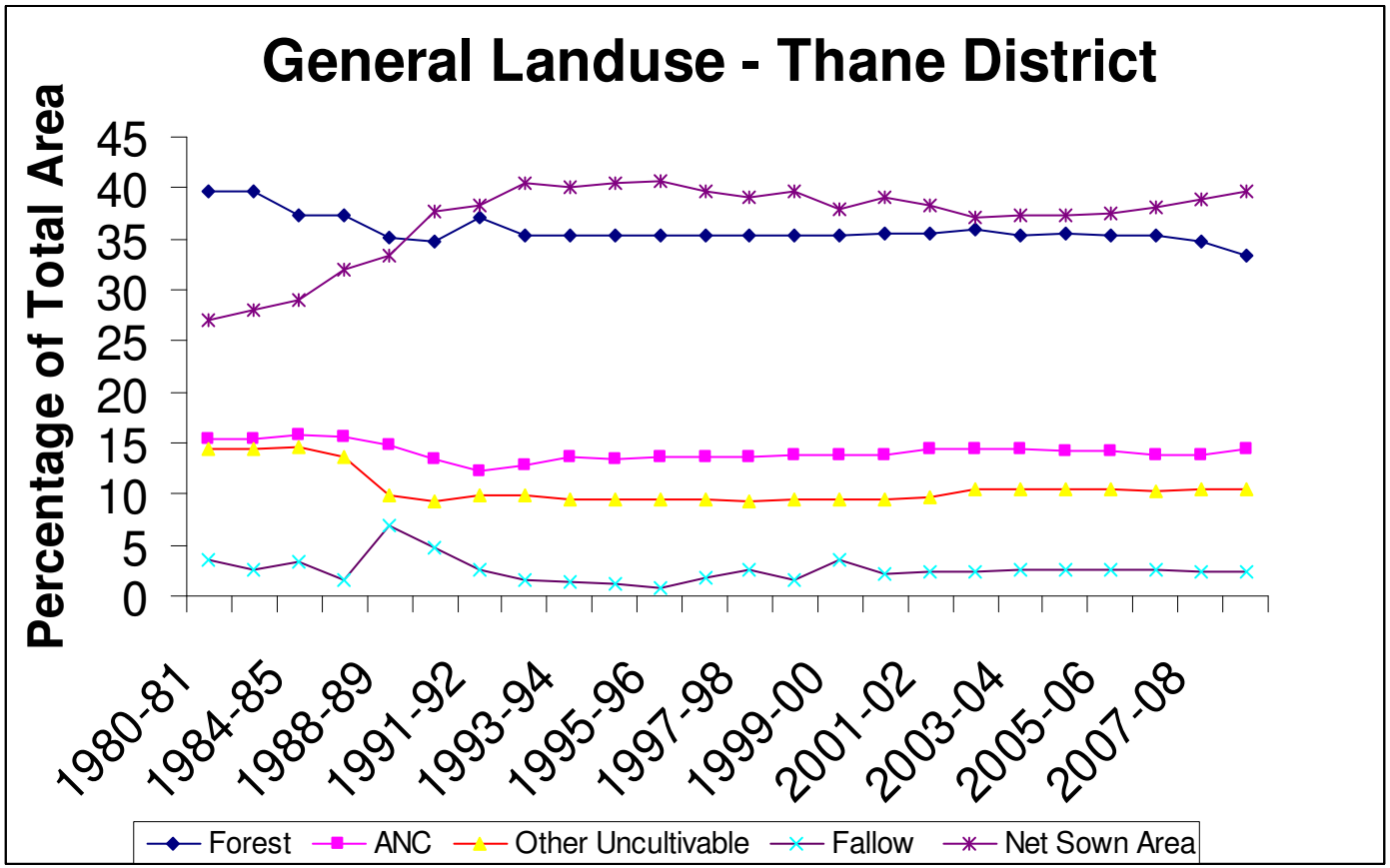

General Landuse - Thane District
Percentage of Total Area
45
40
35
30
25
20
15
10
5
0
1980-81
1984-85
1988-89
1991-92
1993-94
1995-96
1997-98
1999-00
2001-02
2003-04
2005-06
2007-08
Forest
ANC
Other Uncultivable
Fallow
Net Sown Area

Fig. 4.1

Comparative Landuse Study Thane District and Maharashtra state (2001)

Sr. No.	Categories	Thane District	Maharashtra State
1.	Forest	330300 (35.37%)	5149700 (16.74%)
2.	Area not available for cultivation	129100 (13.82%)	2912400 (9.46%)
3.	Cultivable waste	89100 (9.54%)	2453900 (7.97%)
4.	Net sown area	355300 (38.05%)	17222300 (55.99%)
5.	Fallow land	29900 (3.20%)	3020000 (9.82%)
	TOTAL	933700	30758300

Source: Season and Crop Reports , Commissionerate of Agriculture, Pune, Government of Maharashtra. **Table No. 4.2**

Net sown area in the study region is relatively less under cultivation (38.05 percent) than Maharashtra state (55.99 percent). The less amount of net sown area in Thane district attributed to highly diversified relief where as the western coastal plain is marked out its plain surface with black and sandy soils through out its length and breadth. Moreover, forest cover is very high in the district (35.37 percent) compared to that of Maharashtra state (16.74 percent) in the year 2001. Table No - 4.2 shows that the Area not available for cultivation (13.82 percent) in the study area it is more than Maharashtra (9.46 percent). The area under Cultivable waste is relatively more in the region (9.54 percent) while in Maharashtra state (7.97 percent) the area under other types of land, current fallow and other than current fallow land is less in study region (3.20 percent) while it is more in Maharashtra state (9.82 percent).

SPATIAL VARIATION IN LANDUSE

The spatial pattern of landuse in the Thane district is the result of interaction between physical environment and socio- economic environment but the impact of local and regional factors is clearly evident from the landuse patterns. Besides these factors, amount of rainfall, nature of relief and land, distance from ocean coast etc. has influence on the types of lanuse in the region. The overall landuse has been categorized into different sub types on the basis of recommendations made by food and Agricultural department, Government of India. These subtypes are as follows:

1) **FOREST**
2) **LAND NOT AVAILABLE FOR CULTIVATION**
   a) Land put to non agricultural uses
   b) Barren and uncultivable land
3) **CULTIVABLE WASTE LAND**
   a) Permanent pastures and other grazing land.
   b) Land under miscellaneous tree crops and groves not included in net area sown.
4. **NET SOWN AREA**
5. **FALLOW LAND** a) Current fallow land and
   b) Fallow land other than current fallow.

The above mentioned landuse categories have been used to examine the spatial pattern of landuse in the Thane district.The per cent of each landuse type has been calculated to total geographical area of the region.

GENERAL LAND USE OF THANE DISTRICT

(2008-2009)

Sr. No	Land use types	Area (Hectares)	Percent of Total Geographical Area
1	Forest Cover	312200	33.28 %
2	Land Not Available for Cultivation	135500	14.44%
3	Area Under Cultivable Waste	97600	10.40%
4	Net Sown Area	371400	39.59%
5	Area Under Fallow Land	21300	2.27%
TOTAL		**938000**	**100.00**

Source: Village Revenue Records -2008-2009. **Table No. 4.3**

I. FOREST COVER:

The area under forest cover in the region is 33.28 per cent of total geographical area in 2008-2009. All forested areas in the villages classed as forest under any legal enactment dealing with forests, whether state-owned or private, are included in this category.

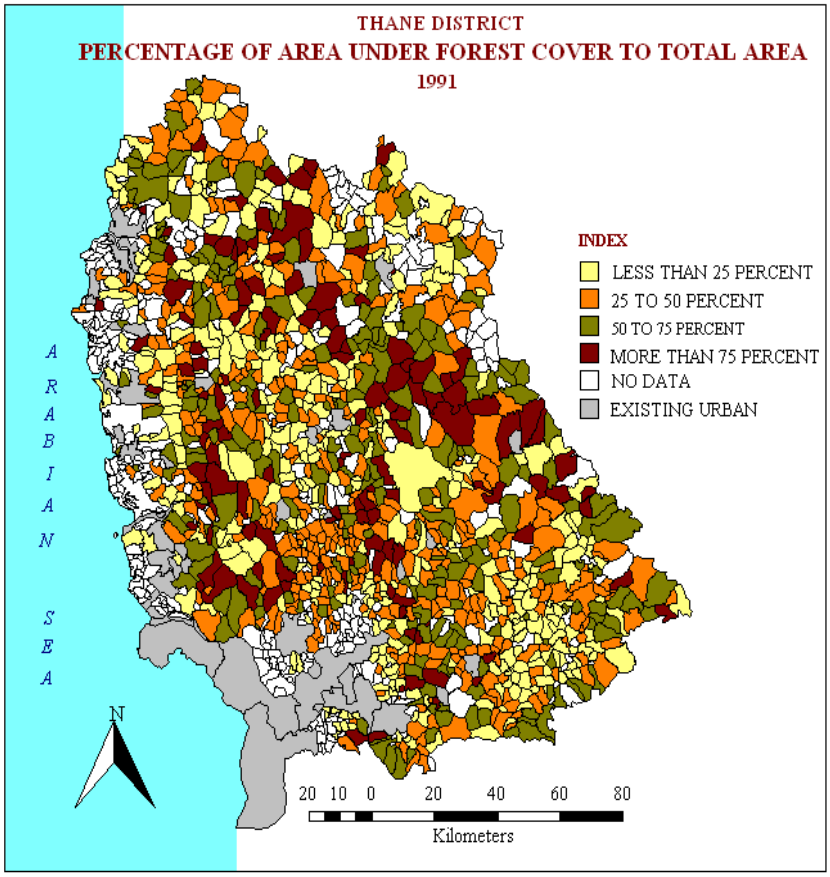
Forests, their types and species, have already been described in first chapter. The highest concentration of forest above 75 percent of the total area is observed in the areas of very high rainfall in the ghat section.

Map - 4.1 a, b & c reveals the spatial variations in the percent of area under forest cover to total area in the region (1991, 2001and 2009). It is observed from this exhibit that the forest cover decreases from east to west and from south east to North West in the region.

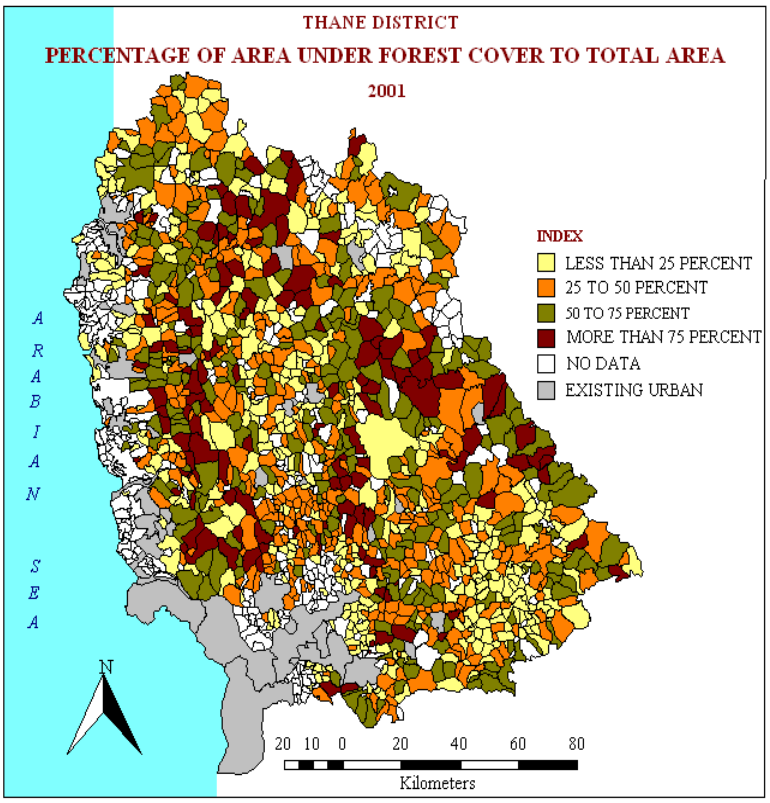
The maximum percent of land under forest cover is found (more than 75 percent) in the eastern part of the region, where as minimum or very less forest cover to the westwards. In the coastal plain most of villages forest cover is absent. The villages located

along the eastern side and central hilly region have more than 50 percent area under forest cover. More than 50 percent area under forest cover found in 266, 290 and 285 villages in the year 1991, 2001 and 2009 respectively. 432, 403 and 413 villages have 25 to 50 percent area under forest cover and less than 25 percent found in 377, 384 and 386 villages in the year 1991, 2001 and 2009 respectively.

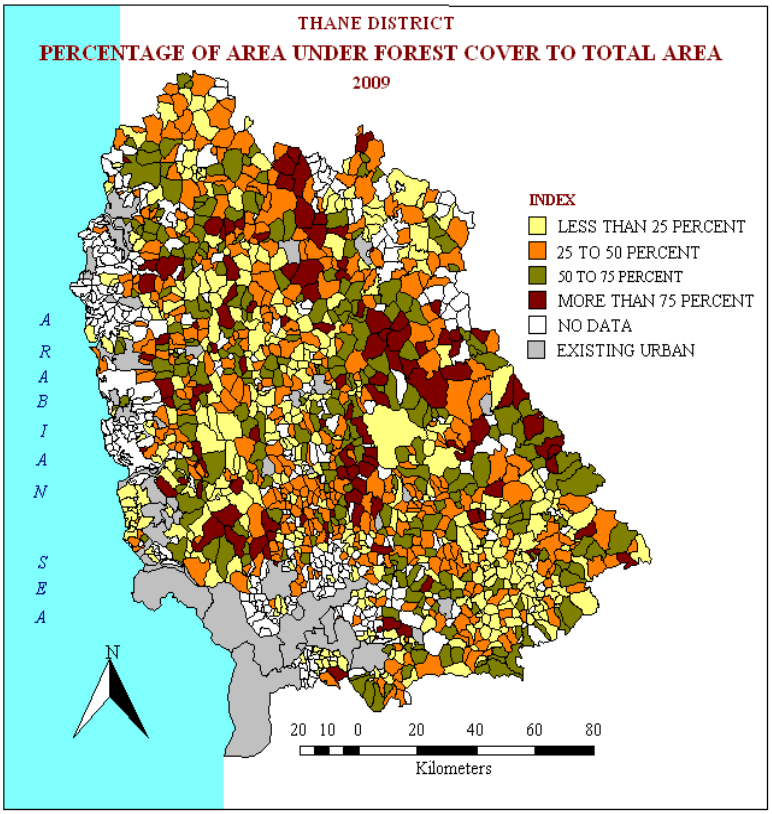
The spatial distribution of forest cover exhibits a tendency of high concentration (above 50 percent of the total area) in rugged , hilly, high rainfall areas (rainfall more than 2000 mm) In the western coastal plain and central lower valley region area under forest cover decreases to less 25 percent of the total area. High concentration of forest cover in the area bound by relief and slope.



Map– 4.1 A



Map - 4.1 B



Map - 4.1 C

2. LAND NOT AVAILABLE FOR CULTIVATION :

This is subdivided into following types:

a) LAND PUT TO NON AGRICULTURAL USES :

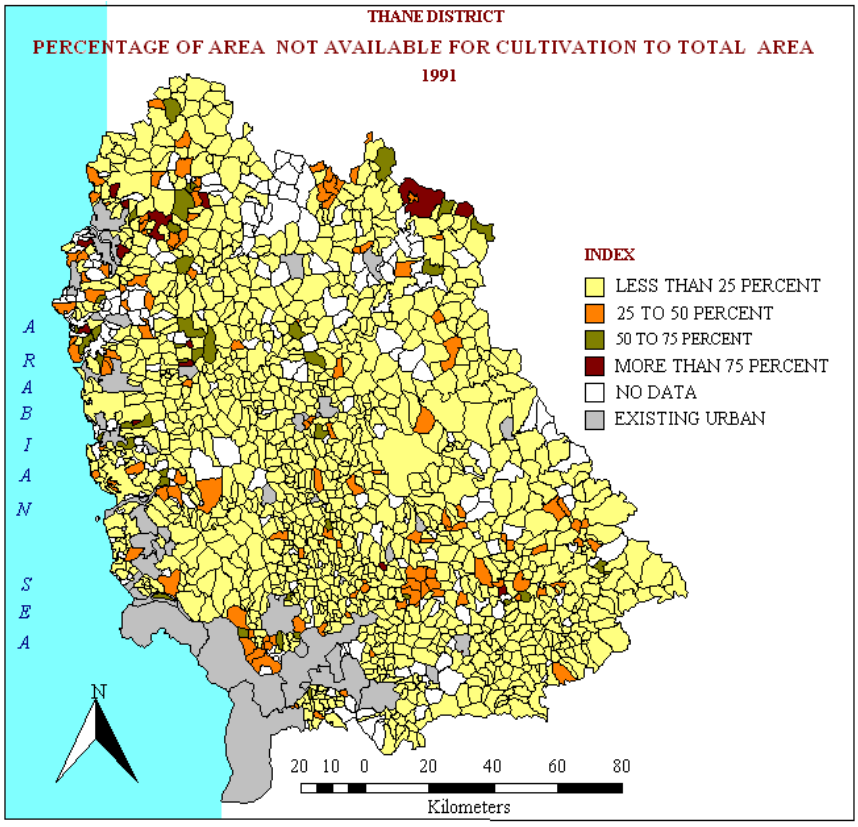
This type includes land occupied by settlements, roads, railways, streams, canals and rivers.

b) BARREN AND UNCULTIVABLE LAND :

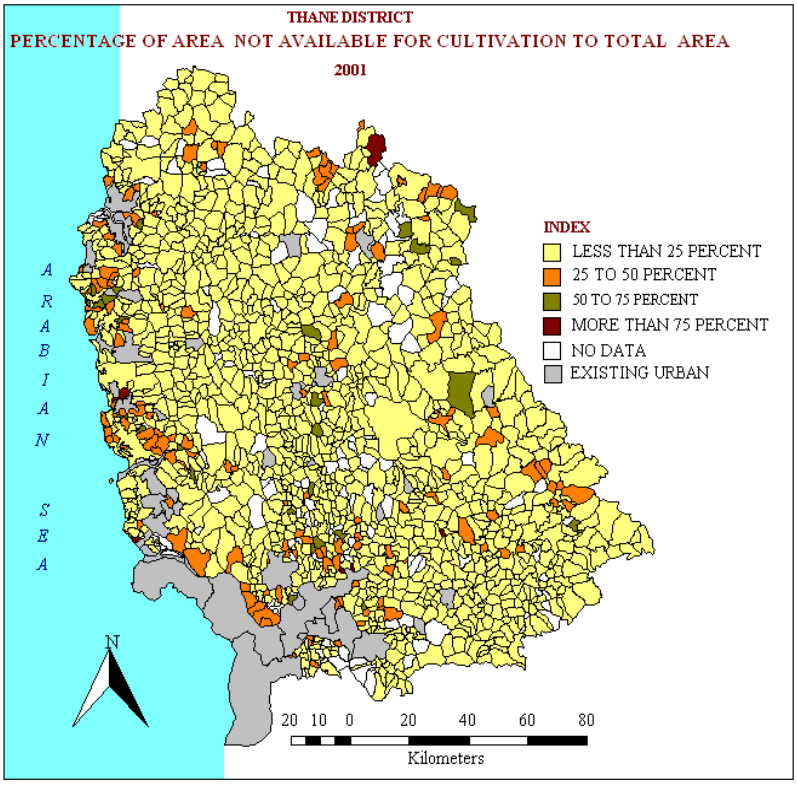
Includes outcrops of hills and mountains. The small part of this land can be brought under cultivation at very high costs. Generally barren and uncultivated land is associated with poor soils, heavy rain fall and intense erosion.

In the study area, the land not available for cultivation does not show much variation in different parts of the district. It varies in the range of about 10 to20 percent of the total area. However, some patches of marshy lands along the western coast and the adverse topographic conditions are reflected in a relatively higher proportion of land not available for the cultivation in the central, eastern side, high relief and steep slope areas of the eastern and northeastern parts. It accounts for 13.82 percent of total geographical area. This type shows considerable variation within the region ranging from less than 20 percent to 40 percent land under not available for cultivation. The maximum land under this category is confined to western margin (68.8 Percent) in the northeast and some patches in the south and central part of the region. The minimum land not available for cultivation is found at northwestern and southeastern part, maximum along the central railway line in the region. More than 60 percent area of land not available for cultivation is found in 21 villages.

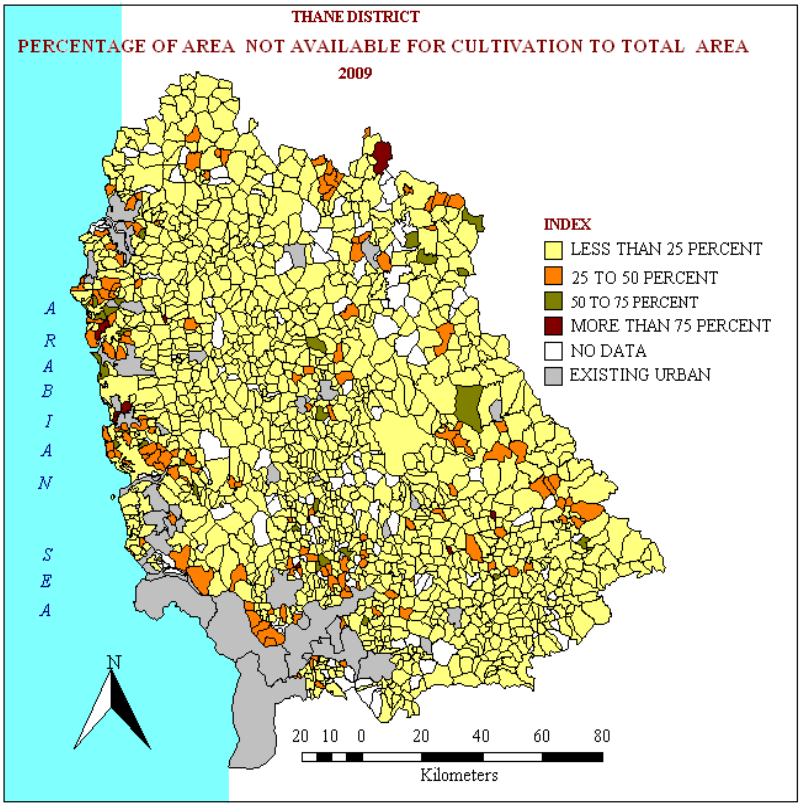
Forty four villages have 40 to 60 percent area under this category; this landuse category spread dispersal in patchy form in the region. One hundred eighty six villages have 20 to 40 percent area under land not available for cultivation. Most of the villages under this group concentrated in northern and south west part of the region. More than one thousand villages have less than 20 percent area under this category. MapNo. 4.2 a, b and c reflects that these villages are spread over each and every part of the area understudy.



Map - 4.2 A



Map - 4.2 B



Map - 4.2 C

3. CULTIVABLE WASTE:

The cultivable waste land includes other uncultivated lands excluding follow land. This category is divided into three types:

a) Permanent pastures and other grazing lands.

b) Miscellaneous tree crops and groves.

c) Cultivable waste.

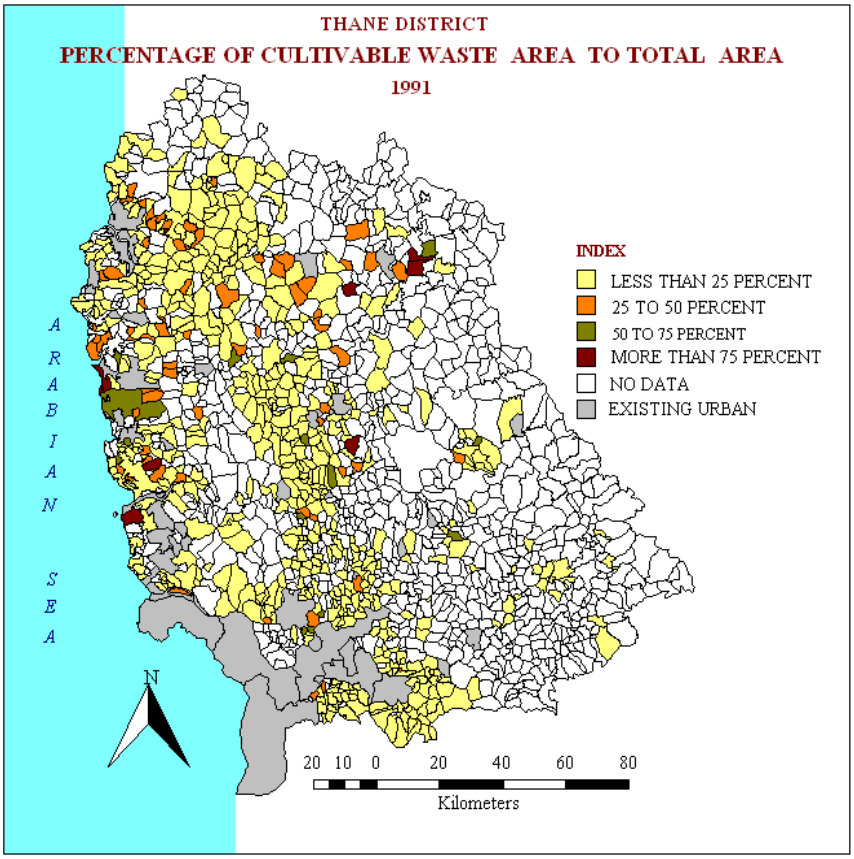
The permanent pastures and grazing lands include all land, i.e. under grass cover, government and private land or permanent pastures which are kept reserved as a village common grazing ground or vast tract of protected land, not open for free grazing and unreserved grass lands. The miscellaneous tree crops and groves include land under grass, bamboo, bushes and other groves for fuels etc. Which are not included in this category and the land not cultivated during the preceding five years is called cultivable waste.

The study area has 9.54 percent of total area under cultivable waste. It is more than that of Maharashtra state (7.97 percent). The spatial distribution of cultivable waste (Plate No. 4.3 a, b and c) exhibits a tendency of high concentration in the rugged, hilly, high rainfall areas. In central and western parts the area under cultivable waste exibits more than 50 percent of the total area. The cultivable waste is observed in various parts of the region ranging from less than 25 percent to 75 percent. The maximum cultivable waste is observed along the coastal tract and in central hilly tracts.

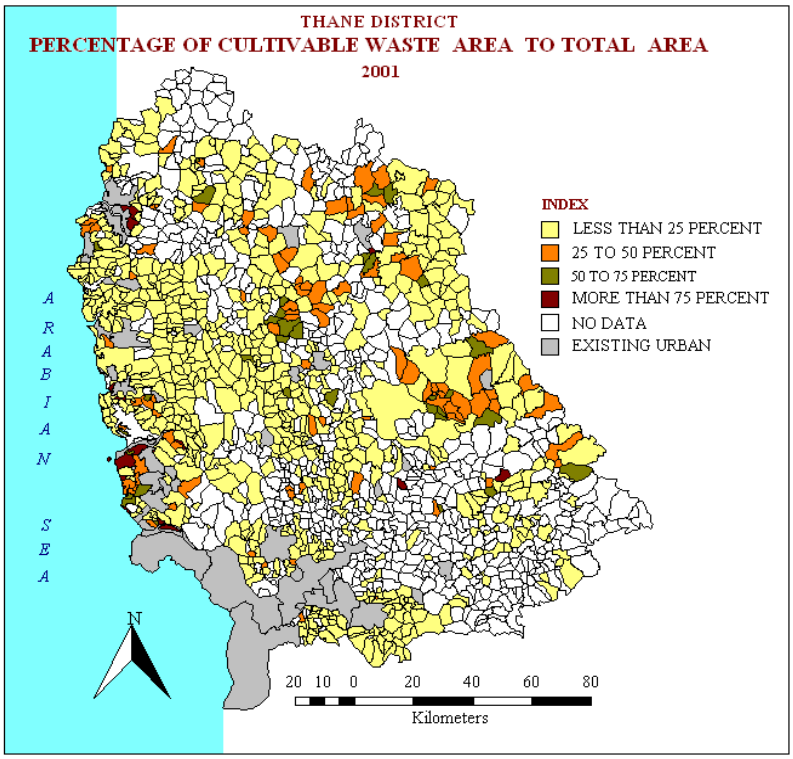
The high concentration of cultivable waste in the area bounded by coastal marshy tract, high rainfall zone could partly be attributed the existence of high level surface of

erosion which are identified by the existence of the top of hill ranges. Those high altitude or steep slopes are generally inaccessible and therefore cannot be easily brought under cultivation.

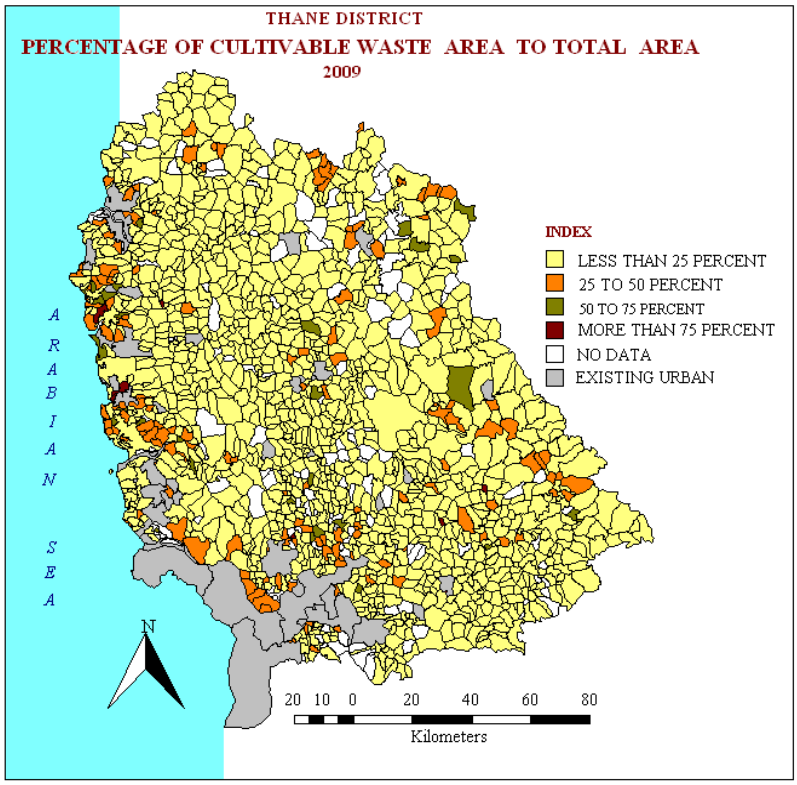
The areal extent of cultivable waste having more than 50 percent is observed as patchy in nature along eastern and western margins in the region. The expansion of cultivable waste has not been attempted at present due to fertile soil largely used for growing crops. The northwestern and northeastern part of the region has observed less than 25 percent of total area extended in 699 villages measures as minimum cultivable waste in the region. Rest of the villages has no area under this category in the region.



Map - 4.3 A



Map - 4.3 B



Map - 4.3 C

4) NET SOWN AREA:

This category includes all agricultural land, the land actually under food, cash and fodder crops including fallows. The Thane district has 33.32 percent land under cultivation to total geographical area showing relatively less than that of Maharashtra (38.27 percent). The proportion of NSA is relatively small (below 25 percent) in the rugged hilly areas in eastern part of the district, receiving rainfall above 2500 mm. At some places in the central and north eastern portion of these areas, the land available for cultivation is very small (less than 25 percent). Net sown area shows an increasing proportion westwards. The coastal plain and traditional zone has about 50 to 75 percent area in this category. In the central plateau region the valleys open up and the area is characterized by low plateau with moderate slopes. This change in the topography reflected in the increasing proportion of the net sown area to the total geographical area.

The coastal and middle zone display much higher proportion of net sown area than the adverse physiography would permit. This is mainly due to the fact that area under grass (fodder), which has been included in the net sown area, is considered in these tracts. These grass areas are not suitable for the crop production but they are the main areas of supply of fodder.

This situation of the landuse pattern of the region can be accounted for by its low level plain plateau region and hilly area and the share of forest cover of the Thane district.

Map - 4.4 A, B and C reveal the spatial variations in net sown area to total area in the Thane district. It is observed from this exhibit that net sown area increases from south to

north in the region. This is the outstanding trend of net sown area. This can be explained by the fact that eastern part of the study area is occupied by the hill ranges, which are stretching north -south parallel to the sea coast. This eastern hilly area is almost barren and covered by vegetation. This is unsuitable for agriculture due to poor fertility of soil. As a result, comparatively less percentage of area has been brought under cultivation. The western coastal part of the region is low -lying plain with medium black soils, suitable for extensive land under cultivation.

The maximum percent of land under net sown area is found at western coast, central lower valley tracts and southeastern part (75 percent) the minimum net sown area (less than 25 percent) in the northeast part of the region which lies in hilly area. The fertile coastal plain at northwest and western as well as in central low- lying area has been enabled to bring maximum land under crop.

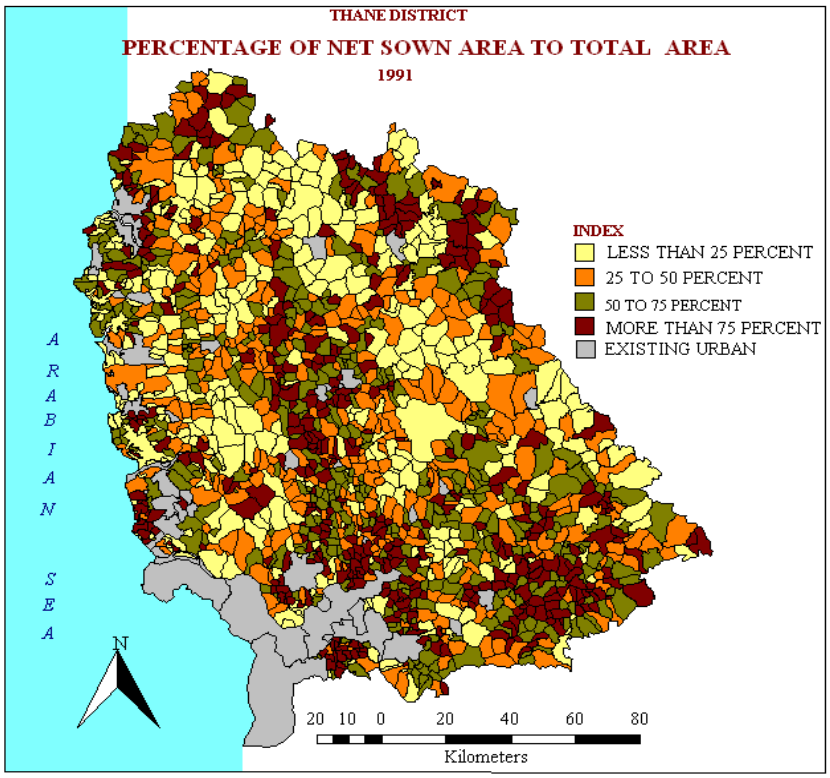
Three hundred fifty five villages have more than 75 percent net sown area to total area in the region. These villages are spread in five patches from south to north and along the western margins of the district. This region is a low level plain of fertile tract of alluvial coastal soil except few villages where unavailability of irrigation and local relief does not permit to increase net sown area. The extensive fertile tract in the western coastal alluvial soil in the central and eastern part appears to be favorable condition for raising various crops in lower valley alluvial fertile soil and hence attempts are being made to bring every piece of land under cultivation. These villages lie in the coastal plain of Thane

district where local physical and cultural environment permits to cultivate more land under cereals, vegetables, fruits etc.

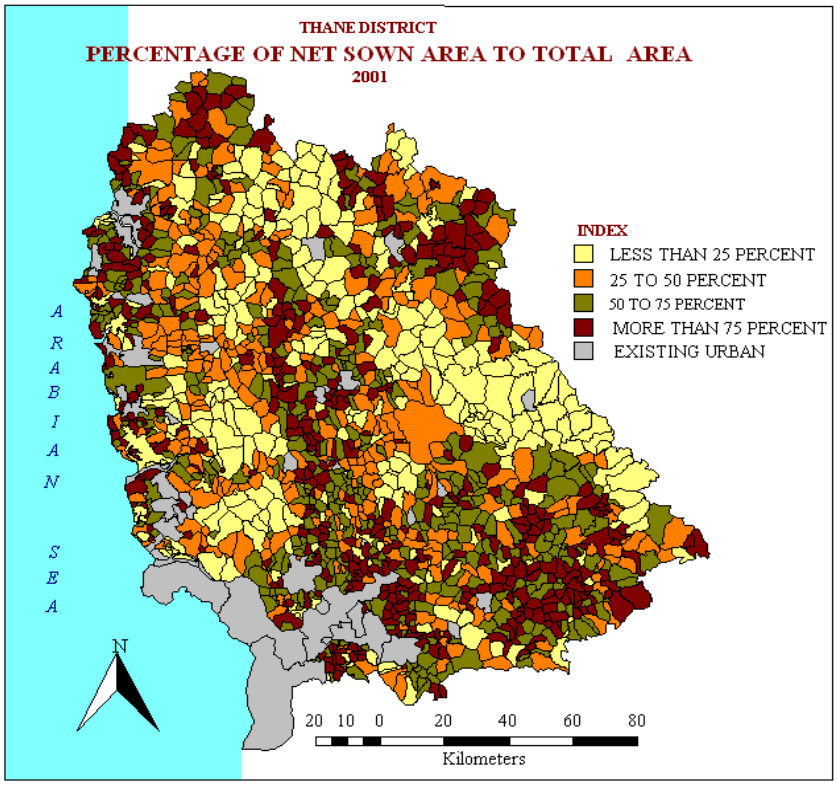
Four hundred sixty villages have 25-50 percent net sown area in the region, these villages mostly lie along the eastern part. Four five patches found in the western and central part (Map - 4.4 A, B and C). From south to north there are continuous patches with 25 to 50 percent land under crops.

Two hundred fifty one villages have less than 25 percent net sown area in the region. These villages are found along the eastern and central hilly tracts and some patches in the southeast part. There are some dispersed small pockets in the south east and northeast parts in the area under study.

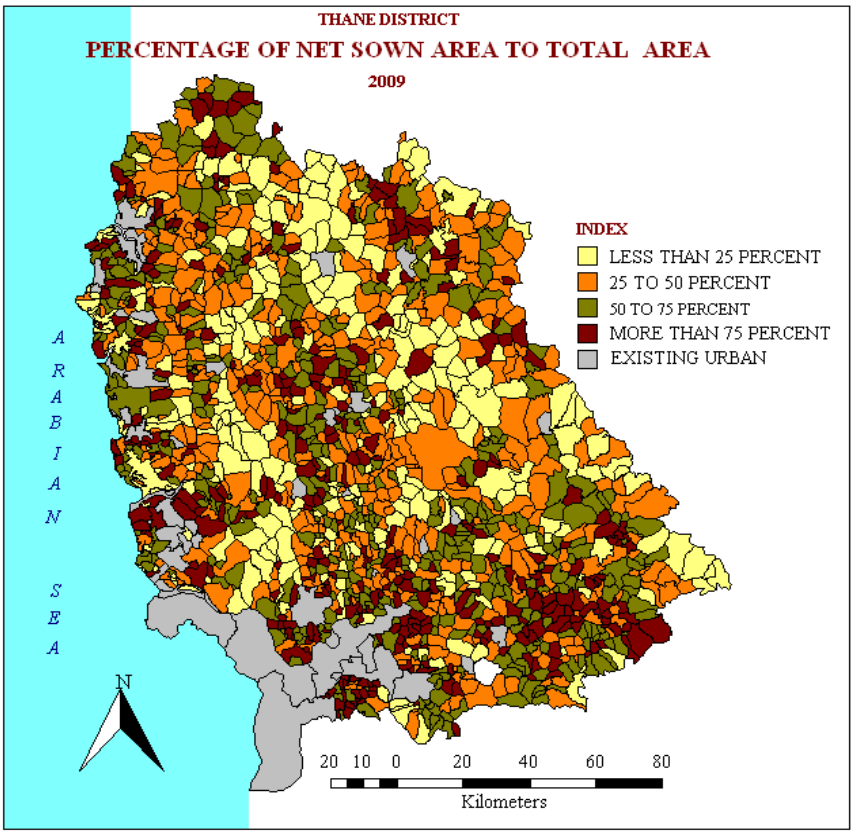
Less than twenty five percent net sown area found in villages, marked out in the south east and north east parts and three pockets in central part. Along the eastern part of study area a hill range stretching from south to north and central parallel range to the western coast. In these foothills villages have poor fertile soil and lack of irrigation facilities hence minimum area under cultivation. The hilly nature of the land and rugged local topography along eastern side acts as constraint on the expansion of net sown area. (Map 4.4 A, B and C).



Map – 4.4 A



Map - 4.4 B



Map - 4.4 C

FALLOW LAND:

The study area has 2.27 percent area (Table .4.3) under fallow land. The fallow land is generally divided into two categories.

a) Current fallow land and

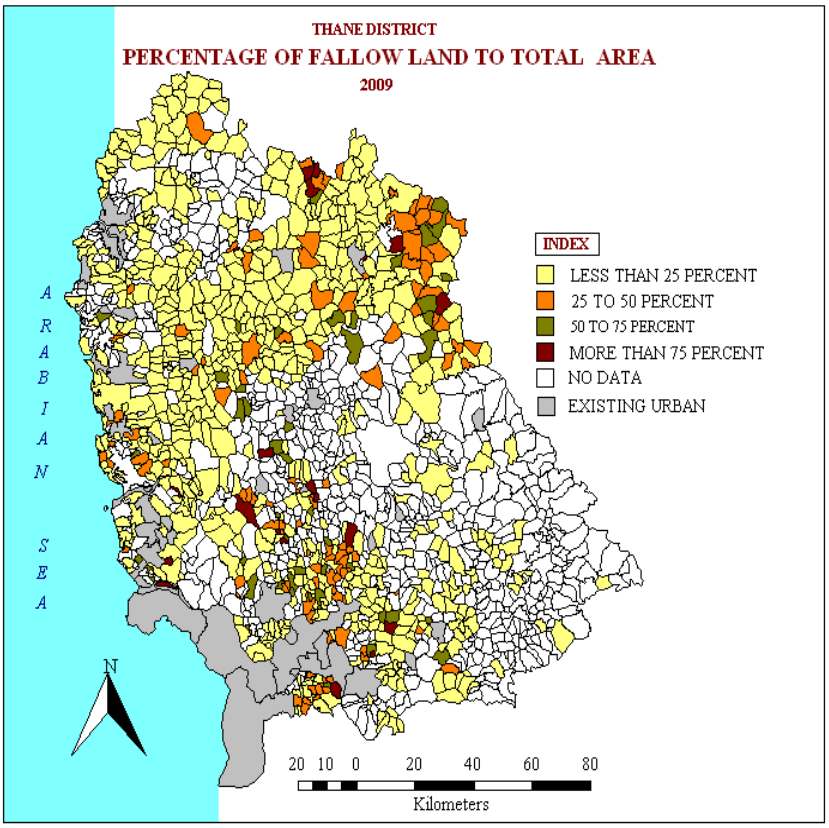
b) Other than current fallow.

The current fallow land includes the land which is not cultivated during current year due to a variety of reasons i.e. as phase of rotation for regaining fertility or due to some other constraints. The land other than current fallow includes arable area which is taken up for cultivation but has gone temporarily out of cultivation for a period of not more than five years. The magnitude of fallow land varies from village to village in the region. It ranges from 10 percent to 60 percent. Fallow land

gradually decreases east to west and increases eastward from sea coast parallel to the hilly tracts. It is observed that maximum land (above 60 percent) under this category is confined to central hilly tracts where as the minimum percent fallow land at the western part of district is in the coastal plain and south eastern part. The fallow land is spread out over northwest to northeast parts and some pockets in the southern part.

More than sixty percent fallow land is concentrated in 36 villages, spread in central and south east parts of the district. These villages are found in patchy form in south and north east parts of the region.

Six hundred sixteen villages have less than twenty percent fallow land, found in northwest and western part in the district. Maximum in northern part and some pockets in south and south-east part of the region. In southern part there are some isolated pockets but western and northwestern part is shown (Map 4.5) continuous under this group of less than twenty percent of fallow land.



Map - 4.5

The distribution of various categories of landuse described in the preceeding paragraphs of this chapter brings out certain characteristics of the distributional pattern of the various categories of landuse. These variations are described through the maps prepared on the basis of data compiled at the village level. As would be apparent from the distribution maps in the chapter, the broad variations are, in terms of location in eastern, western, central or northeastern part of the district, a sequence which holds well in case of variations in relief, slope, soil types and cultural aspects as well.

CHAPTER - V

AGRICULTURAL LAND USE

Agricultural landuse is the result of inter-action between man and environment. Besides physical factors such as relief, climate and soils, agricultural landuse are also affected by socio–economic and technological factors. The term “Agricultural Landuse” denotes the extent of the gross cropped area during the agricultural year under various crops. It is the result of the decision made by the farmers regarding the choice of crops and methods for production. Thus, this decision making is based on not only physical constraints and limitations but also on farmer’s perception of the total environment. His perception of environment is related to contents and nature of available information, much of which is based on traditional approach. The physical as well as cultural environment affects on crop growth and production.(Vaidya B.C.)

The present study is mainly directed at the appreciation of variation in agricultural landuse over the area of the Thane district. It is also related to the changes undergone in the spatial distribution of agricultural use of land, which is result of the direct application of efforts to the available land resources. The quality or the nature and the quantity of the efforts applied are related to the decision made by farmers regarding the actual use of land. These decisions are based on his appreciation of the available land resources. The cumulative effects of the farmers decisions regarding the choice of crops, the methods of tillage and his appreciation of the land resources (Physical Environment) is reflected in the spatial as well as temporal variations in the agricultural landuse in an area.

The present chapter attempts to study the spatial variations in the agricultural landuse, It shows a great diversity concerning the

variety of crops, the type of land under cultivation and the crop combinations. In view of these considerations the agriculture landuse is studied in this chapter with reference to the cropping pattern, temporal variation in the cropping pattern, crop ecology and the spatial distribution of various crops, methods of farm operation and to discuss the possible causes for the existing pattern of cropland in the region.

The areas under various crops have been obtained for Thane district and it was converted into percentage to net sown area, which are later used for depicting the distribution of individual crops. The distribution patterns show variations in agricultural landuse in the Thane district. The district census Hand book, Thane District Gazetteer and Socio - economic Abstract of Thane District have been further used for explaining the agricultural pattern of landuse.

The spatial variations in the agricultural landuse are considered in this chapter. These variations find out a direct expression in the cropping pattern in study area which in turn related to crop ecology and tillage of land. In respect of these considerations the agricultural landuse is studied in this chapter with reference to the cropping pattern, temporal variations in the cropping pattern, crop ecology and spatial distribution of various crops.

CROPPING PATTERN:

Variation in the areal proportion under various crops at a point of time in any area results in the cropping pattern. The cropping pattern therefore can be described in terms of areal statistics. Evolution of cropping pattern in any area is mainly the result of decisions made by the farmer. It is in response to various physical

and cultural factors and hence shows spatial as well as temporal variations.

The existing cropping pattern may not be necessarily the most efficient use of land resources and there is always a scope for change in

response to the improvement in technology, economic factors and the nature of demand. The term cropping pattern in its comprehensive sense may also incorporate both the time and space sequence of crops based on the identification of the significant crops in the study area, the rotation of crops and intensity of crops.

The agricultural efficiency can be determined by considering the ratio of the total cropped area to the net sown area as one of the parameters. Recognizing the fact that the present landuse is a result of interplay of resources and human society, it is necessary to appreciate the present development in relation to the potential in terms of higher level of development in technology.

AGRICULTURAL SEASONS AND CROPS:

There are two agricultural seasons in this study area viz. Kharif and Rabi. However the area has a negligible area under cultivation in Rabi season. Kharif is the main season of this region and stretches from June to October. Paddy (rice) is the principal crop of the region grown in this season and stretches from June to October, Followed by rice, most of the net sown area is under grass (Fodder crop) crop and ragi, vari are also grown in this season. Owing to the inadequate irrigation facilities, most of the crops are dependent on monsoon. The first shower of rain in June helps the cultivators to proceed with sowing of paddy for its seedlings. Cultivators begins to prepare the soil for transplanting the paddy

seedling in the month of July. Harvesting of paddy commences in the last week of October and is continued till the end of November.

Rabi season commences from October and continues till the end of January. Some pulses like Val and Gram are grown in this season. They are sown in October-November and harvested in February-March. At the same time and during rest of the year vegetables are grown, wherever the irrigation facilities are available in the region.

Temporal Variation in Agricultural Landuse Pattern (1981-2009)
Area Under Food Crops (Percentage of The Net Sown Area)

Year	Cereals				Total	Pulses							Total Pulses	Total Food grain	Condi-ments and Spices	Fruits				Total Fresh Fruits And Dry Fruits	Total Vege-tables	Total Fruits and Vege-tables	Total Food Crops
	Rice	Ragi	Vari	Other		Gra m	Green Gram	Red Gram (Tur	Black Gram (Udid)	Horse Gram (Kulith)	Indian Bean	Cow pea				Banana	Mangos	Chiku	Other Fruits and Dry Fruits				
1980-81	57.76	7.26	4.48	0.15	69.67	0.75	0.04	1.07	1.46	0.16	0.198	0.24	3.93	73.20	0.24	0.08	0.12	0.32	0.12	0.65	0.99	1.63	74.83
1982-83	54.10	8.40	4.46	0.11	67.08	0.45	0.08	1.07	1.37	0.19	0.22	0.23	3.63	70.75	0.23	0.35	0.12	0.30	0.11	0.87	1.18	2.06	72.81
1984-85	52.32	8.19	4.28	0.11	64.91	0.48	0.07	1.03	1.25	0.18	0.18	0.18	3.39	68.38	0.22	0.33	0.15	0.29	0.07	0.85	1.29	2.14	70.53
1986-87	48.77	6.92	3.81	0.10	59.61	0.50	0.10	1.27	1.20	0.20	0.60	0.20	4.08	63.83	0.20	0.30	0.13	0.27	0.07	0.77	1.10	1.87	65.70
1988-89	48.29	6.67	4.43	0.16	59.56	0.44	0.42	1.38	1.70	0.39	0.86	0.16	5.36	64.93	0.13	0.32	0.13	0.29	0.09	0.83	1.31	2.15	67.08
1990-91	42.38	5.92	3.91	0.05	52.28	0.73	0.28	1.24	1.50	0.11	0.85	0.14	4.87	57.15	0.11	0.26	0.23	0.51	0.12	1.10	1.19	2.29	59.45
1991-92	41.14	5.35	3.30	0.05	49.86	0.62	0.22	1.12	1.17	0.08	0.84	0.14	4.20	55.00	0.16	0.19	0.27	0.44	0.14	1.03	1.47	2.51	57.59
1992-93	39.77	5.16	3.23	0.07	48.25	0.95	0.21	1.11	1.40	0.08	1.27	0.13	5.16	53.44	0.13	0.19	0.29	0.42	0.08	1.03	1.40	2.43	55.87
1993-94	39.81	5.25	3.25	0.10	48.43	1.01	0.45	0.96	1.70	0.56	0.74	0.13	5.57	54.06	0.19	0.19	0.35	0.75	0.05	1.38	1.46	2.85	56.98
1994-95	40.85	5.24	3.17	0.02	49.31	1.13	0.16	0.84	1.56	0.08	0.74	0.13	4.66	54.13	0.16	0.19	0.34	0.74	0.05	1.37	1.45	2.83	56.96
1995-96	39.46	5.21	3.15	0.07	47.91	1.07	0.13	0.81	1.76	0.08	0.73	0.16	4.76	52.76	0.16	0.18	0.57	1.08	0.05	1.92	1.26	3.18	55.95
1996-97	41.06	5.30	3.17	0.10	49.66	1.07	0.05	0.72	1.23	0.08	0.78	0.16	4.12	53.78	0.19	0.19	0.59	1.18	0.11	2.07	1.15	3.23	57.01
1997-98	41.48	5.43	3.22	0.10	50.25	0.98	0.03	0.81	1.31	0.08	0.62	0.19	4.04	54.30	0.16	0.19	0.60	1.20	0.08	2.07	1.44	3.52	57.83
1998-99	41.46	4.55	4.81	0.02	50.86	1.05	0.03	0.91	1.37	0.08	0.70	0.21	4.36	55.30	0.19	0.24	1.88	1.18	0.06	3.52	1.26	4.79	60.09
1999-00	40.14	4.97	4.89	0.11	50.12	0.67	0.25	0.81	1.40	0.08	0.59	0.22	4.05	54.17	0.20	0.25	2.11	1.24	0.08	3.82	1.32	5.17	59.32
2000-01	39.01	4.65	5.17	0.02	48.87	1.59	0.11	0.82	1.43	1.05	0.60	0.33	5.94	54.81	0.17	0.17	2.15	1.29	0.08	3.77	1.54	5.31	60.13
2001-02	39.68	4.50	2.73	0.02	46.94	1.07	0.25	0.75	1.43	1.01	0.98	0.73	6.24	53.22	0.17	0.17	2.22	1.80	0.53	4.75	1.37	6.13	59.35
2002-03	40.74	4.64	3.56	0.02	48.98	1.01	0.23	0.78	1.36	0.67	0.58	0.34	4.99	54.06	0.17	0.20	2.00	1.88	0.55	4.81	1.50	6.32	60.38
2003-04	40.54	4.60	3.68	0.02	48.86	1.06	0.23	0.77	1.35	0.78	0.74	0.54	5.49	54.47	0.20	0.29	1.75	1.95	0.48	4.69	1.64	6.33	60.80
2004-05	40.29	4.54	3.48	0.02	48.35	1.08	0.23	0.77	1.34	0.40	0.37	0.25	4.45	53.95	0.26	0.26	1.17	2.25	0.54	4.48	1.91	6.40	60.36
2005-06	39.73	4.47	4.10	0.02	48.33	1.16	0.34	0.91	1.70	0.80	0.77	0.51	6.20	53.74	0.26	0.31	0.68	2.39	0.85	4.50	1.87	6.38	60.12
2006-07	39.43	4.44	3.43	0.05	47.36	1.15	0.25	0.81	1.40	0.73	0.59	0.25	5.20	52.60	0.26	0.34	0.39	2.42	0.87	4.27	2.02	6.30	58.90
2007-08	38.61	4.33	3.21	0.05	46.21	1.12	0.22	0.68	1.28	0.77	0.49	0.33	4.91	51.20	0.22	0.30	0.41	2.41	0.88	4.25	1.94	6.20	57.40
2008-09	37.85	4.30	2.80	0.02	44.99	1.15	0.22	0.86	1.45	0.73	0.59	0.32	5.33	50.40	0.24	0.30	0.43	2.39	0.88	4.25	1.96	6.22	56.62

Source: Season and Crop Reports for the respective years Commissionerate of Agriculture, Pune, Government of Maharashtra

Table - 5.1

Area Under Non Food Crops ('00'Ha.)

Year	Fiber crops	Edible Oil Seed				Total Edible Oil Seed	% of Total Edible Oil seed	Total Non Edible oil seed	% of Total Non Edible oil seed	Total oil seed (Edible +Non Edible)	% of Total Oil Seed	Drugs And Narcotics	Total Drugs And Narco-tics	Fodder			Total fodder Crops	% of Total fodder Crops	Total Non – Food Crops	% of Total Non – Food Crops
		Ground Nut	Coconut	Seasamum (til)	Mustard + (Others)							Betel leave (Nagvel)		Grass & Babhul	% of Grass & Babhul	Other fodder Crops				
1980-81	5	1	2	3	10	16	0.64	19	0.75	35	1.38	0	0	582	23.10	12	594	23.58	634	25.16
1982-83	5	1	1	3	0	5	0.19	18	0.68	23	0.87	3	3	680	25.96	1	681	26.00	712	27.18
1984-85	4	1	1	3	0	5	0.18	18	0.66	23	0.84	3	3	768	28.36	0	768	28.36	798	29.46
1986-87	5	1	1	4	1	7	0.23	48	1.60	23	0.76	3	3	994	33.25	0	994	33.25	1025	34.29
1988-89	4	5	2	10	0	17	0.54	36	1.15	53	1.70	6	6	962	30.89	0	962	30.89	1025	32.91
1990-91	4	4	2	9	14	29	0.82	21	0.59	50	1.42	4	4	1361	38.58	11	1372	38.89	1430	40.54
1991-92	4	4	1	11	0	16	0.44	31	0.84	47	1.28	4	4	1497	40.90	0	1497	40.90	1552	42.40
1992-93	5	4	1	13	0	18	0.47	33	0.87	51	1.35	4	4	1606	42.53	0	1606	42.53	1666	44.12
1993-94	3	4	4	5	0	13	0.35	48	1.28	61	1.63	4	4	1544	41.20	2	1546	41.25	1614	43.07
1994-95	2	4	4	9	0	17	0.45	24	0.63	41	1.08	4	4	1576	41.76	1	1577	41.78	1624	43.03
1995-96	2	3	2	8	0	13	0.34	24	0.63	37	0.97	4	4	1628	42.86	2	1630	42.91	1673	44.05
1996-97	1	3	5	3	0	11	0.29	23	0.62	34	0.92	4	0	1558	41.98	2	1560	42.03	1595	42.98
1997-98	1	3	15	3	0	21	0.57	23	0.63	44	1.20	4	4	1494	40.83	0	1494	40.83	1543	42.17
1998-99	2	3	20	3	0	26	0.70	23	0.62	49	1.32	3	3	1425	38.36	3	1428	38.44	1482	39.90
1999-00	2	4	20	14	2	40	1.12	23	0.64	63	1.77	2	2	1369	38.51	10	1379	38.79	1446	40.67
2000-01	5	4	23	14	2	43	1.18	24	0.66	67	1.84	2	2	1362	37.49	12	1374	37.83	1448	39.86
2001-02	2	4	24	9	2	39	1.09	20	0.56	59	1.66	2	2	1367	38.47	14	1381	38.86	1444	40.64
2002-03	2	2	20	9	2	33	0.95	3	0.09	35	1.01	2	3	1320	38.30	5	1325	38.45	1365	39.61
2003-04	2	2	19	9	2	32	0.92	4	0.11	36	1.03	2	2	1316	37.87	6	1322	38.04	1362	39.19
2004-05	3	2	20	7	2	31	0.88	4	0.11	35	1.00	2	2	1340	38.29	7	1347	38.49	1387	39.63
2005-06	2	2	21	8	2	33	0.94	6	0.17	39	1.11	2	4	1350	38.45	5	1355	38.59	1400	39.87
2006-07	2	2	22	9	2	35	0.98	2	0.05	37	1.04	2	3	1410	39.66	9	1419	39.91	1461	41.09
2007-08	2	2	21	7	2	32	0.87	2	0.05	34	0.93	2	2	1510	41.44	4	1514	41.54	1552	42.59
2008-09	2	2	23	7	2	34	0.91	2	0.05	36	0.97	2	2	1565	42.14	6	1571	42.29	1611	43.37

Source: Season and Crop Reports for the respective years Commissionerate of Agriculture, Pune, Government of Maharashtra. Table - 5.2

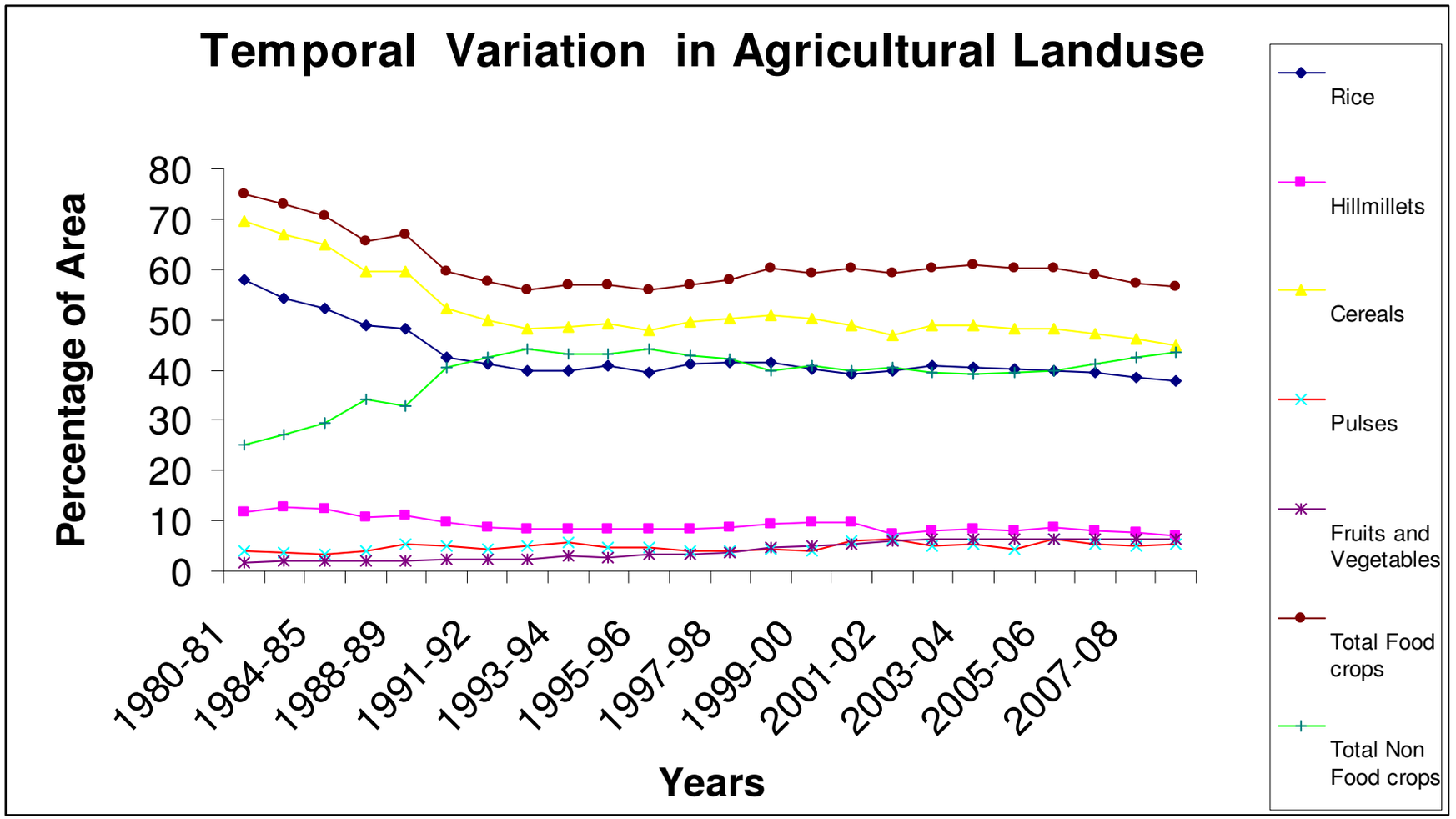

Temporal Variation in Agricultural Landuse
Percentage of Area
80
70
60
50
40
30
20
10
0
1980-81
1984-85
1988-89
1991-92
1993-94
1995-96
1997-98
1999-00
2001-02
2003-04
2005-06
2007-08
Years
Rice
Hillmillets
Cereals
Pulses
Fruits and Vegetables
Total Food crops
Total Non Food crops

Fig.5.1

TEMPORAL VARIATION IN AGRICULTURAL LANDUSE PATTERN

The cropping pattern undergoes changes in response to the changing physical and cultural environments. For an appreciation of such temporal variations in the study area, these changes are analyzed over period of twenty years by studying areal strength of individual crops in relation to the net sown area. Moreover, there is a steady change in cropping pattern. The factors for such changes in cropping pattern differ from village to village and from region to region.

Table - 5.1 displays the temporal variation in cropping pattern in the Thane district from 1981-82 to 2008-09. The identified possible main features of temporal variations in cropping pattern can be summarized as below.

Some individual crops are grouped together for computational convenience. The major classes of crops are:

1) Cereals : Rice, Nagali, Vari, (Hill Millets)

2) Pulses : Gram, Green gram (Mung),Tur,Black gram(Udid), Indian Bean, Cow pea, Horse gram, etc.

3) Oil Seeds : Ground nut, Seasamum, Coconut, Mustard, Niger seed, etc.

4) Cash Crops : Fresh fruits and dry Fruits Vegetables Condiments and Spices

Cereals:

The ever increasing demand for food in a densely populated country like India is reflected in the areal spread of cereals which

have occupied about 45 percent of the net sown area in 2009. The volume of change is considerable through out the period of about last three decades. Importance of cereals some what declined in the decade of 1981 to 1991 (69.67 to 49.86 percent). After that in the next decades i.e. 1991-2001 (48.87 percent) and in 2001-2009 it declined to 44.99 percent. Total decrease in cereals during the study period is 24.68 percent.

DISTRIBUTION OF CROPS

1) RICE (PADDY):

As Rice is the most important crop in the tropics, it is the first important crop among the first ranked food crops in the study area too and occupied 57.76 per cent of net sown area in 1981. Many varieties of rice are grown according to their local conditions. Rice is predominant in the area under review since 1981. The areal extent of rice has recorded steady decrease during the study period.

The total decrease in rice cultivation is 19.91 per cent from 1981-82 to 2008-09. (Table 5.1) Rice cultivation in the year 1981-82 was 57.76 percent and it decreased by 19.91 per cent in 2008-09 (37.85 per cent). Change in agricultural landuse and cropping pattern may be responsible for decreasing area of rice cultivation in the region.

2) Hill Millets:

All the hill millets together occupied significant proportion (7.12 per cent of NSA) of the cropland of the district in 1985. Hill millets like Ragi, Vari, Nachani etc. were grown successfully before 1981 in the district. It consisted of 7.26 per cent Ragi and 4.48 per cent Vari to total NSA (1981-82). The volume of Ragi has decreased by 2.96 per cent (7.26 per cent in 1981 and 4.30 per cent in 2008-09) and that of

Vari decreased by 1.68 per cent (4.48 per cent to 2.80 per cent 1981-82 and 2008-09). Hill millets display a remarkable volume of change in last three decades.

3) PULSES:

The areal extent under pulses in the region is 5.33 percent (2008-09). Pulses was successfully cultivated before (1981-82) in the region (3.93 per cent of total net sown area). Pulses form an important source of protein supply in the daily diet of people, about 5.33 per cent of NSA is occupied by pulses. There is steady increase area under pulses registered every year. It has increased by 1.4 per cent in 2008-09(5.33 per cent of total in net sown area). Gram, Horse gram, red gram and black gram are important pulse crops grown in the region. Black Gram and Gram are important pulses which occupied 2.50 percent of net sown area in 2009. With a slight increase from 1981 to 2009 (2.21 to 2.50 percent). Total pulses showed an increase in the volume in 1991 and 1993 and a negative trend in 1998 (4.04 percent). Again the volume has shown signs of increase in 2001-2002 (6.24 percent) and 5.33 percent to total NSA in 2009.

4) FRUITS:

Fruits are mostly grown in the coastal area. The important fruits grown in the region are bananas, mangoes, chikus etc. They occupied an area of 4.25 per cent to net sown area in 2008-09. The table number 5.1 shows the area under fruits in the region. The area under fruits in the region in 1981 (0.65 per cent to net sown area) has increased by 3.60 per cent in 2009. After 1981 area under fruits continuously increased from 0.65 per cent to 4.25 per cent in 2009. The introduction of new high yielding varieties of fruits and keen

interest taken by the government for increasing area and yield of fruits may be responsible for increasing area under fruits in the region.

5) VEGETABLES:

Vegetables occupied an area of 1.99 per cent of total net sown area in 2009. Brinjal, lady's finger, raddish, chilli, sweet potato, cabbage, fenugreek, etc. are the main vegetables grown in the region. Table - 5.1 shows 0.99 per cent to net sown area under vegetable in 1981-82. Vegetable grown has increased during 1981 to 2009 by 0.97 percent to net sown area. It is observed that area under vegetables has slightly increased from 1981 to 2009.

6) Grass (fodder):

Grass occupies second place after rice in the district, as it has occupied 42.14 per cent of net sown area in the region (2009). In this region in 1981, 23.10 per cent of total land to net sown area was devoted to grass. Grass is mentioned as a crop by revenue authorities in this region, because grass has high economic value. The annual harvest of grass per farmer ranges from less than 500 kg. to 5000 kg. Output is not a product of effort and input but is related to the amount of land under grass.

The area under grass has increased from 1981-82 (23.10 percent) to 2008-09 by 19.04 per cent (42.14 to net sown area). Area under grass steadily increased. Total area under grass increased by 19.04 per cent during study period i.e.1981-82 to 2008-09. This area under grass increase may be the result of decrease in area under forest and rice cultivation.

7) Coconut:

Coconut is mostly grown in coastal villages. It extended over the areas of 0.61 per cent to net sown area in 2008-09. Area under

coconut has steadily increased from 1981-82 to 2008-09. In 1981-82, area under coconut was 0.08 per cent to net sown area, thereafter it has increased by 0.53 per cent in 2008-09.(i.e. 0.61 per cent to net sown area in 2008-09).

Pests and plant diseases cause a serious loss to agriculture production. It is not always possible to estimate accurately the extent of loss caused by the pests as it depends upon the severity of infestation in any particular year.

There are various pests of crops known to the region, Rhinoceros beetle is stoat elongated, kind of pest and is harmful to coconut plant and big trees. It may be the cause of insignificant area under coconut in the region.

8) Betel leaf – (Panveli / Nagveli):

It is purely garden crop grown only for its leaves and is obtained from creeper known as Panvel or Nagvel. In the area under study 0.11 per cent to net sown area was under Betel leaf in 1981-82. The land under betel leaf increased by 0.08 per cent in 1988-89. After 1988-89 area under this crop again decreased by 0.14 percent in 2008-09. These changes in the area under betel leaf may be due to various factors i.e. physical and cultural. The cultivation of betel-vines is very costly and requires adequate financial strength.

9) Oil Seeds:

Variety of oil seeds cultivated in the region, occupied very insignificant proportion of net sown area. Ground nut, mustard, seasamum (Til) and other non edible oil seed like niger seed occupied 0.97 per cent to net sown area in 2008-09. Area under oil seeds has decreased by 0.41 per cent (1.38 per cent in 1981-82 and 0.97 per cent in 2008-09).

9) OTHER MISCELLANEOUS CROPS:

Other miscellaneous crops have remained unaffected during the study period.

The temporal variation reflects the major changes with upward trend in the area under grass fruits and vegetables and hence, the hectarage of these crops have steadily increased .Rice, ragi and vari have not registered increase in hectarage in the region. The area under pulses and coconut have steadily increased over the year.

The net sown area has not changed much in last two decades i.e. 1991 to 2009 but the area cropped more than once has increased noticeable since 1981.

CROP ECOLOGY AND SPATIAL DISTRIBUTION OF AGRICULTURAL LANDUSE

Crop Ecology:

Crops show a marked tendency to adopt themselves to a wide range of environment but the crops also require a specific set of physiological elements for their optimum growth. The spatial distribution of crops is better understood if correlation with crop ecology. Crop ecology is the study of physical environmental requirements of crops. The physical environment is represented by the following factors:

1. Climatic factor : Temperature, precipitation, humidity and Sun light.
2. Physiographic factor : Relief i.e. altitude and slope.
3. Edaphic factor : Soil charactristics and distribution.
4. Biotic factors : Association of different plants which may be helpful, neutral or harmful.

The Thane district is agricultural dominant region of North Konkan, involving 24.00 percent working force in agricultural practice. The crops, namely, rice, pulses, vegetables, fruits, grass, coconut, betel leaf are cultivated in the region. The variation in areal extent under these crops is mostly depending on local environment and traditional approach of farmers in the area under review. Besides these soil types, nature of relief (slope), Irrigation facilities etc. influence the crop cultivation and cropping pattern.

The relative significance of crops and their spatial variations in the area under review was studied in detail with studying crops ecology and spatial distribution of crops in the region.

AGRICULTURE LANDUSE OF THANE DISTRICT (2008-09):

Sr.No	Crops	Area (In '00' Hectares)	Percent of Net Sown Area
1.	Rice (Paddy)	1406	37.89 %
2.	Hill Millets	264	7.19 %
3.	Pulses	198	5.38 %
4.	Vegetables	73	1.97 %
5.	Fruits	158	4.24 %
6.	Oil Seeds	36	0.97 %
7.	Grass and Other Fodder Crops	1571	42.36 %
	TOTAL	3706	100.00%

Source: Revenue Village Record for the respective Tahsil's of Thane District. (2008-09)

Table - 5.3

1) RICE (PADDY) :

Rice is the principal crop in the study area. It is rain fed crop cultivated in Kharif season. This crop is cultivated in one hundred and twenty eight villages occupying 12319.33 hectares (57.23 per

Cent to net sown area). The average annual rainfall amount and climatic conditions in the region favour the cultivation of rice in every village.

ECOLOGICAL CONDITIONS:

Rice is mainly a tropical crop. It thrives well under high temperature and humidity. The distribution of rice depends upon climatic conditions than soil types. Rice is a crop of very wide physiological adaptability. The temperature range for the rice cultivation is between 20^0C to 37^0C. Rice can grow in all types of soils. Lateritic soils shallow and loam soils, and alluvial soils can be useful for rice cultivations. Rice requires heavy rainfall throughout the growing period and hence in study area it is grown during the southwest monsoon period. It grows well in the area where rainfall is between 1000 mms and 1100mms. The crop matures in 100 to 120 days sown in June or July it is harvested in September or October, November.

SPATIAL DISTRIBUTION:

The spatial distribution of rice in the region is shown in Map - 5.1. Rice cultivation is widespread in the region due to favorable geographical conditions. The average annual rainfall between 1500 – 2000 mms and prevalent temperature are conducive to growth of rice in the region. The alluvial coastal soil in the region is also responsible for wide cultivation of this crop and hence the spatial distribution and its areal extent is continued by these factors. The spatial distribution of rice is shown in Map - 5.1. It is obvious from Map - 5.1 that this crop is found in three categories as under.

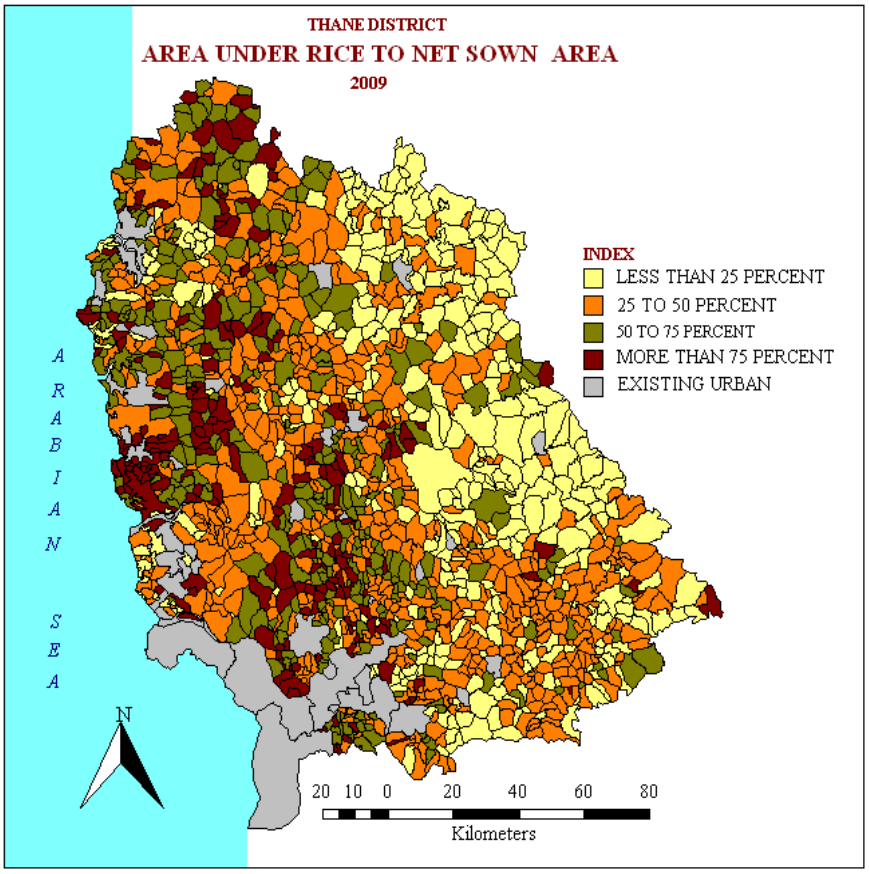
1) High concentration of rice in the coastal alluvial plain.
2) Moderately concentrated area under rice is dispersed in low land and upland areas.

3) Low concentration of rice is found in northeast part on coarse shallow soils in the region.

More than 75 percent area under rice are found in hundred and fourteen villages in three pockets in the southern, northern and western parts of the area under study. The major villages are located in western part confined to coastal lowlands and in the southern and south west part of the region.

Three hundred fifty three villages having 50 to 75 percent area under rice to net sown area is found in north west, western and southern part in the region (Map - 5.1). The area under rice increases its areal extent toward south, north and west. In the central part there are few pockets in this group. The increase in area can be attributed to the local fertile soils (i.e. coastal alluvial soil) on which this crop is cultivated.

Maximum number of villages (633 villages),where rice is found between 25 to 50 percent to net sown area is along the eastern and central parts and three pockets in the north west and south east part of the region. Most of the villages under this group are at the eastern margin of the coastal plain, where foot hill villages and coarse shallow soil is present. Less than 25 percent of net sown area under rice is confined to far eastern part and dispersed in nature into four-five pockets. Three pockets are in northern part two is in central or south central part of the region. Three hundred thirty six villages have less than 25 percent net sown area in the study region (Map- 5.1)



Map - 5.1

2) GRASS:

Grass is one of the oldest crop in this region. In most of the villages more than 40 per cent of the cultivated land is under grass. The fields under grass are not resown with other crops. Grass is listed as a crop by revenue authority. On this grass growing area, land grazing of animals is not practiced. This crop provides fodder to livestock. Grass occupies 1,57,100 hectares (36.25 per cent to net sown area) and stands second in rank in the region.

ECOLOGICAL CONDITIONS:

Grass is mainly tropical and subtropical crop grown in Kharif Season. The grass growing region is around 15-25 meters above the sea level. Almost all the rainfall is received during rainy season and

their is no winter rainfall. The rainfall amount is between 1500mm to 2000mm. The temperature between 20^0C to 35^0C coarse to shallow medium coarse black soils determines the areal extent. This is an ideal condition for growing grass.

Varieties of grass grown in this region are Fool which is low quality grass, Rohida is good and Baradi, Beru etc. Best quality of grass which has high economic value.

SPATIAL DISTRIBUTION:

The spatial distribution of grass is found in all villages in the region. Except close to coastal tracts, grass growing is widespread in the region due to favourable geographical conditions. The average annual rainfall amount is between 1500 mm to 2000 mms. High yielding varieties of grass found in this region i.e. Beru, Bardi, Mushee etc. have high economic value. It is seen from the plate No-5.2 that the areal spread of grass increases from the west to the east and central part in north to south direction, which is at the height of 15-25 meters from sea level.

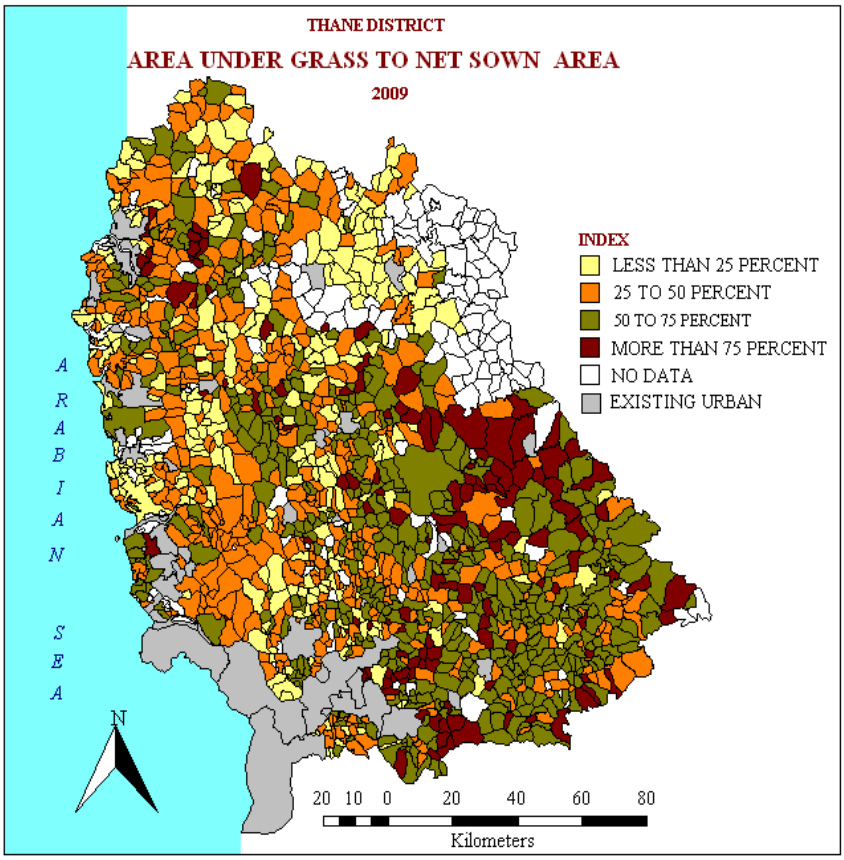
The grass distribution in the region falls into three categories.

1) The area which has less than 25 percent to net sown area is found in two hundred eighty villages.
2) Moderate concentration of grass between 25 to 50 percent to net sown area is found in four hundred seventy three villages.
3) High concentration of grass where more than 50 percent of net sown area is devoted to grass is found in six hundred fifty villages which display the spatial distribution of grass in the region. The major concentration of grass (covering more than 50 percent land to net sown area in) is found in six hundred fifty villages.

Among these north eastern and eastern villages has maximum land (more than 75 percent to net sown area) devoted to grass. The patches are found in north, central and south eastern parts in the study area.

Four hundred seventy three villages have 25-50 percent area under grass. These villages are extended throughout the western coastal plain area. Maximum concentration of villages is in the western parts where lowland region and coarse shallow soil, which is devoted to grass growing in the region. Some patches are found in the northwest, central and southeast part in the region.

The spatial distribution of grass in the region occupying less than 25 percent of net sown area is found in two hundred eighty villages, these villages are mainly concentrated in northern, northeastern and southern parts of the region (Map No-5.2). The minimum area under grass in this category is found in the northeastern part of the region.



Map - 5.2

3) <u>FRUITS</u>:

Fruits rank third in the western coastal plain. It accounts for 2.73 percent to net sown area (587.65 hectares). The fruits are cultivated for commercial purposes. The most important fruits are Chiku, Bananas, Mangoes etc. Area under fruits (Horticulture) has been increasing day by day and farmer preferred plantation of various fruits according to local conditions i.e. soil and irrigation facilities.

<u>VARIOUS FRUITS GROWN IN THIS REGION</u>

<u>CHIKU:</u>

It is grown mostly in the coastal villages in Thane District. Coastal climate of area and about 75" to 100" of rainfall from June to September suits the crop. Planting is done in Monsoon or in

November- December. Plants are usually spaced thirty feet apart. In general for cultivation, the whole garden is hand dug at the end of the monsoon. Manure of sheep dung, bone-meal and groundnut cake are usually applied twice in a year. Once in September-October and again in March. The trees are usually irrigated after the end of Monsoon. Chiku starts to bear fruits after three years of planting and continues for about 75 to 100 years, if well cared for. The flowers appear on the tree almost throughout the year, though flowering is most profuse during the rainy season. The fruit takes about six months to be ready and the maximum crop is obtained from November to April, though fruits are available almost throughout the year. An average tree yields of about 2,000 fruits per year.

BANANAS:

The famous varieties of bananas in this region are Rajeli, Tambdi, Saphed Velchi, Sonkeli and Basrai. The best period for plantation is from May to June. Banana requires ample water, hence irrigation is required at an interval of 6 to 8 days in the hot season.

ECOLOGICAL CONDITIONS AND FARM OPERATIONS:

The Best period for plantation is from May to June. Banana requires ample irrigation. Flowering starts after about nine months and continues for three to four months or more. The crop takes from eighteen to twenty months for maturing after planting. It can be allowed to multiply in the same field. The crop is harvested when the fruits get rounded and dry petals drop down. The plant is cut down immediately after the bunch is harvested.

MANGOES: Is an important fruit crop in the north Konkan i.e. Palghar Tahsil. The best varieties are Hapus, Payari, Kala Hapus, Bangadi Payari, Majgaon, Batli, Farnandis and Ladva.

ECOLOGICAL CONDITIONS:

The Mango crop requires deep well drained soils, and the tree attains very large size measuring 50', 50' in fertile soils. The climate best suited is the equable climate with little variation in maximum and minimum temperature as prevalent in the coastal area of the region. Planting of Mango grafts is the only way to develop good gardens. Since the plants do not develop deep roots they have to be regularly watered. Watering is essential for about three years after which the roots go deep enough.

4) VEGETABLES:

Vegetables rank fourth in the study area. It accounts for 2.55 percent of net sown area (548.91 hectares). Brinjal, Sweet Potato, Bhendi (Lady's Finger), Radish, Bitter – Gourd (Karle), Snake-gourd (Padval), Little-gouvd (Tondli), Bottle-gourd etc. are the main vegetables grown in the region.

BRINJAL:

This is the most important among the vegetables crop grown in the region. It grows well on medium brown soils, in garden land with the help of manure and water in considerable quantities. In dry land it is sown in June in see-beds, planted during July, begins to bear fruits in September and if occasionally watered, goes on bearing for four months.

SWEET POTATO (RATALE): It is grown in small patches in the region though not very extensively. The crop grown during the cold season and under irrigation. It matures in about five months.

BHENDI (LADY'S FINGER) :

It can be cultivated through out the year but thrives well in kharif season.

BITTER –GOURD (KARLE):

It is grown either as a rain-fed crop or in garden lands.

LITTLE GOURD:

It is a common wild creeper growing on bushes and hedges in the region. It is a perennial crop growing vigorously for three to four years. Any type of soil and climate is suitable for this crop.

ECOLOGICAL CONDITIONS:

The above mentioned crops can grow in varied climatic conditions and soil types. Generally these crops are cultivated in all seasons in the presence of irrigation.

It is observed that twelve villages have more than 10 percent land under vegetables (Map - 5.3) these villages are in northeast, central and two patches are in in northeast, central and southern part. Five to ten percent land under vegetables is found in seven villages (Map - 5.3) as show three patches in northeast, central and southern part.

Thirty four villages have less than five percent land under this crop. These villages are scattered throughout the region. Most of the villages are concentrated in central part surround by Palghar Town.

SPATIAL DISTRIBUTION: (Fruits and Vegetables)

The spatial distribution of fruits in the region is shown in Map - 5.3. Horticulture mostly depends on the farmers attitude. Map - 5.3

reveals that the distinct areas of fruits and vegetable distribution are as under:

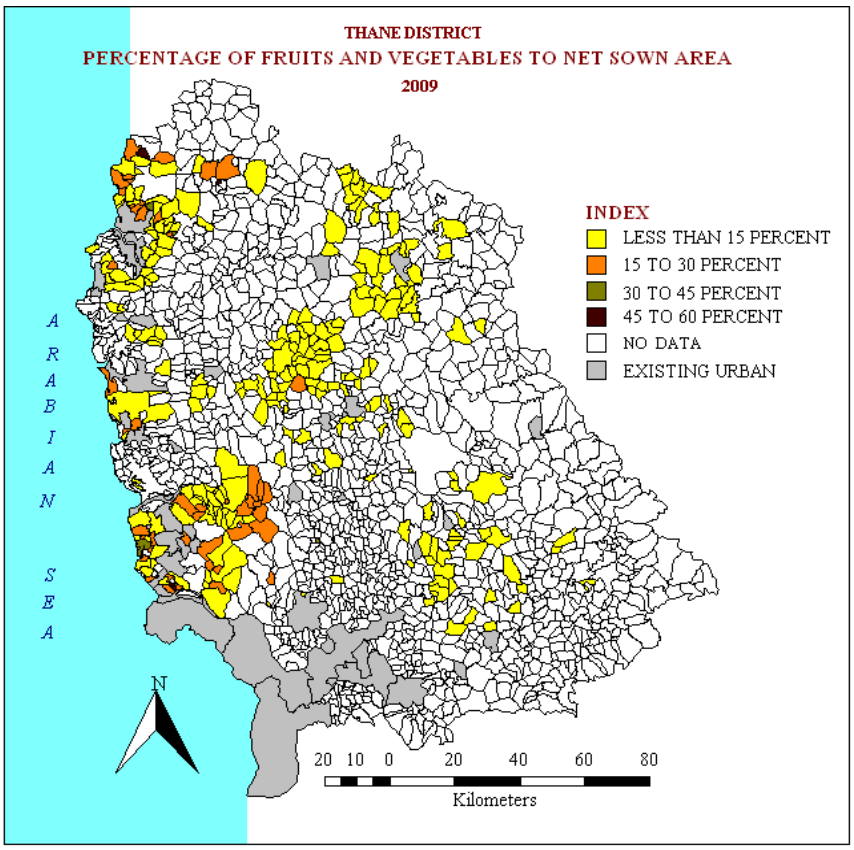
1) The areas of more than thirty percent net sown area are found in eight villages.
2) About fifteen to thirty percent area under fruits to net sown area is in forty eight villages and
3) The area having less than 15 percent under fruits to net sown area is found in two hundred thirty three villages.

The land with more than fifteen percent to net sown area under horticulture is found in the western coastal parts in the region (Map - 5.3). More than thirty percent land to net sown area is found in three patches in the western coastal region. The north eastern villages have coarse shallow soil at uplands.

Less than 15 percent land area under fruits and vegetables was observed in two hundred thirty three villages, covering wide spread in six patches in the region (Map - 5.3). Wide distribution of fruits and vegetables is found along the western side, north west, central and northeast part of the region.

The distribution of fruits is largely influenced by the attitude of farmer. It was observed that there is no specific pattern of horticulture in the region.

The vegetables particularly, Brinjal, Sweet potato, Bitter- gourd, Lady's finger and chili's are cultivated on alluvial soil to medium soils. The production of this crop is sold to Mumbai and in local Market.



Map - 5.3

PULSES:

Various kinds of pulses are grown to a small extent, chief among them being udid (black gram), Tur, Val, Harbhara (Gram), Chavali, Kulthi (Horse Gram), Mug (Green Gram) etc. pulses occupied an area of 0.52 percent to net sown area (111.93 hectares). Pulses are grown to a small extent in this region. Pulses like Tur, Val, Gram, Chavali and Mug (green Gram) are grown along the eastern part of the region.

ECOLOGICAL CONDITION:

A pulse like 'Tur' is generally sown in June-July. The crop is harvested from January onwards. The crop is favorite among the

cultivators as it has the highest demand and it serves as a restorative rotation crop. It adds to the nitrogen contents of the soil due to its being a legume. 'Val' is taken as rabi crop or as a second crop in rice fields. It is damaged by heavy rains, cloudy and cold weather when flowers begin to fall off and fertilization fails to take place. Usually val is sown in November and harvested in March. The crop is ready for harvest in 130 to 150 days.

GRAM (HARBHARA):

It is grown as a rabi crop, usually after rice. After the rice crop is harvested, fields are ploughed once or twice, and gram is sown, they mature in about three months.

MUNG (GREEN GRAM):

It is grown both as a rain-crop in sandy soils and as a cold weather crop in low water fields.

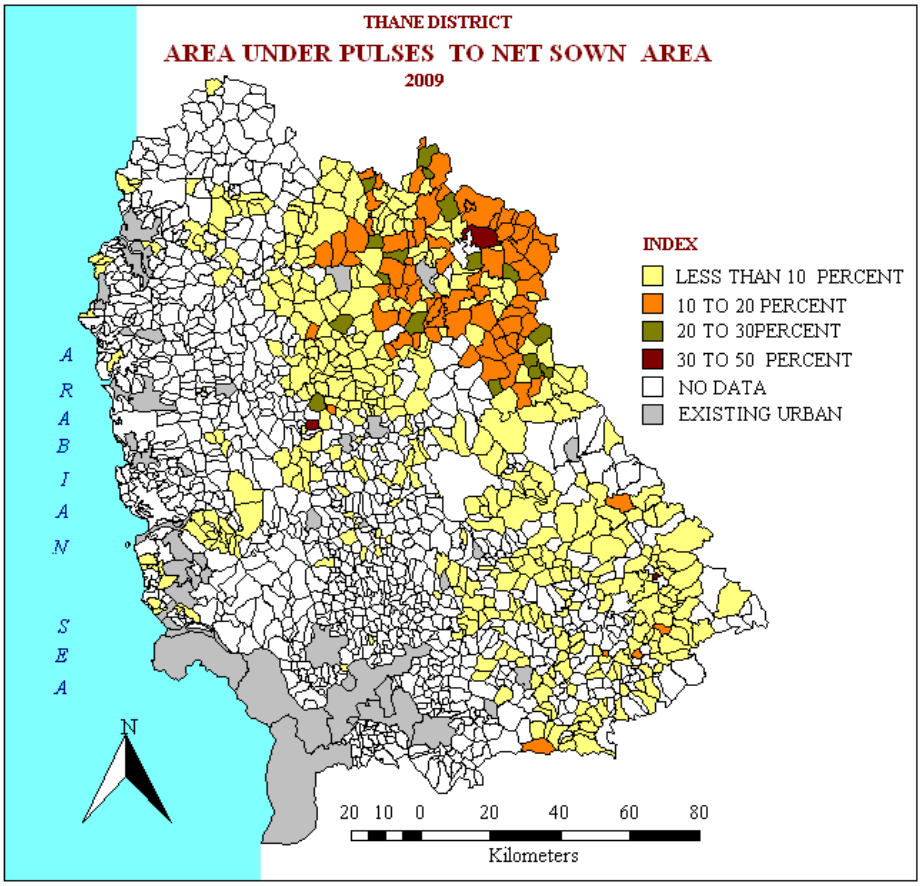
CHAVALI:

It is grown as a rabi crop. As the crop is grown along with paddy it gets a well prepared soil. It is sown in rows about six feet apart by broad casting the seed. The crop flowers in six weeks and during the same period the pods are ready to be picked up.

SPATIAL DISTRIBUTION:

Map - 5.4 reveals the spatial distribution of pulses in the region. The spatial distribution of these crops is attributed to soil types. It is observed that eastern and northeastern part of the district cultivating this crop. There are forty five villages having more than fifteen percent land area under pulses in eastern, northeastern and southeastern part and some patches in the northwest and central part. Three hundred thirty six villages have less than fifteen percent land under pulses in eastern and southeastern parts, confining to shallow coarse soils. two patches found in western part.

Maximum hectare under this crop is at northeastern corner (forty percent to net sown area) while minimum is recorded in western coastal plain(3 percent to net sown area.)



Map - 5.4

Hill millets :

This group of crops includes Nagali, nachani or ragi (Eleusine coracana G.), vari (Panicum miliacenum L.) are the important constituents. Hill millets cover an insignificant area of 26500 hectares ranking third among the crops grown in the district. They occupy 7.12 per cent of the net sown area.

ECOLOGICAL CONDITIONS:

Ragi and vari are generally grown on poor, lighter soils while rala thrives best in red loamy soils. They can be grown in areas with a wide range of rainfall, from dry lands to wet lands i.e. 500mm to 1000mm of rainfall.

Farm Operations:

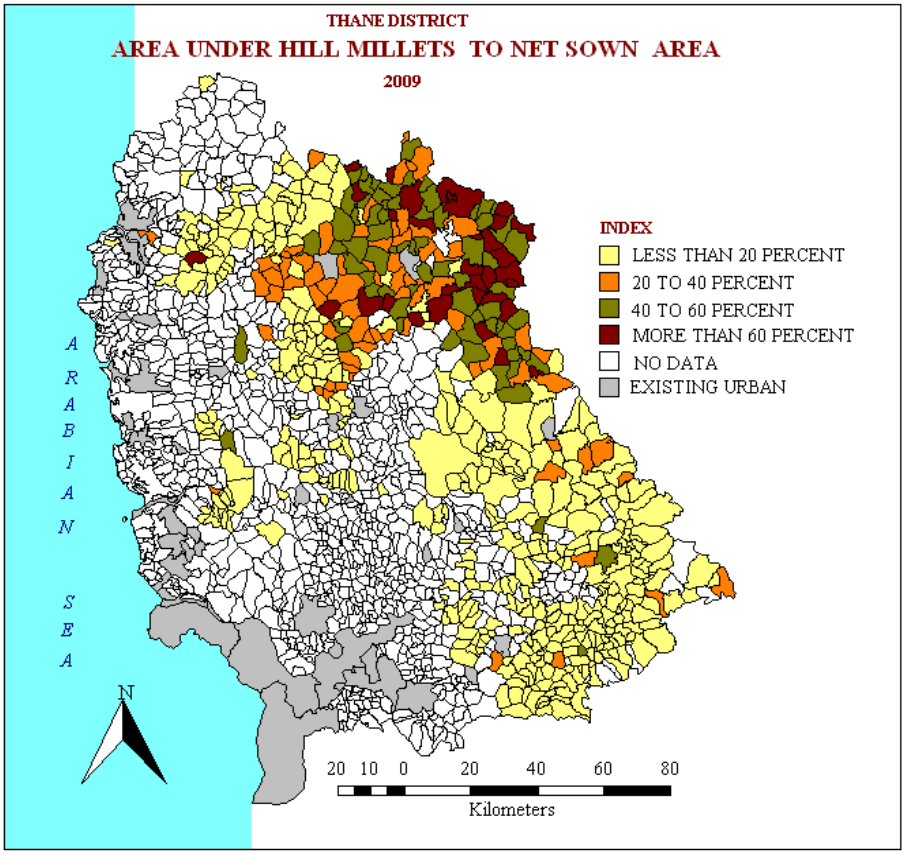
The hill millets are grown in kharif season in the district. These millets are sown in June or July mostly by broadcasting. These crops are not manured and not much of interculture is done. The harvesting season starts from September and lasts up to January depending upon the period of sowing.

SPATIAL DISTRIBUTION:

These millets have high nutritional value but in the areal distribution they are the weakest group of crops. All these hill millets are associated with rice in the eastern hilly and heavy rainfall region. In the rice growing areas hill millets are grown as a supplementary crop. In spite of the competition from rice, hill millets occupy a very strong position in the areas which are physiographically most adverse to the cultivation of other crops. They ranked first occupying sometimes a major proportion of the area up to 70 per cent of the net sown area in the north eastern part of the district. In other areas where rice ranks first, hill millets occupy second or third important crop.

Hill millets allotted the lands which are not suitable for cultivation of rice. Such areas unfit for rice are moderate to steep slopes with a thin soil cover. Thus, the nature of the slope and the amount of rainfall are strongly associated with the areal distribution of hill

millets. Maximum concentration of hill millets is observed in the areas receiving rainfall over 2000mm in the northern, northeastern and eastern part, westward from this zone of concentration their areal strength is decreases and in coastal plain region millets are practically absent.



Map - 5.5

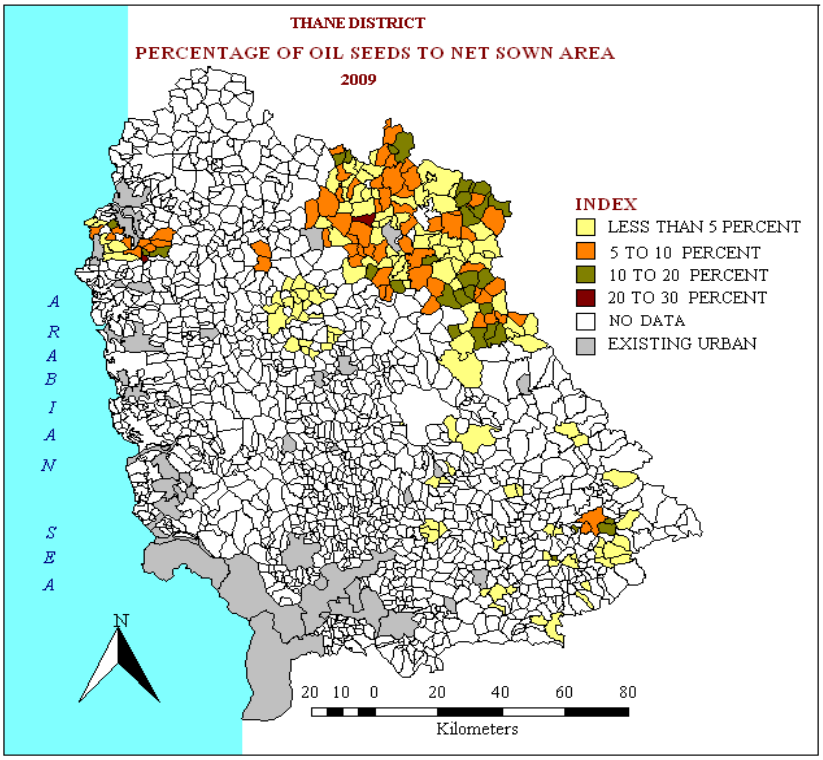
OIL SEED:

Variety of oil seeds cultivated in the region, occupied very insignificant proportion of net sown area. Ground nut, mustard, seasamum (Til) and other non edible oil seed like niger seed occupied 0.97 per cent to net sown area in 2008-09. Area under oil seeds has decreased by 0.41 per cent (1.38 per cent in 1981-82 and 0.97 per cent in 2008-09).

SPATIAL DISTRIBUTION

The spatial distribution of oilseeds is largely influenced by the amount of rainfall received and temperature condition during specific stages in growth. Oilseeds are grown on variety of soils, therefore soil as a factor influencing their spatial distribution is not that significant.

In some of the physical regions, particularly in the western portion of the district, oilseeds are totally absent and in some villages the proportion of oilseeds in the net sown area is very small i.e. less than five percent (Map - 5.6). In the northeastern part eight villages cover more than fifteen percent of the net sown area. Though oilseeds are spread in the southeastern part of the district, their proportion to the net sown area varies from 1 to 26 percent. Map - 5.6 reveals the areas of high and medium to low concentration of oilseeds in the district.



Map - 5.6

CHAPTER – VI

QUANTITATIVE ANALYSIS IN AGRICULTURAL LANDUSE

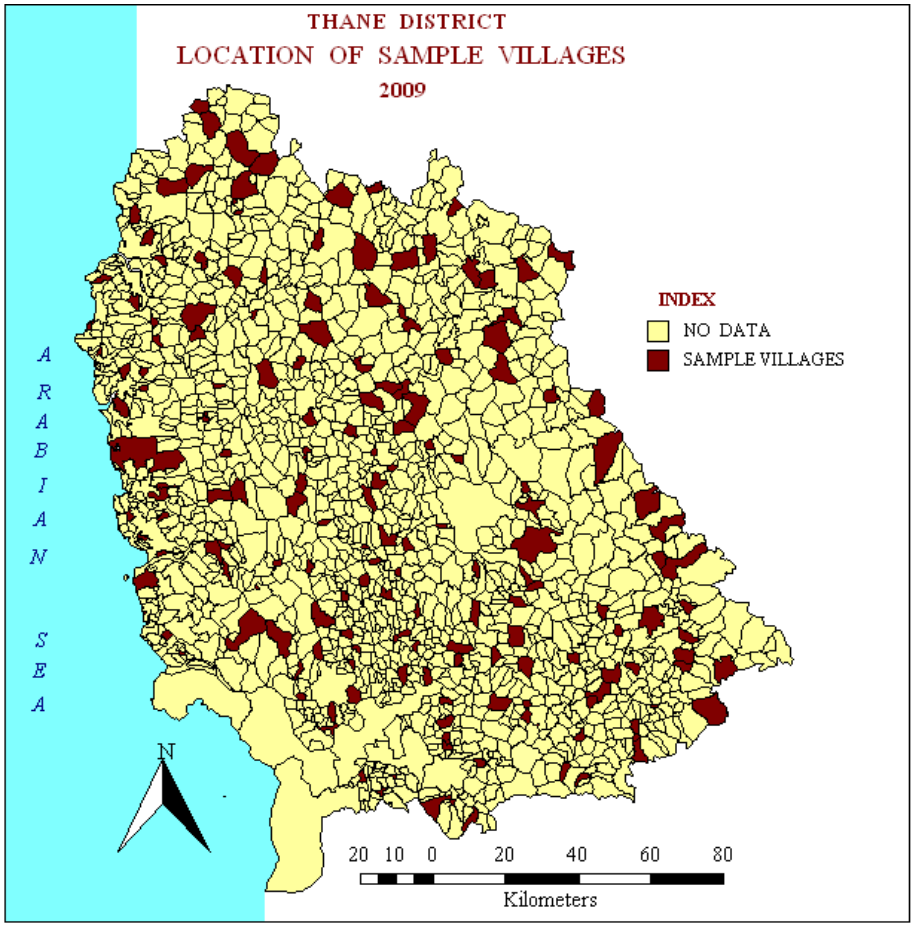
In the earlier chapters different elements of physical and cultural environment, their spatial distribution and their impact on agricultural land utilization was assessed. In the chapter these relationship are further studied and analysed applying quantitative techniques like simple correlation, multiple regression and time series analysis. It would have been impossible to handle a large volume of data consisting of fifteen variables and one hundred seventy five observations without the help of Computer.

The problem of choosing the right size of sample, however, is a little more complicated. The simplest rule is that the larger the size of sample, the more likely it is to give a reliable picture of the parent population. As a further rough guide, it can be said that the size of sample should be at least 5 per cent to 15 percent of the total for satisfactory results. The decision on defining parent population and choosing the best sampling method, however, depend to a large extent on commonsense (M.Husain, 1996, pp 207).(Map - 6.1)

Systematic Sampling

In this method, a regular pattern of selection is made instead of choosing each individual separately. This method is also known as quasi-random. For instance, if study of crop combination is to be made in 2000 villages of an areal unit and 20 sample villages are to be selected, the villages should be given a serial order, every hundredth village of the list be chosen. The required sample villages will be reached quickly. If used sensibly, systematic sampling can often be more convenient than true random sampling and can be

equally effective. This method, though helpful in making quick and effective sampling, however, suffers from the setback of subjectivity as each village of the area does not have an equal chance of being included in the sample (M.Husain, 1996, pp 210).



Map - 6.1

In order to investigate the associations between land use types on the one hand and physico-cultural elements on the other, following fourteen variables – X1 to X6 dependent and X7 to X14 independent-were carefully selected from the set of available variables:

X1- Net sown area (NSA) (Percentage of total area)

X2- Grass (Percentage of total area)

X3- Rice (Percentage of NSA)

X4- Pulses (Percentage of NSA)

X5- Hill Millets (Percentage of NSA)

X6- Cash crops (Percentage of NSA)

X7- Irrigated area (Percentage of NSA)

X8- Accessibility

X9- Owner Cultivators (Percentage of total agricultural workers)

X10-Density of population

X11- Slope > 3^0 (0-50 Meters per Kilometer)

X12- Slope > 6^0 (50-100 Meters per Kilometer)

X13- Slope < 6^0 (More than 100 Meters per Kilometer)

X14- Distance from coast

X15- Distance from major stream.

Among the independent variables, distance from coast indirectly represents the variations in the slope, rainfall distribution and soil types. It is assumed that degree of slope and amount of rainfall increase as the distance from coast increases. This is backed by the fact that all the isohyets are almost parallel to the coast line (Fig.2.6). Thus, this variable in fact represents the rainfall pattern. Secondly increasing distance from coast also means change of relief from low land coastal plain to low divides and low plateaus, broad open valleys to hilly rugged areas. It, therefore, reflects the variations in climate as well as in relief. Another variable, distance from the major stream, is defined in order to bring out the variations in the land use with changes in the slope characteristics and soils across the river valleys. Two more variables of slope types represent 'relief' factor. The amount of slope in degrees was obtained from the available Survey of India

District planning map showing different categories of slope was prepared. This slope map was superimposed on the map showing physical regions and proportion of the area of physical region under a particular category of slope was obtained by GIS software GRAAM ++ CSRE, IIT BOMBAY. The variables irrigated area and accessibility in terms of distance from nearest town and route length per unit area, are included to estimate the relations between these two economic elements and the landuse types. Lastly the variables like population density and proportion of owner cultivators may throw light upon the impact of social factors upon land use.

Correlation analysis

Using the 175 x 15 data matrix 'Pearsons product moment correlation coefficients' were calculated. Students't' test was applied to determine significant 'r' values at 0.05 and 0.01 levels of significance. The results obtained (Table No.6.1) reveal certain significant associations between the selected variables which are summarized as follows:

NSA

The area under cultivation (NSA) is strongly influenced by the 'relief' factor. It has a positive correlation with slope > 3^0 (r = 0.10). It is obvious that the gently sloping lands and rolling plains would offer maximum scope for cultivation and in the hilly terrain with slopes (slope > 6^0), there is very small proportion of total area available for cultivation (r = -0.10) and slopes more <6^0 does not appears significant. The NSA also decreases with the distance from coast (r = 0.52) as the terrain changes from low lying coastal plain to hilly rugged areas from coastal gentle slope to hilly rugged

areas steep slope. Distance from the major stream has no significant correlation with NSA indicating that NSA is independent of locations in the valleys or on the divides. The economic factors irrigation (r = 0.10) indicates positive correlation and accessibility (r = -0.50) have negative correlations with NSA meaning thereby that increase in the irrigation would offer scope for bringing more area under cultivation as expected and NSA does not influenced by accessibility. Lastly, the increase in NSA is associated with owner cultivators (r = 0.21) but the population density decreases with increase in NSA. This perhaps can be explained by the fact that with increase in size of holding the proportion of labour increases and relatively the proportion of owner cultivators decreases.

Grass

The distribution of grass is strongly affected by the nature of terrain which is indicated by a positive correlation with slope $> 3^0$ (r = 0.34) and a negative correlation with slope $< 6^0$ (r = -0.04). In the study area it is observed that the lands unsuitable for cultivation area given to grass, a fact which explains its positive correlation with slope $> 3^0$ and negative correlation with slope $< 6^0$ and also with distance from stream. Distance from coast (r = 0.14) influence the distribution of grass. The area under grass decreases in more accessible, and irrigated areas (r = -0.24 and r = 0.02 respectively). Population density is low in the grass concentration areas though the proportion of owner cultivators (r = 0.13) is observed to be higher.

Rice

The concentration of rice in the western coastal plain of the district is indicated by it's association with slope > 3^0 (r = 0.59) and distance from coast (r = 0.41). Irrigation and accessibility both have a negative correlation with rice suggesting that due to heavy rainfall rice does not need irrigation and the accessibility in the hilly tracts is poor. Correlation of rice with density of population is weak (r = 0.06). The proportion of owner cultivators is higher in the rice growing areas indicated by positive correlation (r = 0.19). Significant negative correlations of rice with cash crops indicate that rice is not significantly grown in association with these crops.

Pulses

The area under pulses increases with the increasing distance from the coast (r = 0.30). This correlation suggests that pulses are concentrated in low moderate slope areas. Pulses are grown on the gently sloping lands below 6^0 of slope (r = 0.24). Irrigation and accessibility are also associated with pulses, but the proportion of owner cultivators decreases (r = -0.01) as the size of holding becomes larger away from the coast. Pulses and cash crops are positively correlated with each other while grass and rice show a negative correlation. Pulses and grass do not show any significant relation.

Hill Millets

The area under hill millets increases with the increasing distance from the coast (r=0.35), the distance from coast influences the spatial distribution of Hill Millets significantly. Hill Millets exhibits similar relationship as that of Pulses with slope elements, irrigation,

cultivators and population density. The location of Hill Millets on plateaus and hilly tracts instead of on the better land near the streams, is reflected in a positive correlation between Hill Millets and distance from stream (r = 0.19). Like in Hill Millets, pulses are associated positively with cash crops and negatively with grass and rice.

Cash Crops

The spatial pattern of cash crops is positively influenced by a single factor i.e. irrigation (r = 0.24) with respect to the relief factors, area under cash crops increases with increase in areas with gentle slopes below 3^0 (r = 0.33) and decreasing distance from coast (r = 0.28). It decreases in the steeply sloping hilly areas (r = -0.37 for slope > 6^0). Improved accessibility also has some bearing on increase in the proportion of cash crops (r = 0.27). The proportion of owner cultivators is less in the areas where cash crops are important (r = - 0.44) a fact which indicates that there is intensification of agriculture. The cash crops are positively related to the density of population (r = 0.18), again indicating the significance of labour inputs in intensive agriculture.

The correlation analysis provides a basic structure which can be used for identification of useful quantitative technique to be used for a more precise explanation of the spatial variations in landuse. The above analysis brings out clearly the importance of physical factors like slope and distance from coast and economic factors like irrigation and accessibility as major factors influencing the landuse patterns. The increasing proportion of cultivators in the hilly tracts with low NSA and the decreasing proportion of owner cultivators in the irrigated areas with cash crops are clearly brought out. However, the distance from major streams which differentiates

between valley locations and divides location does not show any significant relationship with the landuse variables.

Multiple Regression

In geographical research analyzing the degree of correspondence between different spatial patterns 'regression model' is a very valuable technique which helps to understand the functional relationships between variables. One variable is considered to be 'dependent' upon one or several other variable. Here, multiple regression model is used to obtain the degree of association between the agricultural landuse variables (X1 to X6) (dependent) and the physical and socio-economic variables (X7 to X15) (independent), which were mentioned in the correlation analysis. The multiple regression model used is:

$$Y = a + b1\ x\ 1 + b\ 2\ x\ 2 + b\ 3\ x\ 3 + \ldots\ldots\ldots + b\ m\ \ x\ m + e$$

Where Y = dependent variable

X1……..Xm = independent variables

a = constant or Y intercept

b1……..bm = regression coefficients

In all six multiple regression equations were derived in order to estimate the influence of physio-socio-economic variables on the location of agricultural landuse in 175 sample villages of the district defined earlier. The partial correlation coefficients derived indicate the inter correlation of one independent variable with the dependent variable, with all other independent variables held constant. Thus, these coefficients indicate the relative importance of each independent variable in explaining the total

variance. The significance of the individual multiple regression coefficients was tested at 0.01 and 0.05 levels of significance. Lastly the level of 'explained variation' indicated by R^2 was calculated. The results of the analysis are summarized as follows:

1. Dependent variable X1 NSA
   Independent variables X7 to X15

Among the variables included in the regression set distance from coast appears to be very important, followed by slope > 3^0 and population density. The coefficient is negative for the variable slope > 6^0. Slope above < 6^0 and distance from stream are not significant though they are included in the regression set. About seventy eight per cent of the variation is explained by the five above mentioned variables. Though the correlation analysis reveals significant relationship of NSA with all variables (except distance from stream) only five variables included in the regression set and only three were observed to be significant in explaining the occurrence of NSA. However, the economic factors having significant positive correlations with the NSA as revealed by correlation analysis do not occur in the regression set.

2. Dependent variable X2 Grass
   Independent variable X7 to X14

The occurrence of grass is strongly influenced by distance from coast and slope > 3^0. Regression coefficients for both are negative. The factors distance from stream and slope > 3^0 are less important in the regression set. These four variables account

for about fifty three per cent of the total variation. Like NSA, grass also has significant correlation ('r' values) with all the remaining variables except distance from stream but only four were considered important enough to be included in the regression set. Though grass has a strong positive correlation with slope < 6^0, in the regression analysis the effect of slope < 6^0 upon grass is not that significant. The economic factors which have significant negative correlations with grass do not occur in the regression set.

3. Dependent variable X3 Rice
   Independent variables X7 to X15

The occurrence of rice is explained by six independent variables. Of these 'b' coefficients for three i.e. slope < 6^0, distance from stream and slope > 6^0 are important. Regression coefficients for the coast are not significant and thus, the contribution of the variables owner cultivators, distance from coast and irrigated area to the total variation is not important. The total variation explained by six variables is about sixty per cent. The correlation analysis reveals that distance from coast has a strong negative correlation and distance from stream does not have a significant relation with rice. However, in the regression analysis distance from stream, explaining the location of rice confined to valleys appears to be more important than the distance from coast.

4. Dependent variable X4 Pulses
   Independent variables X7 to X14

Four variables in the regression set explain the occurrence of Pulses. The only variable which contributes significantly to the total variation explained is distance from coast. The regression coefficient for the remaining variable i.e. slope > 6^0 irrigated area, and slope < 6^0 are not significant indicating their lesser importance. About sixty five per cent of the total variation is explained by these four variables. Slope > 6^0, which has a very strong positive correlation with Pulses does not appear that significant in this regression analysis. Another interesting relationship is between irrigation and pulses which is positive in correlation analysis but because of the combined effect of other variables it has become negative in the multiple regression analysis.

5. Dependent variable X5 Hill Millets
Independent variables X7 to X14

The variables slope < 6^0 distance from stream and distance from coast are more or less equally important in explaining the occurrence of Hill Millets as indicated by the respective partial correlation coefficient values. Other variables like slope > 6^0 and population density are less important. The total variation explained is rather low at twenty six per cent. Hill Millets does not have very strong correlation with other variables as indicated in the correlation analysis, though some important relationships are singled out in the regression analysis. Hill Millets has a positive correlation with the distance from coast as revealed by correlation analysis, but the regression coefficient slopes negatively.

6. Dependent variable X6 Cash Crops

Independent variables X7 to X14

The regression coefficient for five variables in this case is significant. Only for the variable distance from stream 'b' is not significant. The contribution of the variable irrigated area is most important in explaining the occurrence of cash crops followed by population density. Slope < 6^0, distance from coast and owner cultivators. The total variation explained is about sixty eight per cent. The correlation coefficient for distance from coast and accessibility are nearly equal but in the regression set accessibility has not been included. Besides, the correlation coefficient is positive for distance from coast and negative for distance from stream but the regression coefficients are negative and positive respectively.

The application of multiple regression model to explain the influence of various factors upon agricultural landuse reveals that among the set of selected independent variables, by and large, the variables related to physical environment like slope > 6^0, slope < 6^0, distance from coast and distance from major stream appear to be more important than the factors chosen to represent the socio-economic environment like irrigated area, accessibility, proportion of owner cultivators in the total agricultural workers and population density. Only in the case of cash crops the most important variable contributing to the total explained variation is irrigated area. In this particular case other variables like population density and proportion of owner cultivators are also important.

In five of the six equations, the 'b' coefficient for distance from coast is significant and the partial correlation coefficient also

indicate its importance as an explanatory variable. The variables slope > 6^0 and slope < 6^0 have significant 'b' coefficient in three cases each where as the distance from stream appears to be a less important explanatory variable with significant 'b' coefficient in only two equations. Among the socio-economic variables 'accessibility' was not found to be important enough to be included in the regression set at ninety five per cent level. Thus, it does not appear in any of the regression equations.

Time Series Analysis

"A time series may be defined as a collection of readings belonging to different time periods, of some economic variable or composite of variables." (Ya-lun Chou)

Trend, by secular trend or simply trend we mean the general tendency of the data to increase or decrease during a long period of time. This is true of most of the series of business and economic statistics. An upward tendency would seen in data pertaining to population, agricultural production etc.(S.C.Gupta)

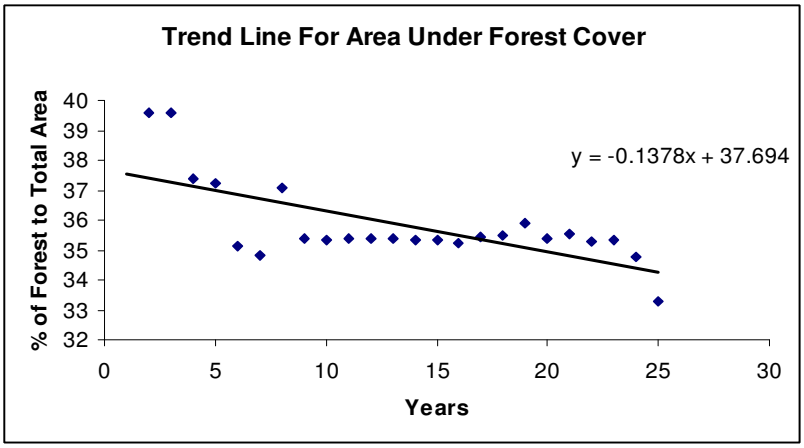
General Landuse

Trend lines for general landuse explains average situation of landuse types and future condition, trend line for forest cover decreases continuously. The area under forest has declined since 1981, and it predicts that it may gradually decline in the district. While trend line for area under non agricultural uses shows increases in the area, means over all trends towards more land brought under non agricultural uses i.e. residential, industrial etc. Trend line for barren and uncultivable land also decline means this category of land goes to other purposes i.e. non agricultural uses. Other uncultivable area does not shows significant changes. There is slightly upward moving in the net sown area. Trend line for area sown more than once shows significant growth, it is a positive sign that intensification in agriculture may increase in the next period. Gross cropped area does not show significant growth.

General Landuse Trend Lines

1. Forest (Percentage to total geographical area)

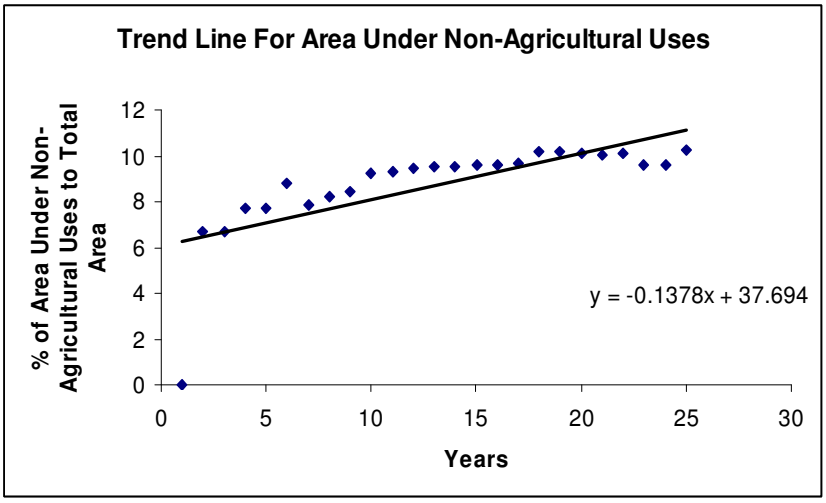
   y = -0.1378x + 37.694



2. Area Not Available for Cultivation

   Area under Non-Agricultural Uses (Percentage to total geographical area)

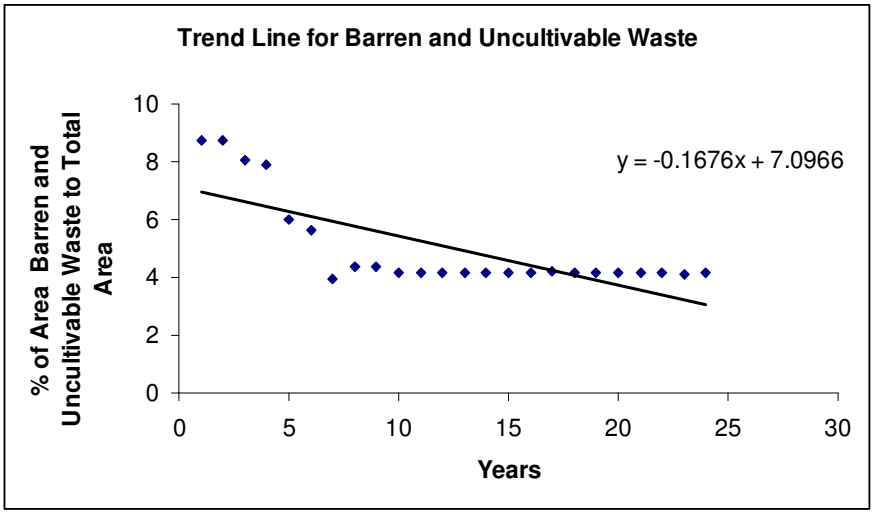
   y = 0.1348x + 7.3987



3. Area Not Available for Cultivation

Barren and uncultivable Land (Percentage to total geographical area)

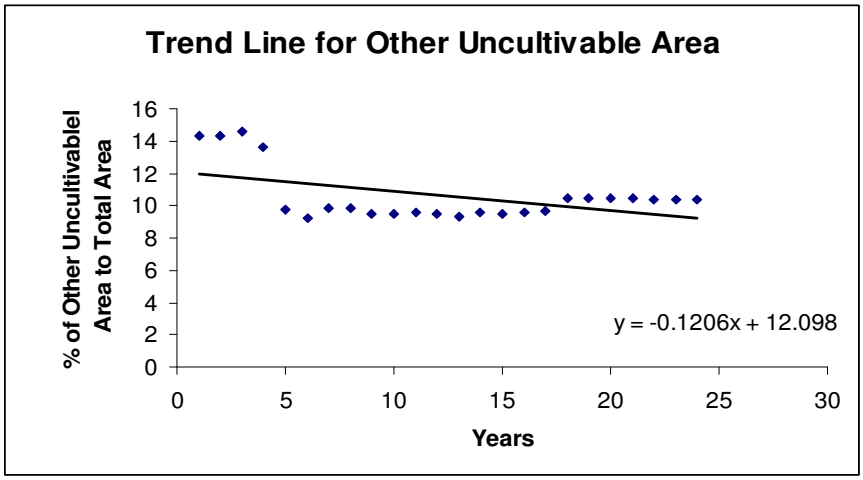
y = -0.1676x + 7.0966



4. Other Uncultivated Cultivated Land

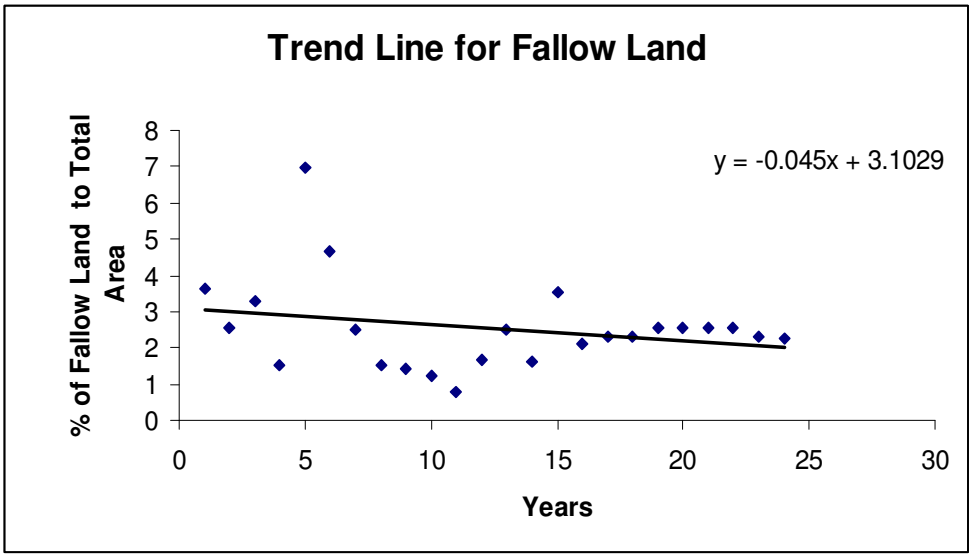
(Percentage to total geographical area)

y = -0.1206x + 12.098



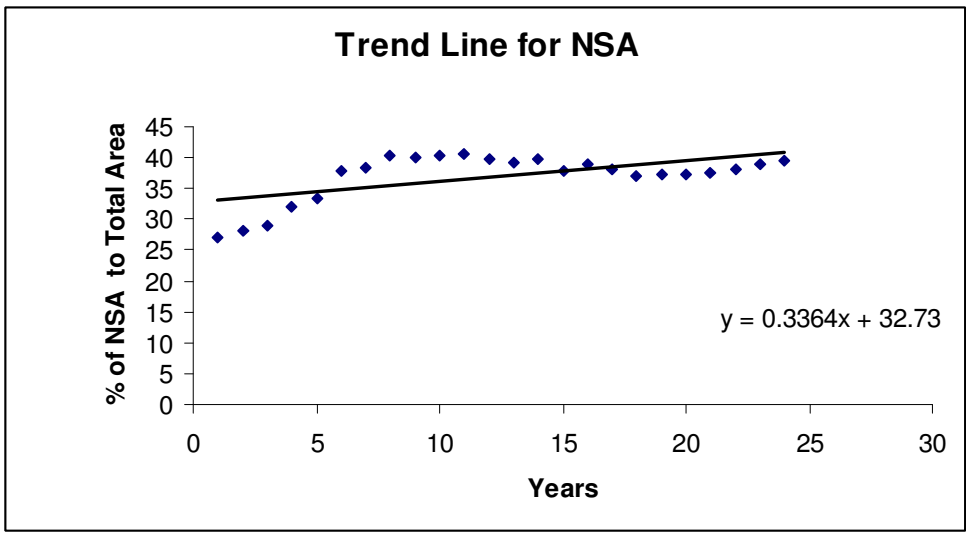
5. Fallow Land (Percentage to total geographical area)

y = -0.045x + 3.1029



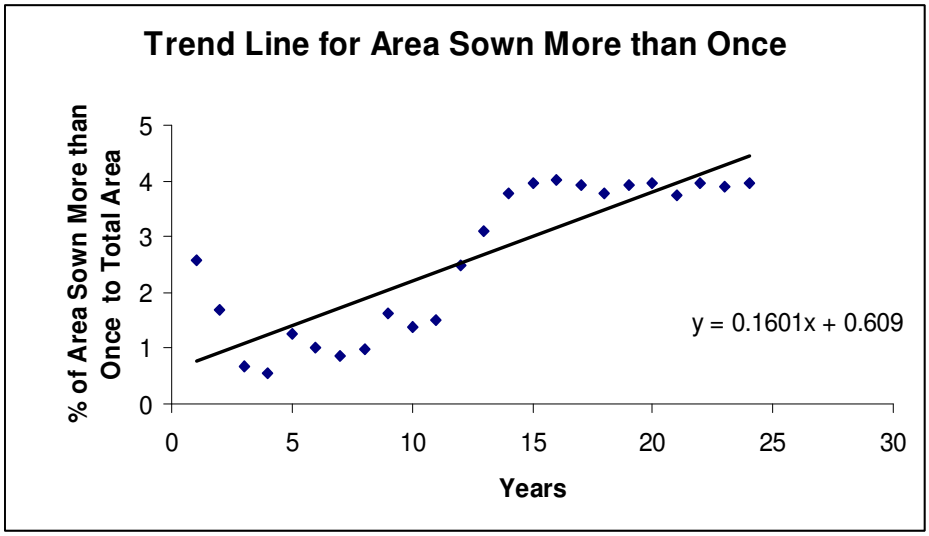
6. Net Sown area (Percentage to total geographical area)

y = 0.3364x + 32.73



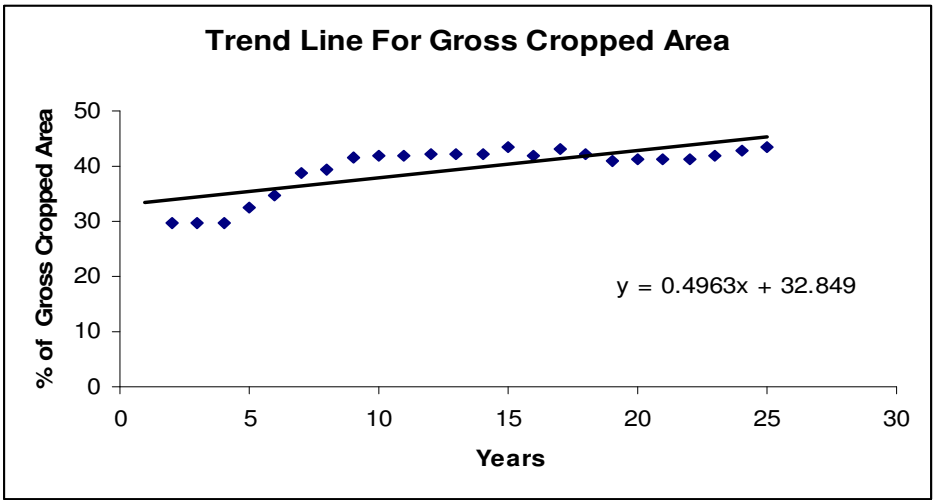
7. Area Sown more than once (Percentage to total NSA)

y = 0.1601x + 0.609



8. Gross Cropped Area (Percentage to total geographical)

y = 0.4963x + 32.849



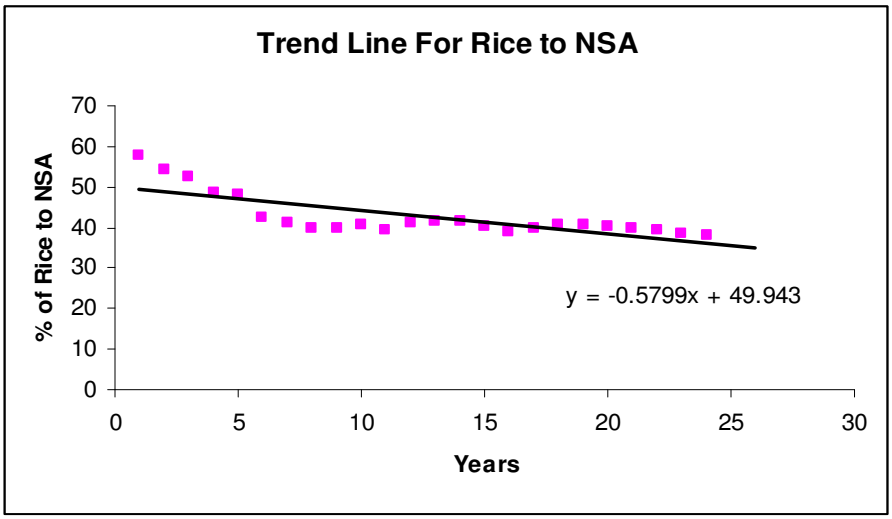
Agricultural landuse and Trend lines

Several crops are grown in the region, trend lines for the position of various crops in past and present help us for future prediction. There is decrease in the area under cereals. Area under pulses to net sown area has slightly increased. Area under total food grain does not shows significant growth. Trend line for cash crops continues to increase, this is a good sign. The area under fruits and vegetables may increase in near future. Trend line for the area under total food crops does not increase but there is a slight decline. Area under non food crops i.e. grass shows slight increase.

Agricultural Landuse Trend Lines

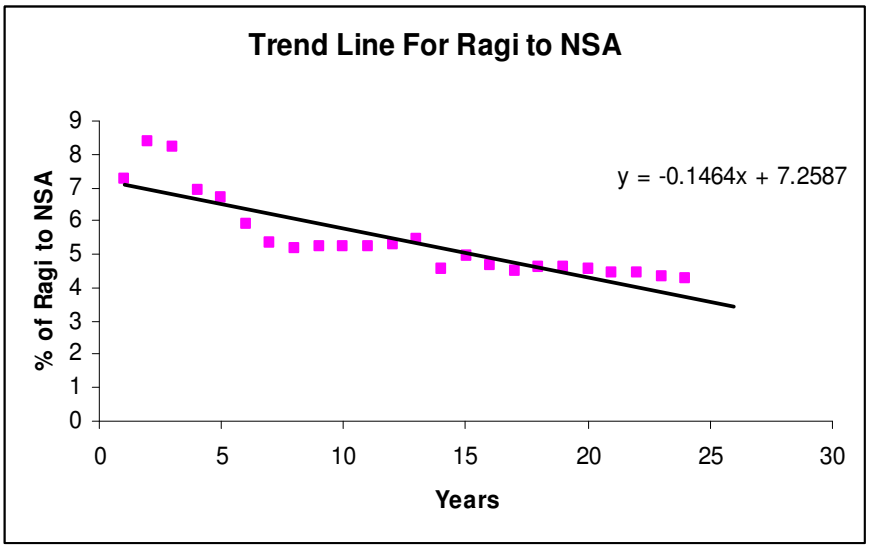
1. Rice (Percentage of Net Sown Area)

   y = -0.5799x + 49.943



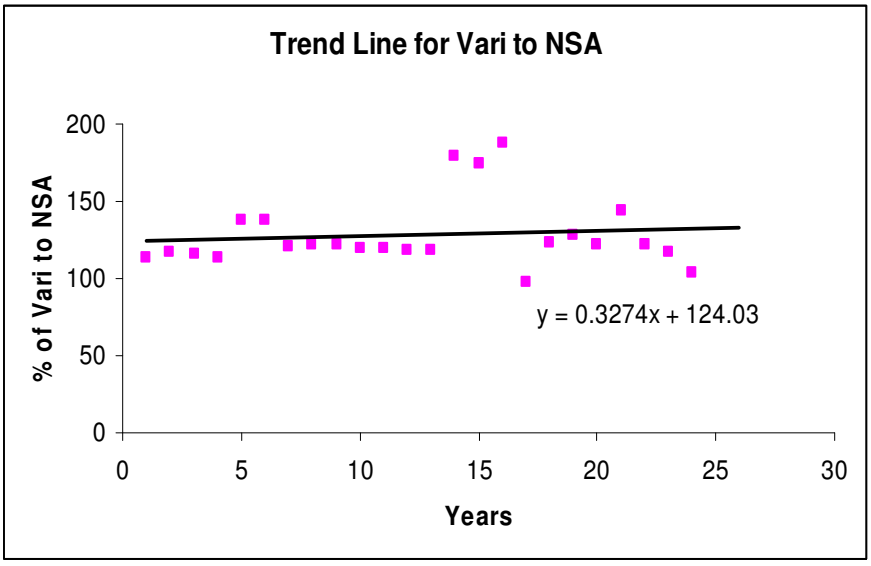
2. Ragi (Percentage of Net Sown Area)

y = -0.1464x + 7.2587



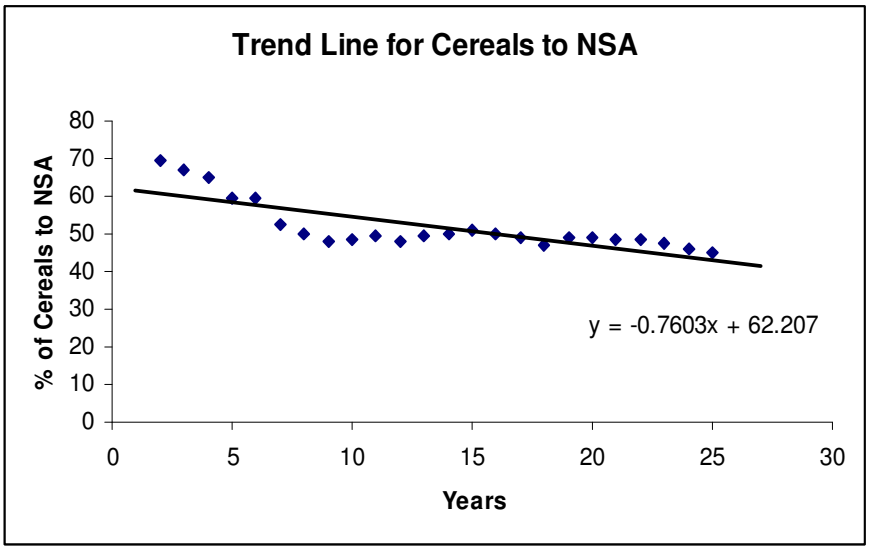
3. Vari (Percentage of Net Sown Area)

y = -0.0295x + 4.1075



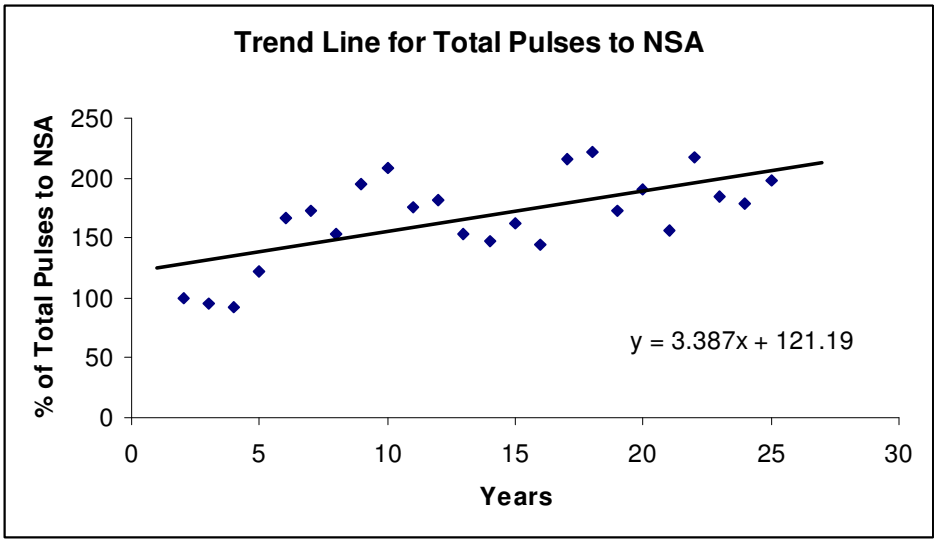
4. Total Cereals (Percentage of Net Sown Area)

y = -0.7603x + 62.207



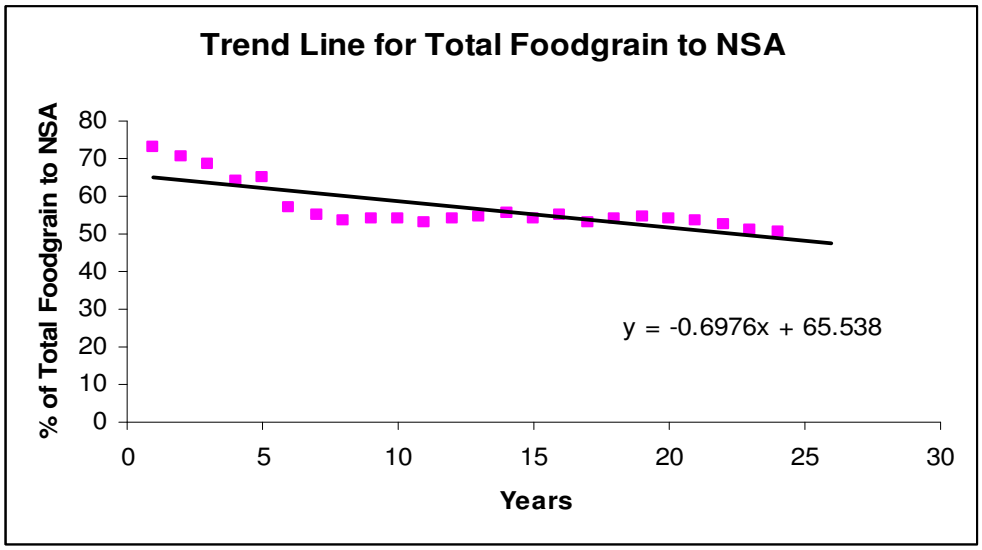
5. Total Pulses (Percentage of Net Sown Area)

y = 0.0611x + 3.9635



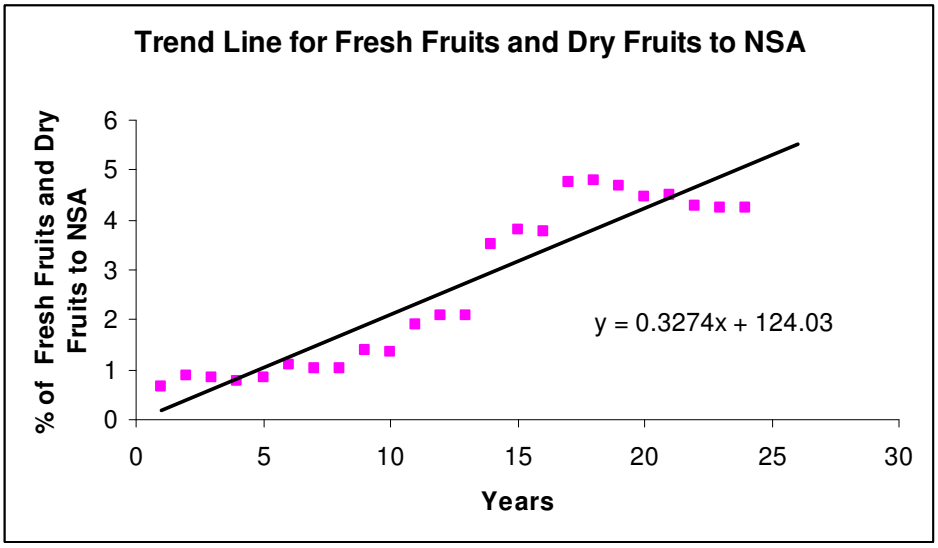
6. Total Food grain (Percentage of Net Sown Area)

y = -0.6976x + 65.538



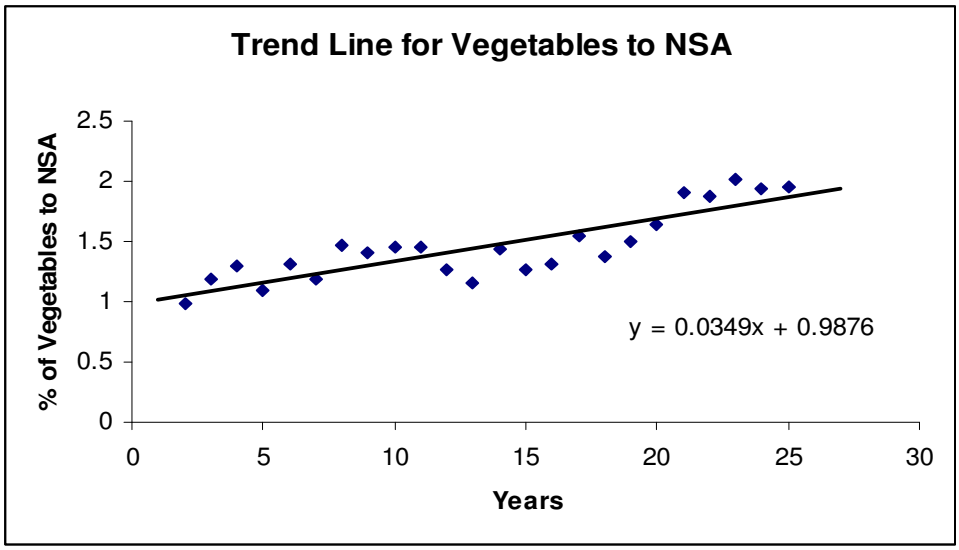
7. Fresh fruits and Dry fruits (Percentage of Net Sown Area)

y = 0.2141x - 0.0492



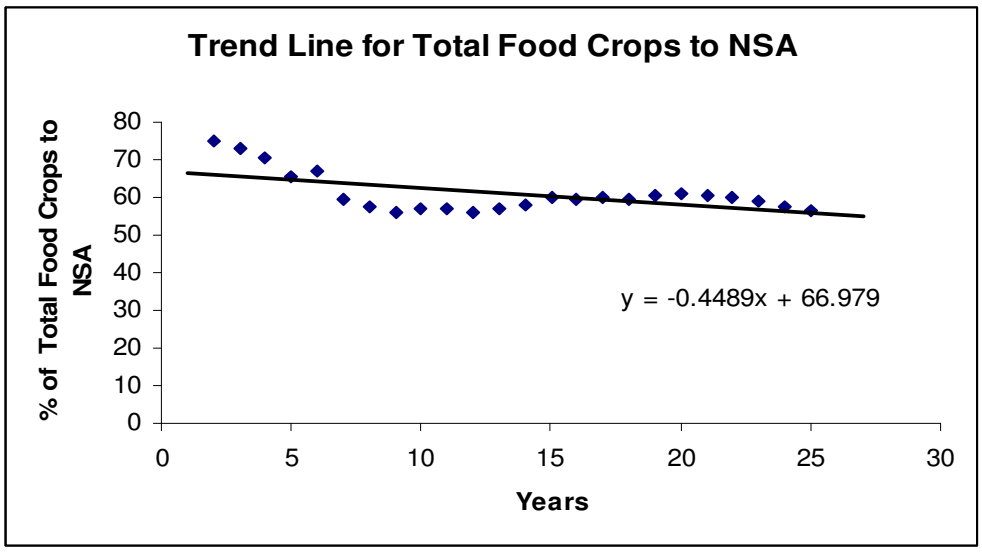
8. Total Vegetables (Percentage of Net Sown Area)

y = 0.0349x + 0.9876



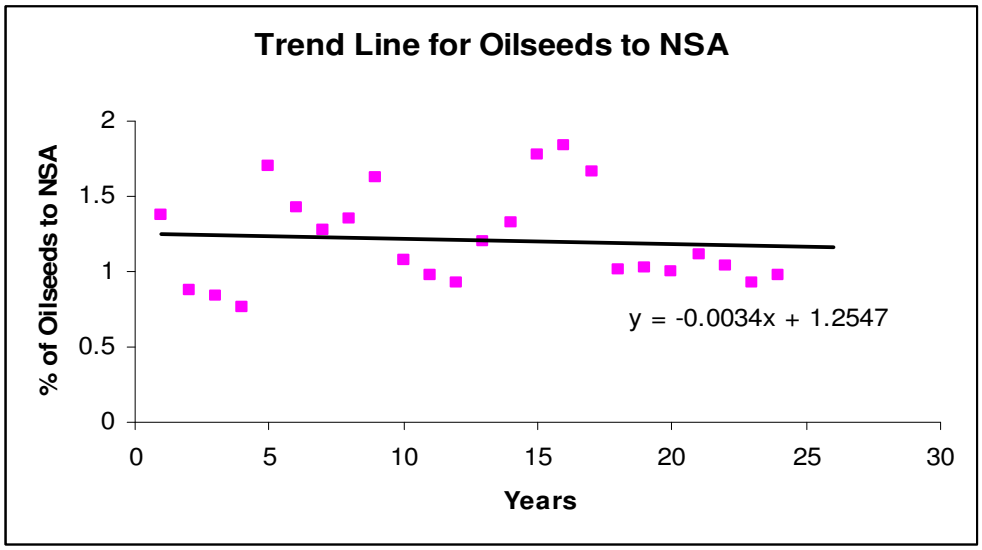
9. Total Food Crops (Percentage of Net Sown Area)

y = -0.4489x + 66.979



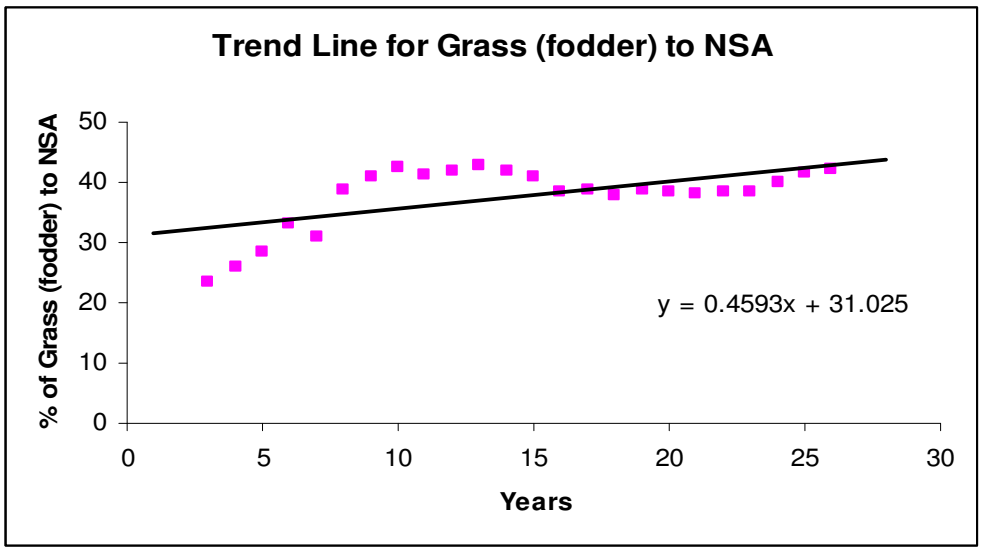
10. Total Oilseeds (Percentage of Net Sown Area)

y = -0.0034x + 1.2547



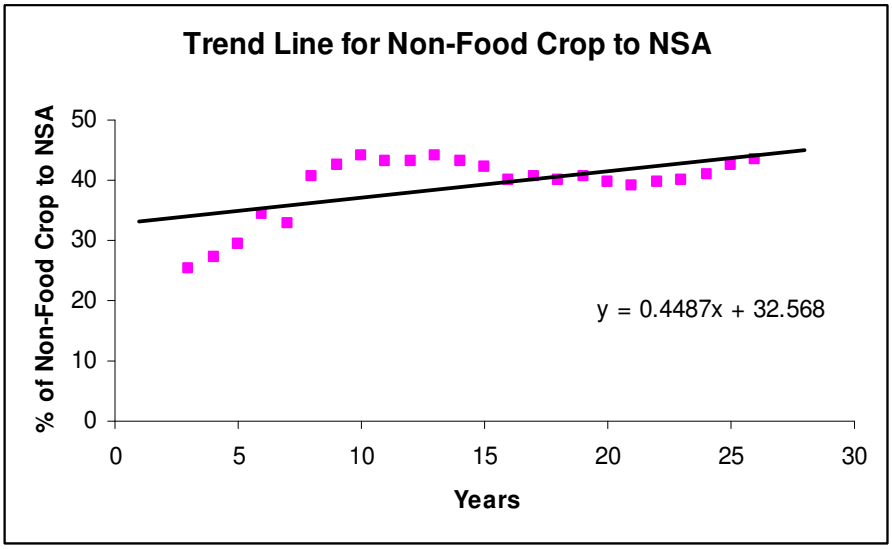
11. Grass /fodder (Percentage of Net Sown Area)

y = 0.4593x + 31.025



12. Total Non food crops (Percentage of Net Sown Area)

y = 0.4487x + 32.568



Results of Quantitative Analysis

Three different methods viz., the analysis of simple correlation, multiple regression and time series analysis were used. The analysis of simple correlation, multiple regression for finding out the correlation between characteristics of variation in the landuse and socio-economic as well as physical factors was done. Time series analysis for the temporal analysis of general and agricultural landuse in the district was also carried out. The results of these analysis indicate a strong influence of factors of physical environment on the spatial variations in agricultural landuse and time series analysis indicates the temporal changes in landuse pattern and help to predict the future condition with forecasting trends. The entire analysis for spatial data was based on the sample village observation based on the systematic sampling. And for the temporal analysis of landuse data from 1981 to 2009 was used. The results of the correlation analysis and multiple regression bringing

out the importance of these factors of physical environment can be considered.

The time series analysis has brought out the temporal changes of general and agricultural landuse. Forecasting trend lines helps to predict the future situation of various crops and changes in landuse categories in the district. Landuse types viz. Area under forest cover tend to decline in the near future. It is shown from the trend line that land use for non-agricultural purposes increase in the future. Trend line for area sown more than once has increased since last twenty five years and it means increasing intensification of agriculture.

CHAPTER -VII

AGRICULTURAL REGIONALIZATION

After unfolding the agricultural landuse pattern in earlier chapter an attempt has been made to spot light the spatial distribution of various crops, their growth and response to physio-socio-economic conditions prevalent in the region. The cultivation of crops and their growth are closely related to the decision making process on one hand and adaptation of innovation in agriculture. The selection of crops for sowing in the field, present composite picture of cultivation of crops in the region. The hectarage under individual crop gives relative strength and realistic picture of cropland use in the analysis of crop ranking of the region. The ranks of crops and their combination provide spatial variation in the distribution patterns.

In this respect the study of crop combinations and diversification's manifest the present agricultural scenario.

Region is one of the basic concepts of geography. It has been defined differently by different geographers. A widely accepted definition of region is "an area that is differentiated from other areas according to the specific criteria." It has also been defined as "a differentiated segment of the earth surface" (Whittlesey, 1929).

Study of spatial variations in the distribution of various phenomenae which forms the core of geographic studies leads to the identification and explanation of occurrences of phenomenae over the earth's surface. The occurrences which have some similarities can be grouped together and thus, a region which has some similarities and which is distinguished in some respect from the surrounding area is delimited. Geographers still have remained concerned with the ideas

of region and are using regional methods of investigation. Various types of regions are demarcated making use of selected variables. Delimitation of a region poses many a complex problem as it is difficult to incorporate all the relevant variables in the process of delimitation. The regions based upon only one variable are defined as single feature regions while multiple-feature regions take into account a number of variables (Datye, 1984).

Geographers identify region based on physical and cultural characteristics. The landform regions, climatic regions, pedological regions and biotic regions are some of the examples of physical regions, while population regions, linguistic regions, industrial regions, agricultural regions and trade and commerce regions are the examples of cultural regions. The main techniques used for the delineation of agricultural regions have also been examined (M. Husain, 1996).

Agricultural regionalization has attracted the attention of many scholars in the field of agricultural geography. Geographers have been interested in the overall agricultural region, although they by no means completely agree on its definition or the importance of its study in agricultural geography. Agricultural geographers have commonly used the physical and cultural attributes to define agricultural region.

Engelbrecht (1883) constructed individual distribution maps of major crops and animals for the U.S.A. and later in 1930 for other countries. Finally, he summarized his findings in his world map of “agricultural zones” (Landbauzonen). Multiple-feature regions then attracted many a geographers. Instead of emphasizing one factor, a number of variables were considered in combination to demarcate complex multi-factor regions. All these efforts can be grouped in

four categories viz., land capability regions, field system regions, farming system regions and functional regions (Gregor, 1970).

Buchanan (1959) thinks that the definition must be in agricultural terms – a crop, a crop association, a crop and livestock association, a system of organization of farm processes etc. Further, it was "usually determined principally by climatic conditions. Subdivisions of the region were the results of differences in land reliefs, or in slope and in soils", which might cause variations in the proportion of land used for crops, pasture or forest, or in the relative importance of the crops. Economic principles were important also, but only in the capacity to "strengthen the influence of the physical factors to join with them in determining the boundaries of the region." Whittlesey (1939) and Hartshorne and Dicken (1935) have emphasized the economic factors like operational structures of the farm rather than crop. Hartshorne and Dicken classified the agricultural regions of N. America and Europe using statistics for the measurement. Besides the physical and economic aspects, a cultural concept of the agricultural regions was espoused by Waibel (1933), Cholley (1946), and Carol (1952). Waibel viewed the agricultural and economic forces stressing the entire range of human forces as they are reflected in number and distribution over the earth surface and in social, economic, cultural and above all intellectual differentiation.

The worldwide classification of agricultural systems was worked out by Whittlesey (1936) and Hahn (1892). Based on a combination of various economic forces, Whittlesey identifies thirteen major regions. Hahn stressed more the cultural outlook in his six regions or economic forms. A third worldwide classification is based upon Bakers (1926-33) approach, but only in full detail for the U.S.A. and Canada.

In the late 1930's British geographers used statistical data for delimitation of agricultural regions. Agricultural Atlas of England and Wales used parish statistics which has several limitations. The quantitative revolution induced geographers to apply different quantitative methods in the analysis of data. At the same time, introduction of the digital computers enabled geographers to handle a large volume of data. Making use of these facilities in the delimitation of crop association regions of the Middle-west of the U.S. Weaver (1954) used the standard deviation to measure the deviation of actual occurrences against the theoretical curve. The Weaver approach to determining multifactor crop combination regions can be regarded as a vital step forward in the integration of a number of variables for regional delimitation, Thomas (1963), modified the Weaver approach, making use of all the data available for the calculation of variance for each crop combination. Coppock (1964) extended the Weaver method to the whole spectrum of agricultural activity by converting livestock and crop production to common units and differentiating between various intensities of production by weighting in England and Wales. Johnson (1958) used simple scale of gradation based on averages, for identification of crop association regions of East Pakistan.

In the last four decades, Indian geographers have been applying quantitative techniques to study the crop association regions. Indian geographers have delimited agricultural regions based upon techniques like crop-association, cropping pattern, crop concentration, crop diversification and agricultural efficiency. Most of these works are the modifications and applications of the ideas of Weaver, Kendall (1939), Pownall (1953), Nelson (1965), Doi (1957) and others. Other techniques introduced by scholars like Rao (1954), Rafiullah (1956), Shafi (1960), Bhatia (1960, 1964, 1965),

Athawale (1966), Ahmad and Siddiqui (1967), Sengupta and Sadasyuk (1968), Sinha (1968), Ayyar (1969), Mohammad and Amani (1970), Sharma, (1971), Sharma (1972), Husain (1972), Dikshit (1973). Bagchi and Jana (1974), Majid Husain (1996) have contributed to the various aspects of agricultural regionalization in India.

I. Crop Association Regions:

Approach and methods of agricultural regionalization have been discussed earlier. This enables one to choose the most appropriate method for the present study of crop associations with respect to the available agriculture data for district. The data available are collected for three different levels of administrative units viz., village, tahsil and district. Data regarding the areal strength of crops for a village have to be collected from different tahsil headquarters. An ideal plan for agriculture regionalization should cover the entire agricultural activity in the study area, but the agriculture region has been reduced here to the level of crop association region. There fore an attempt is made to delimit the crop association regions in the study area in four stages as follows:

i) To present areal strength of the crops grown in the region by ranking and interpret the factors responsible for this rank distribution.
ii) Identification of crop combination regions applying Doi's method.
iii) To delineate the patterns of crops combination of the Thane District by applying Doi's method and plot it in a regions of crop combination.

iv) To identify the crop diversification patterns of the study region by applying Bhatia's method of crops diversification and find out the variables responsible for such patterns in the area under study.

The purpose of the study is to evaluate the influence of certain physical environmental and cultural factors on the spatial variation in agricultural landuse. In view of this, physical regions representing different rainfall, soil and relief features were defined in earlier chapter.

CROP RANKING

1. Arbitrary Choice Method

The relative strength of individual crop could be assessed from the actual share of total harvested land that a crop occupies. This is the most elementary method for studying crop associations but it helps one to understand the overall spatial pattern of crop distribution. The crop areas could be arranged into descending order of magnitude and termed first, second, third, fourth, fifth ranks. The rank grouping may be useful in identifying the major crop or crops in the study area.

The first six crops have been identified and mapped. The ranking crops and number of village are shown in Table - 7.1-

Crops Ranking Frequency

Sr. No	Crops	I	II	III	IV	V	VI
1.	Rice	651	777	67	21	01	-
2.	Hill millets	116	73	349	57	20	07
3.	Pulses	05	38	243	338	33	05
4.	Fruits Vegetable	-	26	153	76	91	60
5.	Oilseeds	-	03	44	87	123	59
6.	Grass	754	585	-	14	10	06

Source: Compiled by Author **Table -7.1**

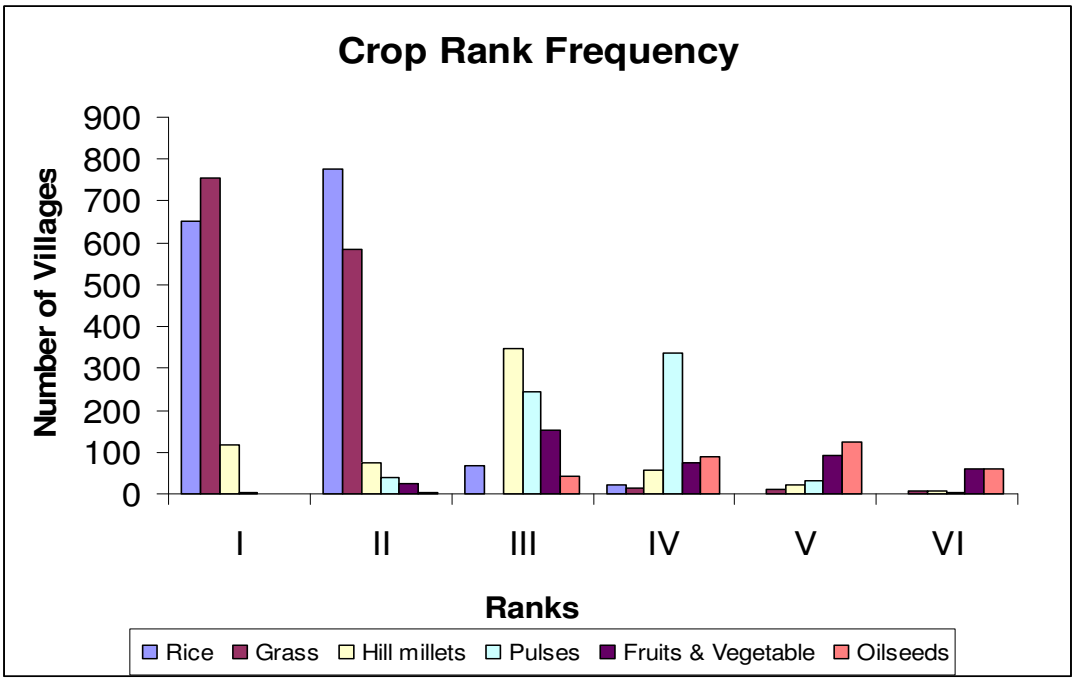
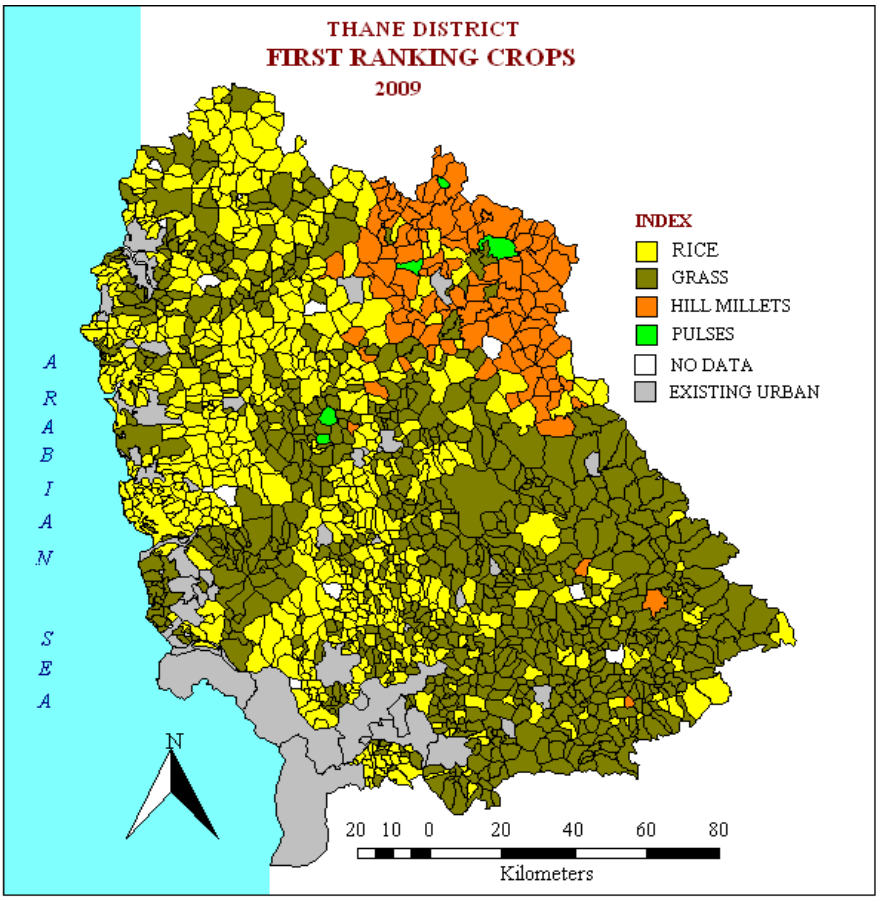


Fig. 7.1

First Rank Crops:

Among the crops grown in the study area, rice, hill millets, and grass dominate the agricultural landscape. Rice occupies the western most part of the district in a north-south belt. It is the first rank crop in six hundred fifty one villages. Hill millets as a first rank crop appear in one hundred sixteen villages dominating the entire northeastern part of the district. Rice is associated with coastal alluvial soil and some pockets are in the eastern margin of the region.

Grass occupies a significant first rank position in seven hundred fifty four villages in the south and southeastern part and some patches in the western coastal belt of the district. Pulses are not as important as first rank crops and appear only in five villages. Oilseeds and fruits and vegetables do not occupy the significant first rank position anywhere in the district (Map - 7.1).



Map - 7.1

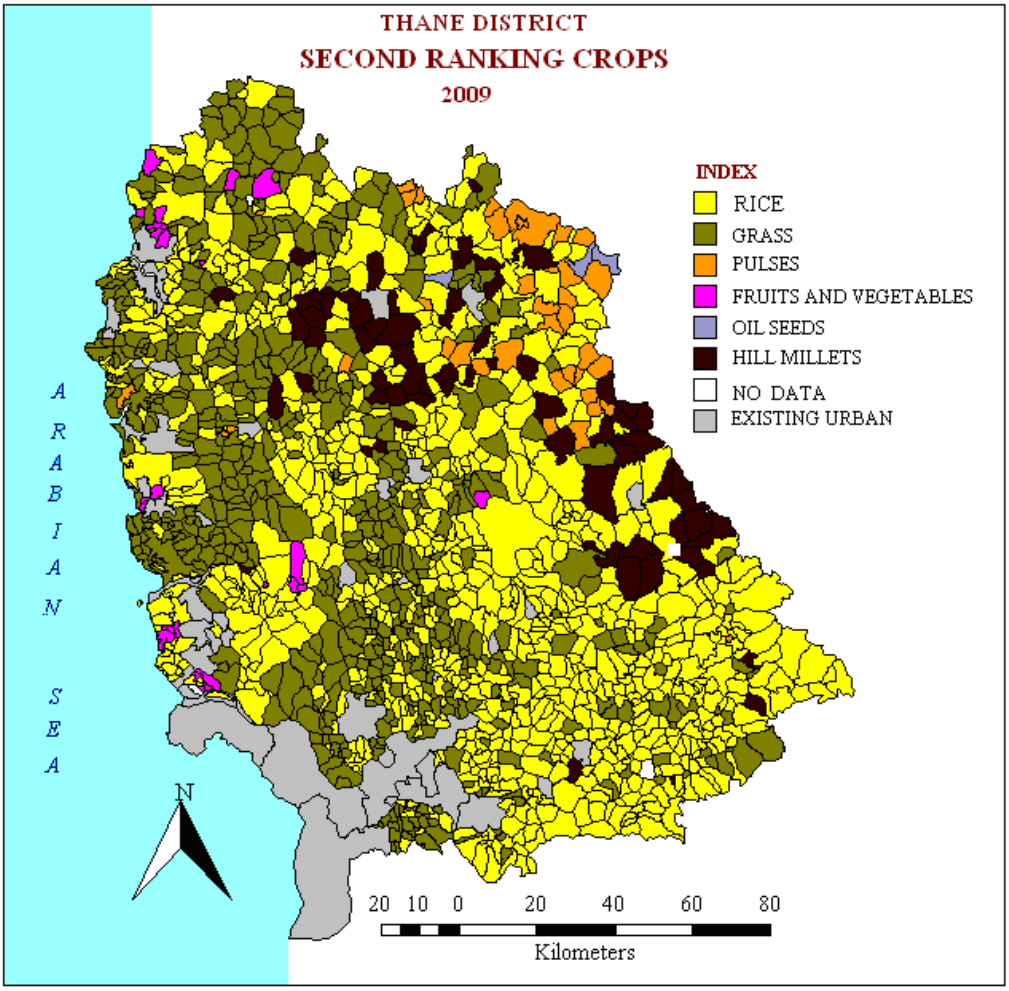
SECOND RANKING CROPS:

The second ranking crops present relatively large number of crops than those of first ranking. Map No. 7.2 reveals six crops ranked second. These six crops are rice, grass, hill millets, pulses, fruits vegetables and oilseeds. Table No.7.1 displays second ranking crops, number of villages in the region.

Rice dominates the region and holds the second rank in seven hundred seventy six villages occupying wide-spread in size in the region. This crop is found in southeastern, central and some patches in northern parts of the region.

Grass ranks second in 585 villages in the region (Map No. 7.2). Rice is spread out in western parts and some patches in eastern tract. There exists a significant association between rice and hill millets (in the eastern part) and hill millets and pulses (in the northeastern part). In most of the villages, wherever rice occupies the first rank, grass is the second rank crop and vice versa. The same is true about rice and hill millets. Cash crops are important as second crop in the coastal irrigation areas and in almost all cases they are associated with irrigated area.

On the eastern margins of pulses (thirty eight villages) dominant regions as well as oilseeds (three villages) are important as a second rank crop. The entire map is dominated by rice, grass, hill millets and pulses combinations in the district.



Map - 7.2

THIRD RANKING:

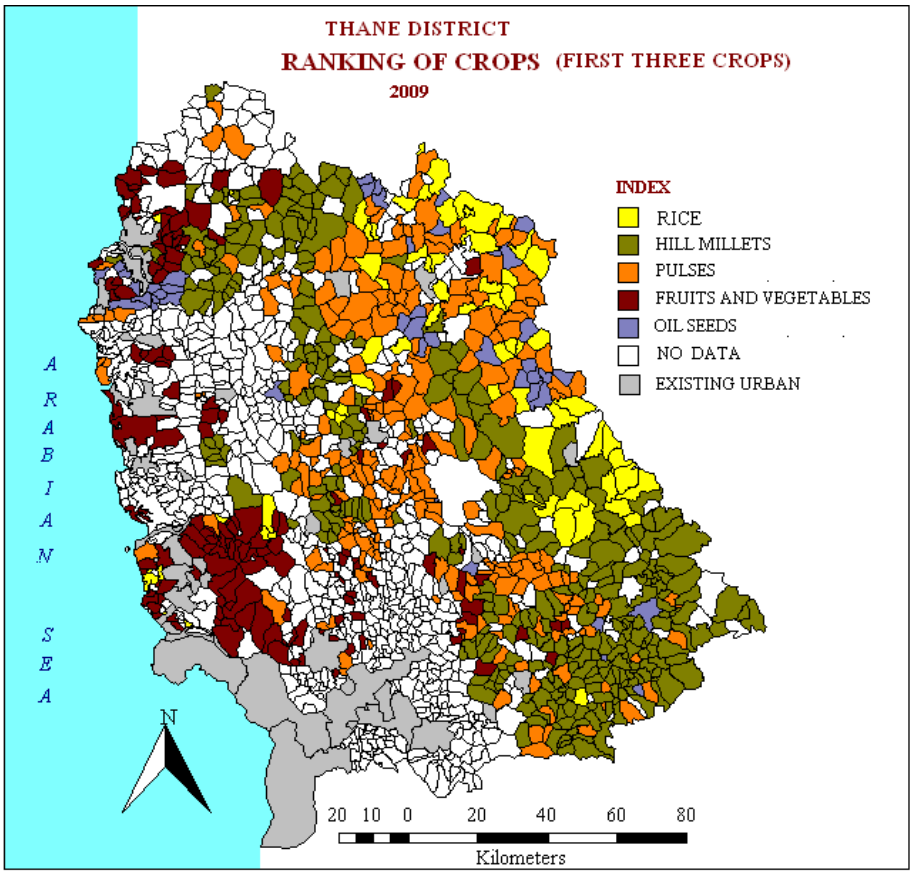
It is evident from Map No. 7.3 - that third ranking crops are wide spread and patchy form in their areal distribution pattern. These ranking crops are also five in number. These five crops are namely, hill millets, pulses, fruits and vegetables, rice and oilseeds. Among these crops hill millets, pulses, fruits and vegetables are the dominant crop in this rank group. Table No 7.1 displays the distribution of third ranking crops and villages in the region. It is seen from Map No-7.3 that hill millets occupies maximum area in 347 villages and holds third rank in the region, its areal extent

sprawls over the eastern and part in north-south direction, parallel to hill ranges and two pockets in central and northern part of the study region. Pulses are associated with rice and hill millets in the eastern heavy rainfall regions; with rice and with oilseeds in the southeastern part.

The fruits and vegetable rising villages concentrated in the part west and northwest, it is associated with coastal climate comprises in 153 villages. Fruits and Vegetables occupy dominant position in third ranking crops extended over western, northwest and central parts of the region. Oilseeds combine with pulses and hill millets grown in forty four villages in eastern and northeastern part of the district.

As third rank crops, hill millets, pulses, and cash crops replace rice and grass and dominate the entire district. Pulses and hill millets and pulses and oilseeds are closely associated either as second rank or as third rank crops.

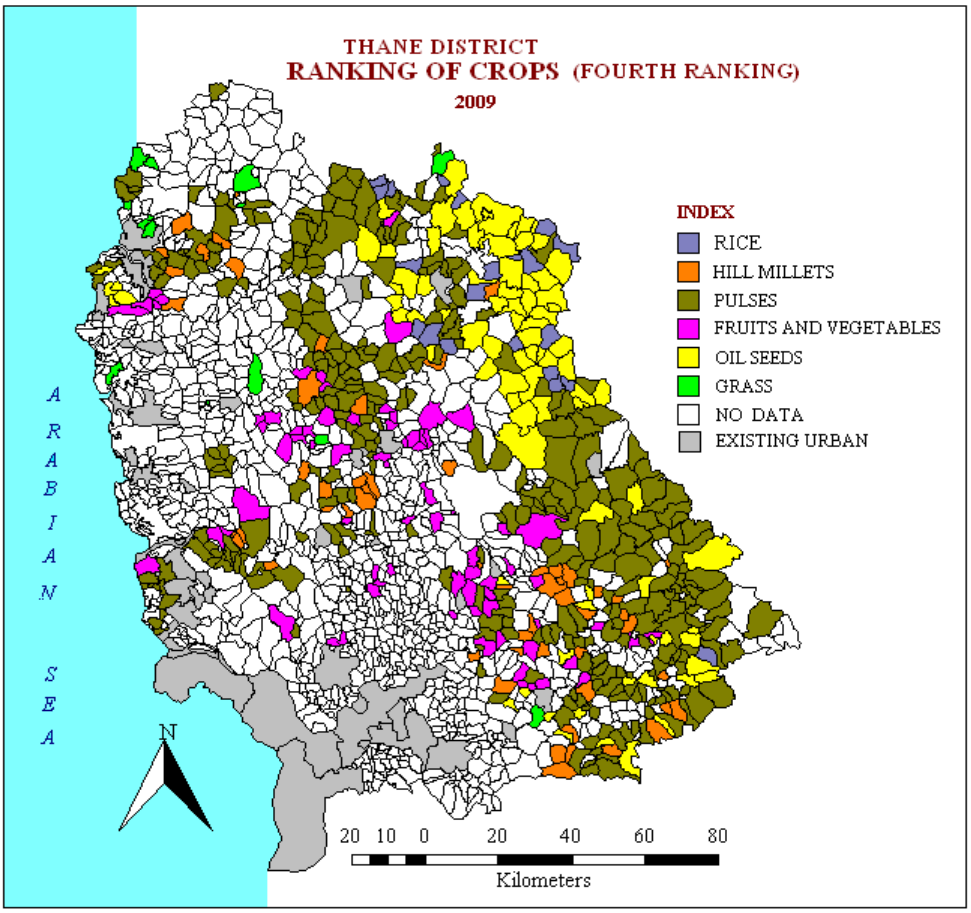
Oilseeds are associated with rice and pulses in the eastern heavy rainfall regions; with rice and pulses in the transitional zone; and with hill millets and pulses in the eastern tracts. Cash crops appear in combination with rice and grass in the western zone and with grass and either pulses or oilseeds in the eastern parts. Cash crops are absent in the eastern regions. Pulses appear with rice and hill millets in the central part; with rice and either grass or cash crops in the western zone; and with rice and oilseeds in the central parts.



Map - 7.3

FOURTH RANKING CROPS:

Fourth ranking crops are distributed in many villages. There are five crops namely, pulses, oilseeds, fruits and vegetables and hill millets. Pulses hold largest coverage among fourth ranking crops in the region. It is cultivated in northeast, central and northern part in 329 villages in the area under study. Oilseeds ranking fourth and is confined to 87 villages in the western part and some pocket form in northeast. Most of the fruits and vegetables growing villages in fourth rank are dispersed through out the region. Hill millet growing villages are spread in three pockets in the southeast, central and northwest part of the district.



Map - 7.4

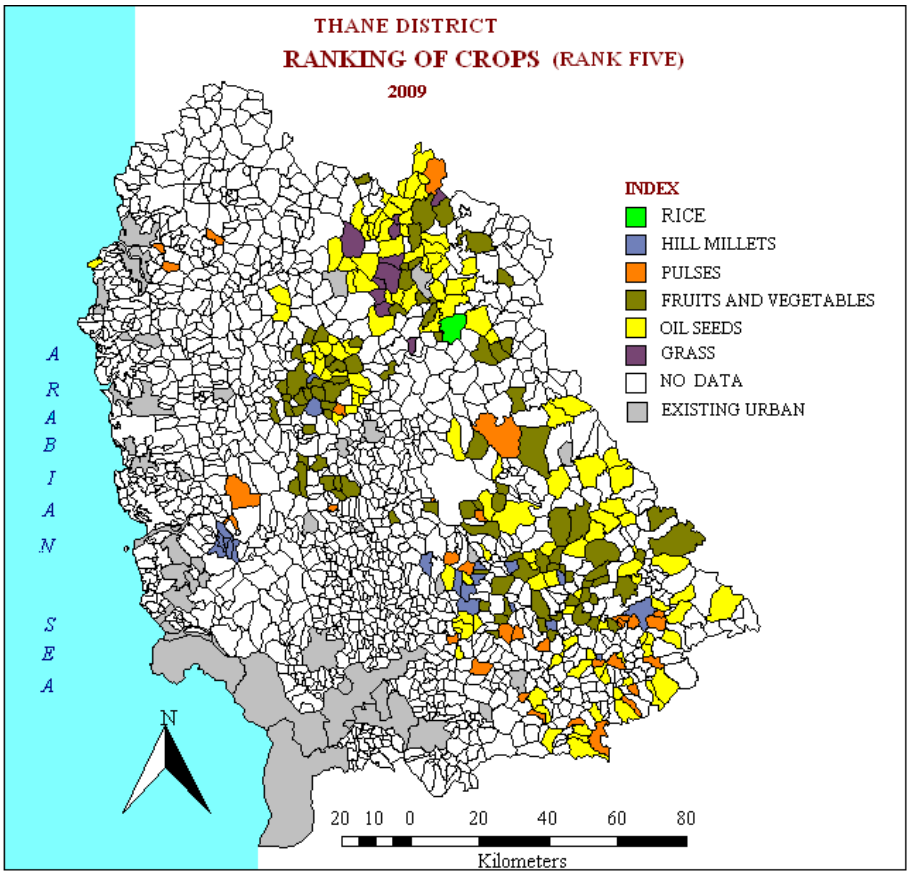
FIFTH RANKING CROPS:

Three crops presents in fifth ranking the crops namely, oilseeds, fruits and vegetables and pulses (Map - 7.5 and Table 7.1).

Oilseed holds largest coverage in one hundred twenty three villages among fifth ranking crops in the district. It is cultivated in northeastern and eastern part.

Fruits and vegetables are found in northeast part in fifth ranking covering in ninety one villages. Pulses grown in thirty three villages in the fifth rank. Pulses growing pockets are dispersed in the eastern part of the area under study. Shallow coarse soils and foot

hills region has grown pulses and some other patches in the northwest and central part.



Map - 7.5

CROP COMBINATION:

Agricultural practices and typology are best represented by crops in any region. The principal crops tend to concentrate according to their requirement of physical environment. A single crop like rice can dominate a region and also occurs as a monoculture in three villages. Cropping pattern or crop combinations become essential. Crops combination can be identified by taking recourse to ranking. Ranking leads to determine few dominant crops, but at the same time ignoring others in any given region. These crops which have low ranks. Though there are

various methods to determine cropping patterns, in the present study K.Doi's method has been used.

K.Doi's Method

The method is a derivative of Weavers method of crop combination region. By taking recourse to all table which gives critical values for different combinations, it is possible to identify crop combinations percentage of different crops to net sown area are calculated and the combinations decided as per the table after due correction. The results according to Doi's method are more realistic is in comparison to other methods. They are equally suitable in regions of high specialization, as well as in the region of no marked variations. In the present study Doi's method is applied to villages which constitute the study region.

Five crop combinations have been identified for district. (Map - 7.6).

Monoculture:

These are the regions where only one crop is dominant to the extent to enable us to define then as monoculture areas. Rice appears to be the only important crops in twenty nine villages.

Two crop combination :

Rice, hill millets, pulses, grass, fruits and vegetables appear in various combinations with each other. Rice and hill millets are combined to form either pulses or grass combinations. Rice- hill millets combination occurs in the eastern and north east zone. While rice and Fruits and vegetables are associated in the irrigated tracts. Rice and pulses are in the combination eastern and south east part. Rice - grass combination occurs in the western coastal plain in five hundred fifty three villages.

Three Crop Combination:

There are three hundred thirty one villages in three crop combination in the region. Five crops enter in this combination are namely, Rice, hill millets and pluses in twenty four villages. Grass, rice, fruits and vegetables occurs in one hundred fourteen villages. Grass, rice, fruits and vegetables combination appears in western part in patchy form of the study area. Map -7.6 and Table -7.2 shows the crops in order. Rice, Grass and Vegetables combination is found in twelve villages. Three crop combination of rice grass and pulses observed in hundred villages in central and northwest and southeast part of the region.

Four crop combination:

Three hundred twenty four villages have been included into this category of combination in the eastern zone, two- three patches in the northern and central part. Combinations are of rice, hill millets, pulses and oilseeds in fifty four villages in the eastern part of study region. Another high magnitude of combination in this group namely, grass, rice, hill millets and pulses in one hundred forty nine villages lies southeast, central and northwest part of the district.

Five Crop combination:

Two hundred eighty six villages in the southeast and in the form of patches in the central zone have been classified as five crop combination regions. All the crops appear in the combination e.g. rice, grass, hill millets, pulses, fruits and vegetables in forty one villages. The combination of hill millets, pulses, oilseeds, rice and grass observed at southeast part and some patches along the eastern margin of the district.

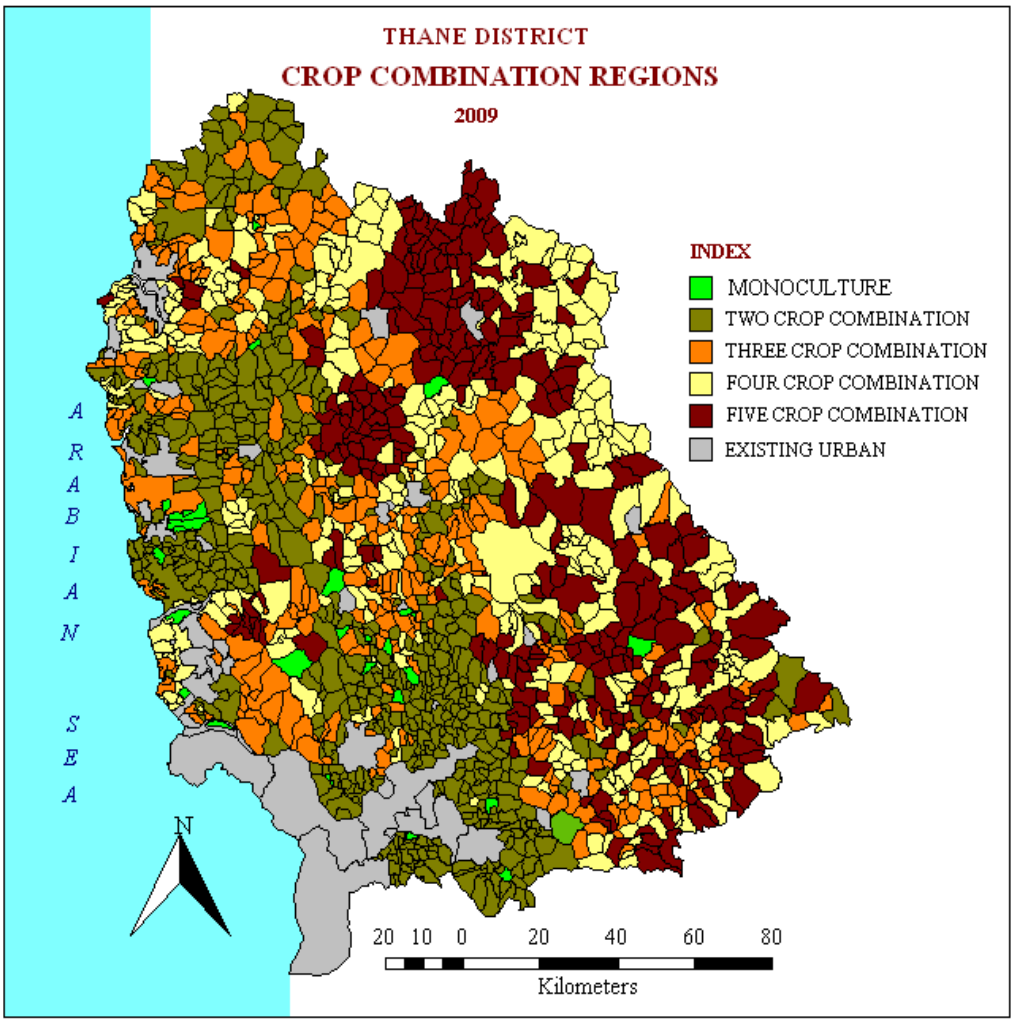
The crop combination regions reveal the importance of various crops in combination. The spatial variation in the number of

crops in combination reflects their association with the physico-economic attributes. Monoculture is practiced in the western coastal plain with rice. The transitional zone of eastern margin exhibits a number of combinations. Here the agricultural landscape is not dominated by a single crop, instead, a variety of crops are grown. On the western side of the mountainous region, monoculture in the west and east is replaced by two crop combination. The generalized pattern of crop combination as one goes from west to east would be monocultures – two crop combination – three, four, five crop combinations Monoculture in the west and central part indicates the dependence on one crop. In the transitional zone a farmer has relatively more choice of crops.

Crop Combination in Thane District

Combination Types	Crops in Combination	Number of Village involved	Percentage Total Area
Monoculture	Rice	29	1.78
Two Crop-combination	Grass/Rice/ Hill millets/Pulses/fruits and vegetables	571	34.99
Three Crop-combination	Rice/Grass /Fruits/ Pulses/hill millets/	331	20.28
Four Crop-combination	Rice/Grass/fruits and Vegetable/ Pulses/hill millets/	324	19.85
Five Crop-combination	Rice/Grass/ Fruits and Vegetable / /Pulses/hill millets/Oilseeds	286	17.52

Source : Compiled by Author **Table -7.2**



Map - 7.6

Combination Types	Crops in Combination
Monoculture	Rice
Two Crop-combination	Grass/Rice/ Hill millets/Pulses/fruits and vegetables
Three Crop-combination	Rice/Grass /Fruits and vegetables/ Pulses/hill millets
Four Crop-combination	Rice/Grass/fruits and Vegetable/Pulses/hill millets
Five Crop-combination	Rice/Grass/ Fruits and Vegetable / Pulses/ hill millets/ Oilseeds

CROP DIVERSIFICATION:

The Crop – diversification technique is applied to compute crop diversification pattern of the region. Its meaning is of raise variety of crops on arable land. It reflects the impact of physio –socio-variables. Moreover, it shows the contemporary competition among crops for an area, scope for rotation, the effect on double cropping, (Hussain, 1979). The greater number of crops led to greater competition, the higher is the magnitude of diversification.

Many geographers and economists so far have applied the concept of diversification in variety of sense. This concept, initially, was applied in the field of manufacturing to identity the degree of diversification and concentration by Clean (1930) later on by Tree (1938), Florence (1942) and Rainwald (1949). Gibb Martin (1974) has used diversification concept in computing measurement of diversification of employment in industry. Among geographers, Bhatia (1965) adopted and introduced crops diversification technique in order to understand crop competition in the region followed by Jasbir Singh (1976). Ayyer (1969) modified Bhatias method of crop diversification with accounting for that crop which occupy at least one per cent of the gross cropped area. (Dr. B. C. Vaidya, Agriculture land use in India).

Crop Diversification Technique:

In order to identify spatial pattern of crop diversification in present study. Bhatias method has been adopted in modified form. The crop having five or less than five percentage have been excluded from computation. This modification formula expresses as.

$$\text{Index of Crop Diversification} = \frac{\text{Percent of Net Sown Area}}{\text{Number of `n` Crops}}$$

Where ‘n’ crops are those which individually occupy five or more than five percent of crop to net sown area in the village.

CROP DIVERSIFICATION APPLICATION AND RESULTS:

The obtained results nave been displayed in Table -7.3 and Map-7.7shows crops in number villages and area in crop diversification in the Thane district. Plate No-7.8 shows the area distribution pattern of crop diversification in the region Maximum crop diversification appears in eastern part and lowest at southern and northern parts in the region.

It is seen from the above Exhibit that four crop – diversification region have been identified as:

1) Area of high crop diversification
2) Area of Moderate diversification
3) Area of low diversification and
4) Area of very low diversification

The four categories of crop diversification its class magnitude village and area as shown in Table No- 7.3. It is observed from this table that the largest area appears in the moderate crop diversification class covering 35 percent area in the region.

Crop Diversification

Sr. No.	Class of Crop Diversification	Magnitude of Crop Diversification	No of Village	Area Involved (Ha.)	Percent of Area
1	0-10	High	416	239096	25.49
2	10-20	Moderate	586	336835	35.91
3	20-30	Low	311	178782	19.06
4	Above 30	Very Low	270	154582	16.48

Source: Compiled by Author **Table -7.3**

AREA OF HIGH DIVERSIFICATION:

It is visible from Map - 7.7 that the area of high diversification appears in eastern part and some pockets in central part stretching south to north and northwest villages. The largest numbers of crops are found in high degree of diversification. There are six major crops, namely rice, grass, hill millets, fruits and vegetable, pulses and oilseeds enter in this diversification. High crop diversification observed in 416 villages covering 239096 hectares (25.49 per cent to total area) in the region. The eastern margin of the region is end to the hill range and foot hill villages have uncertain and lack of irrigation facilities, shallow soil of upland dose not give high yield per hectare. Hence high diversification of crops is obvious in this part of the region. In the central pockets also found high diversification rice grown is kharif season and some plantation crops through out the year. After kharif season the land may utilize for raising vegetables with the availability of irrigation by well.

AREA OF MODERATE DIVERSIFICATION:

The area of moderate diversification covers 336835 hectares (35.91 per cent to total area) in the area under study. The area of crop diversification appears along the eastern margin and in some pocket forms at northern, central and southern parts in the region. The major pockets are found along the coastal alluvial tracts (Map No. 7.7) where moderate diversification is observed, some patches are found in the southeast part. The crops in moderate diversification are rice, grass, hill millets, fruits and vegetables, pulses and oilseeds. These crops are raise on fertile coastal alluvial to shallow coarse soils in the region. The coastal tracts given high yield per hectare in coastal alluvial plain.

Five hundred eighty six villages appeared in the moderate diversification, southern part in the region identifies a small patches of moderate crop diversification on coastal alluvial tract, where rainfall ranging between 1500 mm to 2000mms. Major pockets of moderate crop diversification appears in the central and southern part in the alluvial to shallow course soil in the region.

AREA OF LOW CROP DIVERSIFICATION:

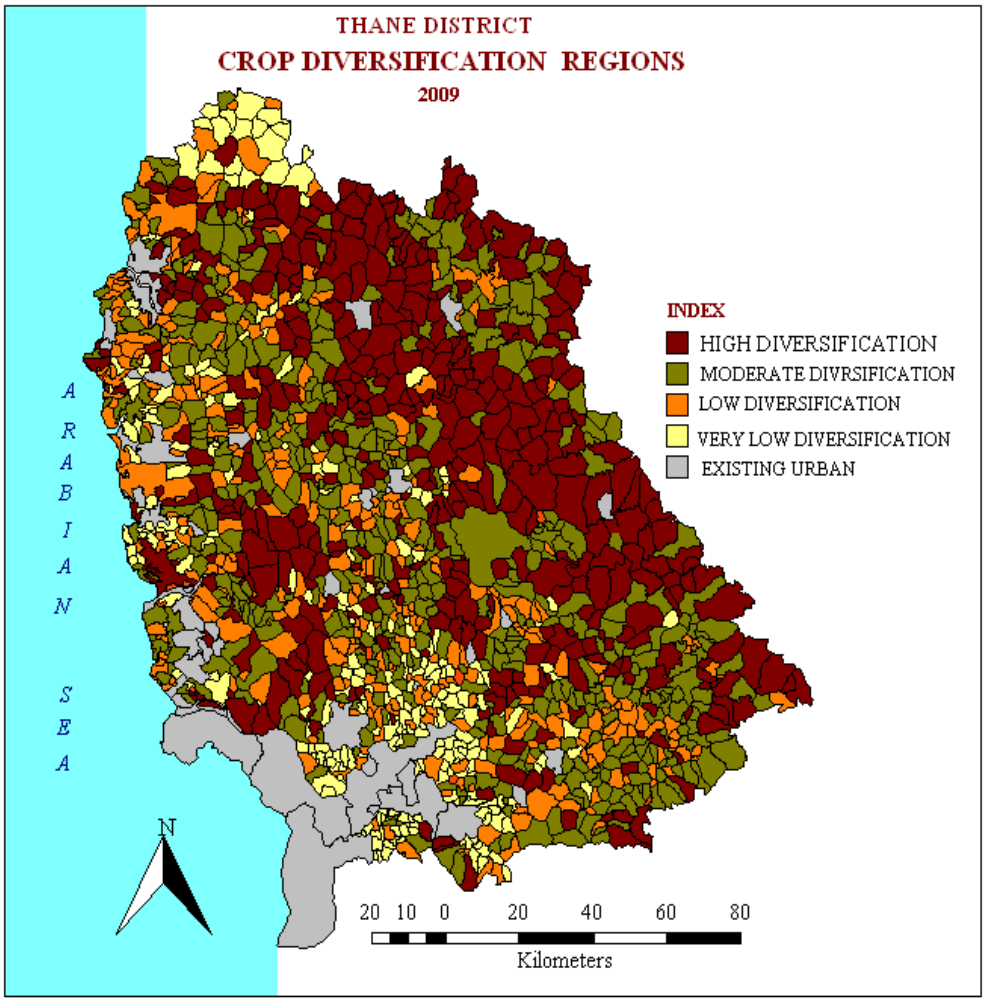
The area of low crop diversification covers 178782 hectares (19.06 per cent to total area) in the area under study (Map -7.7 and Table-7.3). Low crop diversification region appears disintegrated in patches in the south, central and north part of the region. The largest patch of this category is observed western coastal region.

Three hundred eleven villages appeared in this category of crop diversification. Rice Grass, Pulses, Fruits and Vegetables enter in this diversification. It appears western margins of the area under study.

AREA OF VERY LOW CROP DIVERSIFICATION:

This category covers 154582 hectare (16.48 percent to total area) under very low crop diversification in the region. The area of crop diversification appears in some patches in the north, south, central and some dispersed patches in the western coastal plain of Thane district.

Two hundred seventy villages appeared in this category of crop diversification in the area under study (Map - 7.7 and Table - 7.3) Rice and Grass are the major crops grown in alluvial soil to shallow coarse soils in the region.



Map- 7.7

RESUME:

To attempt an exposition of agriculture landuse pattern in the region the village has been taken unit for study to throw light on crop combination and diversification. The area strength of individual crop has been discussed by ranking. This falls into five descending order. Grass stands as first in ranking while rice in second ranking crops. Rice ranking in the first in six hundred fifty one villages, consequently occupying the predominant position within the region. Grass has been observed in first ranking in seven hundred fifty four villages. Other crops such as hill millets, pulses, fruits and vegetables have been ranking below rice and grass in the descending order.

The application of Doi's method shows the realistic picture of crop combination in the region. It has been observed that two and three crop combination cover the largest areal extent in combination. Out of seven crops in total six crops namely, rice, hill millets, grass, fruits and vegetable and pulses enter in the three crop combination in 571 villages on (34.99 per cent to total area in the region). followed by this two crop combination three crop combination enter in three hundred thirty one villages on 20.28 per cent to total area in the region) Other crop combination are also significance in the region. The crops of four and five are covering the area of 19.85 and 17.52 percent to total area. Crops namely rice, grass, hill millets, pulses, fruits and vegetables are in combination.

In order to understand the competition among crops in the region the crop diversification has been computed by applying Bhatia's formula. According to Bhatia's method four crop diversification categories have been revealed in the region. The

result of crop diversification establishes relationship with physio–socio-economic conditions. The largest area covers with moderate crop diversification in 586 villages on 35.91 per cent followed by high crop diversification in four hundred sixteen villages on 239096 hectares (25.49 per cent) The high diversification is observed on eastern side and some patches spread west wards. The moderate crop diversification is found on extensive pockets in the study region, where crops namely rice, grass, vegetables, fruits, pulses and hill millets are grown in this diversification. Whereas the low diversification crops observed in three hundred eleven villages on 178782 hectares (19.06 percent) very low crop diversification covers 154582 hectares (16.48 per cent) observed in two hundred seventy villages.

CHAPTER - VIII

SAMPLE SURVEY

MICRO LEVEL CASE STUDIES

This chapter is devoted to study the sample villages at micro level selected from each of the crop combination zone. This helps to evaluate the interactions of various elements and the resulting landuse patterns. These sample villages were carefully chosen on the basis of certain characteristics in terms of crop combination so as to representative of the prevailing regional characteristics. In order to examine the association between physical and socio-economic conditions at micro level, these sample villages were selected different regions.

A detailed survey of agricultural landuse in each village along with

a related phenomenon was done covering the following aspects:

1. Geographical position of the village
2. General land utilization
3. Agricultural landuse : (i) Kharif crops (ii) Rabi crops
4. Socio-economic background: Investigated through a questionnaire put to individual farmers regarding agricultural practices, size of land holding, attitudes and problems.
5. Input-output data for the important crops in the region
6. Temporal variations in landuse: Data collected from village level land Revenue office (Talathi office).

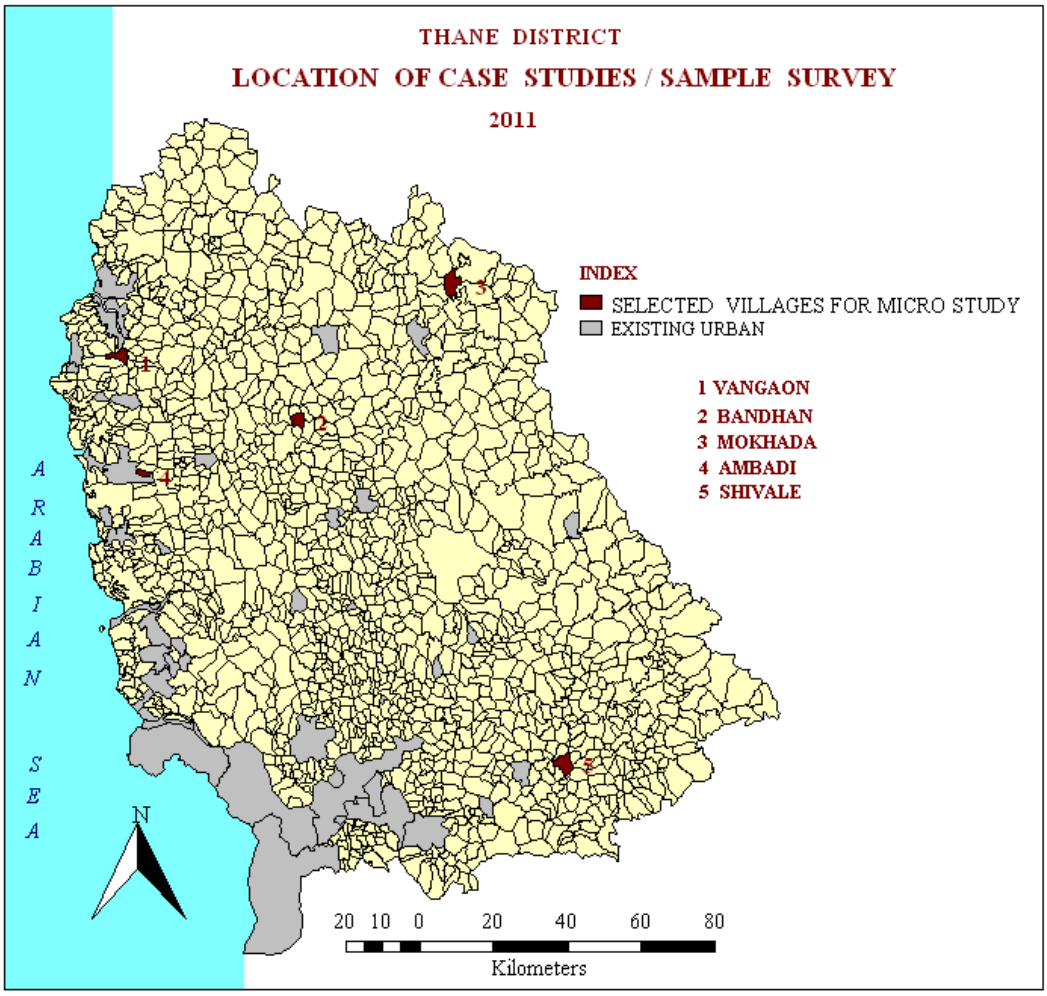
An attempt was made to collect data regarding the temporal variations in the landuse, land holdings and fragmentation. In some villages this information was available but in some cases this is not easily available. Secondly, the information regarding the input structure of the important crops in the sample village was collected through interviews with the farmers of that village.

The input here do not include the supervision charges, land revenue, marketing charges and interest on capital.

The following villages from different regions were surveyed for the purpose of this micro level study of the representative condition.

1. Bandhan – High crop diversification - Four crop Combination
2. Mokhada – High crop diversification - Four crop Combination
3. Vangaon –Moderate crop diversification - Three crop Combination
4. Ambadi – Low crop diversification - Two crop Combination
5. Shivale – Low crop diversification - Two crop Combination

These sample studies are given so as to bring out the general characteristics as well as the individual variations with reference to the region in which the village is located.



Map - 8.1

1. BANDHAN

A Profile of the Village

Bandhan is a small (806 ha.) and isolated village, located in northeast part of Thane city. About 66 km. from Thane, nearly cut off from development of any kind. It is located in the zone of heavy annual rainfall, (more than 2500 mm of rainfall). Except for the area around the village settlement, rest of the village area is a part of a hill range. Other services available at Bandhan include a primary school, a secondary school, a dispensary, a health center, electric power supply, river and tap water for drinking, pucca road, state transport bus stop and post office.

Bandhan has experienced a steady growth of population during the last two decades (Table - 8.4). Population growth, density of population and changes, in the occupational structure Agriculture still dominates occupational structure sharing about 51.65 per cent of the total working force (2001). Among those gainfully employed in agriculture, cultivators form a major portion (72.89 per cent) while agriculture labourers account for 34.43 per cent of total farm workers. The number of total farm workers has gone down in the last decade. The proportion of cultivators among the farm workers has decreased nearly twenty percent. Though the total population has increased, the number of total workers has also increased, a fact which throws light upon the unemployment and under employment problems in the region.

Characteristics of Working Population in Bandhan.

Population Characteristics	**1991**	**2001**
Total Population	901	1057
Density of Population (per hundred hectares.)	12	13
Total Workers	396	546
Percentage of Total Workers	43.95	51.65
Total farm workers	387	398
Percentage of Total farm workers	97.72	72.89
Cultivators	335	253
Percentage of Cultivators to Farm worker	86.56	63.56
Agriculture Labourers	52	145
Percentage of Agriculture Labourers to Farm workers	13.43	34.43
Livestock & Orchard workers	03	-

Source: District census hand book (1991, 2001). **Table 8.1**

General Landuse

Bandhan, though situated on the plateau region, is surrounded by uplands and valleys in the surrounded part. The rugged topography and nature of soil cover have contributed to the present land utilization for cultivation.

Net sown area covers a large area in the eastern half of the village (Map-8.2). It is observed that areas of eastern side suitable for cultivation are given to various crops. Forest occupies an insignificant position in the year 2009 it shows greater decline since 1991 and increase in culturable waste. Rest of the area comes under the category of area occupied by houses, huts, road and barren rock exposures.

Proportion of total area under different Categories of landuse in Bandhan

Sr.No.	**Landuse**	1991	2001	2009
1	Forest	36.25	21.22	14.01
2	Gross Cropped Area	36.31	41.75	41.15
3	Grass	-	-	3.36
4	Culturable waste	-	5.67	26.27
5	Not available for cultivation	6.26	2.94	14.87
6	Fallow	-	-	2.28

Source: Village Revenue Records, Panchayat Office,Bandhan.

Table 8.2

Agricultural Landuse:

About 41 percent area is available for cultivation. Most of it is located along the eastern margins of the village. Some patches under cultivation are also observed along the banks of the stream and its tributaries. Hill slopes have thin soil cover but in the foot hill zone soil is thicker. Light brown soils are common in the cultivable areas, while coarse shallow varieties occupy the hill slopes. Table 8.7 indicated the share of each crop in the total cropped area.

It is obvious that in an area receiving rainfall over 2000 mm., rice should dominate the cropping pattern (Fig. 8.3). Rice alone accounts for about 59 per cent of the cultivated area followed by a vegetable. Generally better agricultural lands are under rice and vegetables, whereas inferior lands are given to horticulture crop like

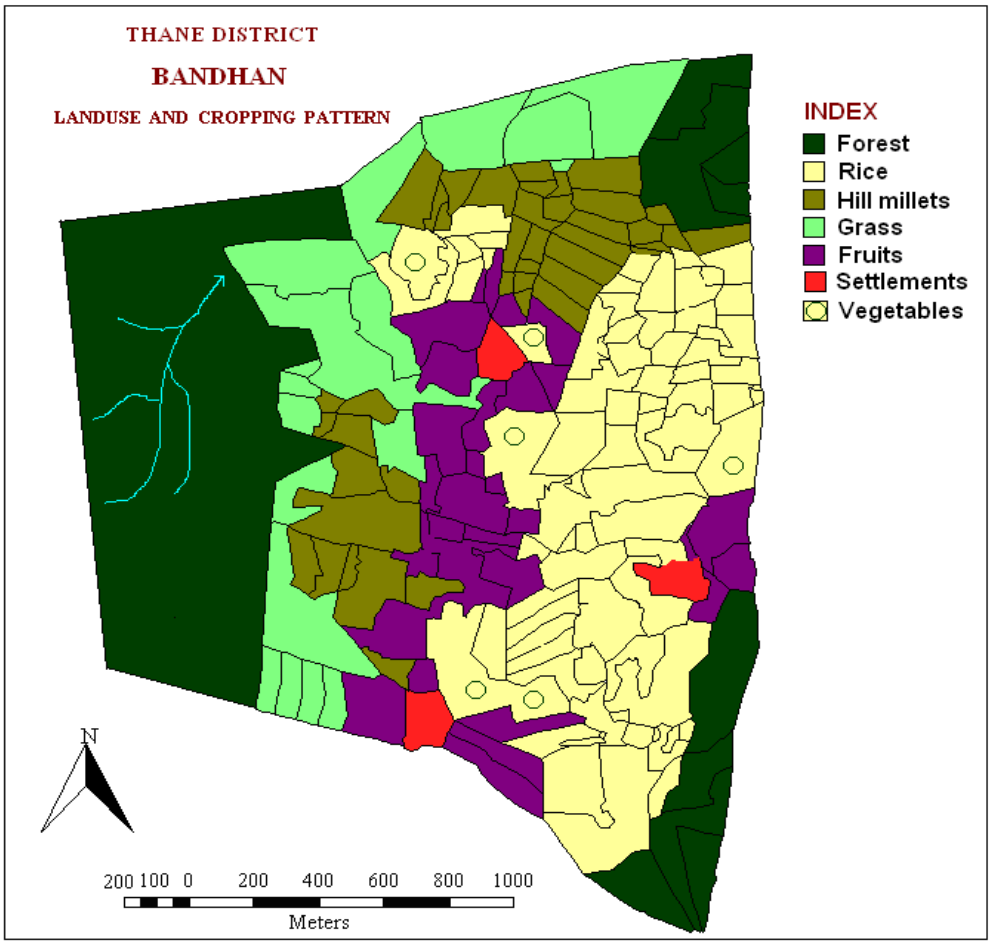
mango. Fruits occupy a comparatively smaller area, along the western margins (about 11.20 per cent of the gross cropped area) while a small area is under grass, generally on the land which is not suitable for cultivation along the eastern margins.

Proportion of G.C.A. Under Different Crops in Bandhan (2009)

Sr. No.	Crop	Gross Cropped Area	Percent of G.C.A.
1.	Rice	197.83	59.39
2.	Fruits (Mango)	37.15	11.20
3.	Vegetables	85.55	25.79
4.	Grass	11.17	3.36

Source : Village Revenue Records, Panchayat Office, Bandhan

(Table 8.3)



Map- 8.2

The information collected from personal interviews with farmers relates to the size of holding, attitudes towards application of new methods, techniques, the type of implements used, investment in the farm, nature of agricultural operation, credit facilities, marketing of agricultural produce and problems and prospects of agriculture in that village.

Land Holdings and Fragmentation:

In order to understand the structure of land holdings resulting from interaction between physico-socio-economic elements and its impact on agricultural patterns, data for the total land holders, size of landholdings, location of the holdings, and number of fragments were collected from the village records available at the Panchayat Office. It is generally understood that a small farmer is a farmer, holding less than five acres of land (Govt. of Maharashtra, 1976). A medium farmer holds between five and ten acres of land and a big farmer is one who owns more than ten acres of land. These categories are broad generalizations, but for the matter of convenience, these classes were adopted with three sub-divisions, in the first category, viz. size classes of 0-1, 1-3 and 3-5 acres.

In Bandhan, 16.90 per cent of the total area is cultivated by 61 per cent of the holders. In contrast, only 20.72 per cent holders own 64.29 per cent area. The problem of fragmentation has been recognized long back. As the farmer's total holdings are in many instances divided into several pieces far apart from one another, efficient cultivation of all these pieces is always a problem. The extent to which fragmentation has occurred in Bandhan where the size of fragments increases with the increase in the size of holding.

The number of fragments, it is also observed, increases with the larger sizes of holdings.

The size of fragments and the number of fragments in different classes of holdings reflect the influence of the nature of the terrain, productivity of the land and the choice of crops to be grown. As paddy is generally grown in small fields, the size of the individual fragment tends to be relatively small in Bandhan.

Farm Operation and Implements

A plough, a blade, harrow, and planker are the common implements used by farmers. Small holders are economically too weak to own all these implements. It is a usual practice to share these implements among three to four farmers. Rice being the major crop grown, the farm size is very small i.e. the total cultivated area is divided and subdivided into numerous small paddy fields of the size of 00.00.10 hectare also . This small size alone explains the emphasis on human and animal labour. Not only 'Bandhan', but the farmers in the whole area of this plateau region do not possess any mechanized tillers like tractor.

The farmers appeared to be conservative in their attitudes towards the adoption of new techniques, use of chemical fertilizers and improved seeds. Experiments in the recent past being unsuccessful, most of the farmers do not use improved varieties of rice. Urea and superphosphate are the chemical fertilizers generally used while farm manure accounts for a major proportion of the total fertilizer application. Pesticides are not used and oil engines or electric pumps are generally used for irrigation.

Farmers require capital for purchases of farm inputs like fertilizers, seeds and other implements. Nationalize and co-operative banks located at Vikramgad and Jawhar, provide the

farmers with credit facilities. Bandhan has a high school (up to 10th std.) and a small provision store. Agricultural produce in this area is transported to Vada, Bhivandi or Navi Mumbai market centre.

Input-Output structure of rice cultivation :

Rice being the most important crop of this village, information regarding the crop calendar and average input structure (per acre) of rice was collected from the personal interviews with a few farmers. The following table gives the inputs per acre of an average farmer in Bandhan.

Major Inputs and yield of Rice – Bandhan.

Sr. No.	Farm Operation	Implements	Labour Male/ Female	Cost (Rs.) (2009)
1.	Ploughing	Plough	1(M)	500.00
2.	Collection and burning of litter (Jan. Feb.)		5(F)	500.00
3.	Preparation of nursery plot May- June) Seed	Harrow 15 to 20 kg.	2(M)	200.00 400.00
4.	Farm yard Manure	15 to 20 carts		1500.00
5.	Harrowing	Harrow	2(M)	200.00
6.	Transplanting (July–August)	by hand	20 (M & F)	2000.00
7.	Fertilizers: (September)	50 to 60kg.		600.00
8.	Weeding (Sept. – Oct.)	by hand	6(M)	600.00
3.	Harvesting and Transport to house / farm yard (November)	By hand	5 (M or F)	750.00
10.	Threshing of paddy, Winnowing etc. (Jan. – Feb.)		10(M)	1000.00
	Total Input		**Rs.**	**8250.00**

Source: Compiled by Author **Table 8.4**

Output

Yield : Average 15 quintals/acre

Transport cost: Transportation charges to Navi Mumbai, Bhivandi Market Rs. 35/- per quintal by truck.

Area under mango has increased in the village, information regarding the average input structure (per acre) of mango was collected from the personal interviews with a few farmers. The following table gives the inputs per acre of an average farmer in Bandhan.

Major Inputs and Yield of Mango – Bandhan.

Sr. No.	Farm Operations	Implem-ents	Labour Male/ Female	Cost (Rs.) (2010)
1.	Preparation of Plot	Tractor	10(M)	1000.00
2.	Preparation for plantation: Digging squares (1 x 1 x 1 m.)	By hand	40 (M)	4000.00
3.	Compound		40(M)	4000.00
4.	Fertilizers: (Before Plantation) Farm yard manure 20 carts Super phosphate 200 kg.		10(M)	1000.00 2000.00 1400.00
5.	Cost of Plant : Rs.30/- x 40 plant			1200.00
6.	Plantation	By hand	20 (M)	2000.00
7.	Fertilizers 50 kg	By hand	5 (M)	500.00
8.	Weeding and inter cultivation		10(M)	1000.00
9.	Irrigation (Dec. To May)	By hand or Pump	25 (M)	2500.00
First Year Total			**135**	**20600.00**
8.	Inter cultivation	By hand	5 (M or F)	500.00
9.	Fertilizers:	By hand	10(M or F)	1000.00
10.	Cost of Fertilizers: 200 Kg			1800.00
11.	Weeding	by hand	10(M)	1000.00
12.	Irrigation (Dec. To May)	By hand or Pump	25 (M)	2500.00
Second Year Total			**60**	**6800.00**
15.	Fertilizers and inter cultivation Fertilizers: 200 kg		20 (M or F)	2000.00 1400.00
16	Crop Conservation		10 (M or F)	1000.00
17.	Irrigation (Dec. To May)	By hand or Pump	25 (M or F)	2500.00
Third Year Total			**55**	**6900.00**
Total Input			**Rs.**	**34300.00**

Source: Compiled by Author **Table 8.5**

Output

Yield: Average 25 quintals/acre

Transport cost: Transportation charges to Navi Mumbai, Bhivandi Market Rs. 80/- per quintal by truck.

Problems and Prospects :

The farmers are facing a variety of problems ranging from very limited scope for expansion of land under cultivation to lack of capital for investment in implements and infrastructure.

Bandhan receives adequate rainfall from south west monsoon in the Kharif season, so there is enough of water required for rice cultivation. Soils deposited in the lowlying areas or depressions have moisture retaining capacity, and are, thus, used for raising two crops in a year rice in the kharif season followed by vegetables, gram as rabi crop. Recently, well irrigation is introduced to provide water for crops. For small holders land is limited and capital is scarce. If the land owned is just one acre, the farmer has to work as an agricultural labourer to earn his living. A small holder is neither in a position to own the implements he requires for tillage nor can he purchase better seeds and chemical fertilizers. This finally leads to inefficient use of both, labour and land.

Bandhan has a large area under rice followed by fruits and vegetables. Proper utilization of available cultivable waste, would certainly lead to a supplementary income for farmers in the form of fruit production. At present about 37.15 hectares, accounting for 11.20 per cent of total land of the village, horticulture indicates a very high potential for further development, through a better organized marketing facilities.

To sum up, Bandhan represents the characteristics of the moderate crop diversification zone. It receives heavy rainfall; the area available for cultivation is still low but some what higher than other nearest villages. Rice dominates the landscape and is the most important crop among the crops grown. The grass is not as significant as that was in rest of the villages in the district belonging to very low diversification.

2. AMBADI

A Profile of the Village

Ambadi a small village (Area = 207.69 ha.) located in the north east part of Thane district about 64 km from Thane city. Common characteristics of the crop association region and low crop diversification well represented here. This village is connected to Palghar (Tahsil Hq.) and Thane by road and railway. Other services available at Ambadi include a primary school, a secondary school, a dispensary, a health center, electric power supply, well water for drinking, pucca road.

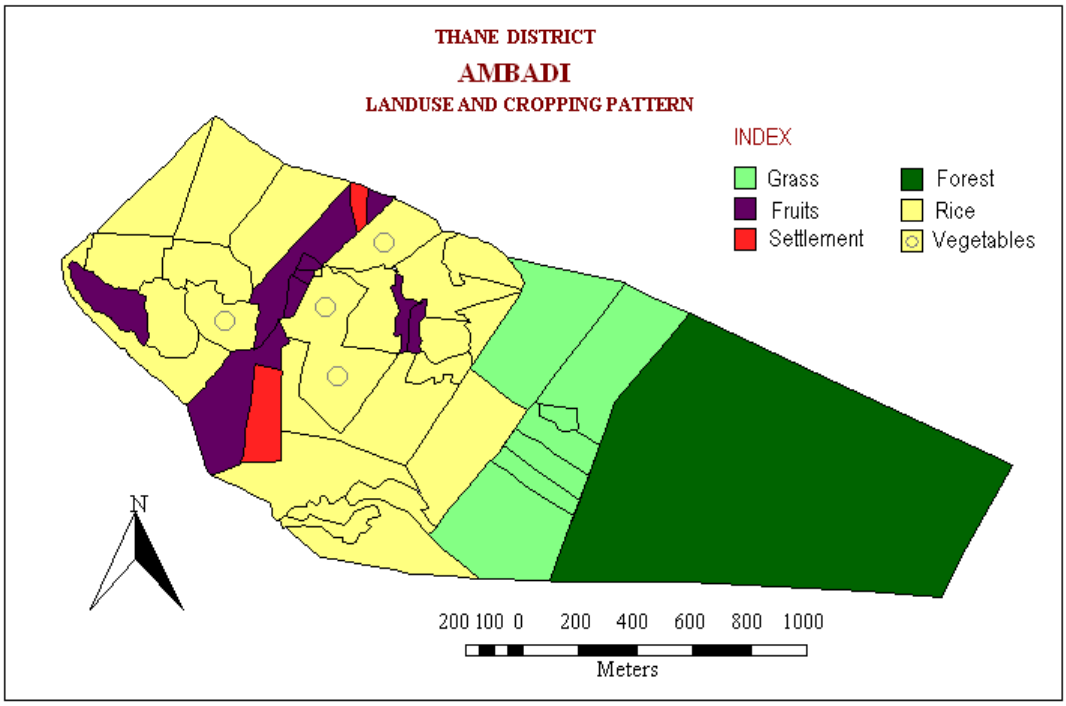
Ambadi has experienced a steady growth of population during the last decade (total increase 35 per cent). Table 8.4 described population growth density of population and changes in the occupational structure. Dominance of agriculture sector in occupational structure shows decline (about 87.56 per cent of the total working force in 1991 and 69.32 per cent in 2001). Among those gainfully employed in agriculture, cultivators form a major portion (80.68 per cent in 1991) while agriculture labourers account for 19.31 per cent of total farm workers. The number of total farm workers has gone down in the last decade. The proportion of cultivators among the farm workers has decreased by 18.24 per cent. Though the total population has increased, the number of total

workers has slightly decrease, proportion of cultivators has declined (30.45 per cent in 2001) and increased in agricultural labourers (69.54 per cent, 2001), a fact which throws light upon the unemployment and under employment problems in the region.

Some Characteristics of Working Population in Ambadi.

Population Characteristics	**1991**	**2001**
Total Population	337	455
Density of Population (per hundred hectares.)	162	219
Total Workers	201	251
Percentage of Total Worker	59.64	55.16
Total farm workers	176	174
Percentage of Total farm workers	87.56	69.32
Cultivators	142	53
Percentage of Cultivators to Farm worker	80.68	30.45
Agriculture Labourers	34	121
Percentage of Agriculture Labourers to Farm worker	19.31	69.54
Livestock & Orchard workers	-	-

Source : District census hand book (1991,2001). **Table - 8.6**



Map 8.3

General Landuse

Ambadi, through situated on the western side of hill range, is surrounded by hills in the eastern part (Fig. 8.7) A small stream rises from the eastern tip and flows westwards, finally to the seawards. The rugged topography in the eastern side and gentle or moderate slope in the western side, nature of soil cover have contributed to the present land utilization for cultivation. Forest occupies an insignificant position in the year 2009 it shows greater decline since 1991 and increase in net sown area.

Grass covers a large area in the southern half of the village (Table 8.6). It is observed that hill slopes and areas not suitable for cultivation are given to grass. Forest occupies an insignificant position and decline gradually since 1991 to 2009 rest of the area comes under the category of area occupied by houses, huts, road and barren rock exposures.

Proportion of Total Area Under Different Categories of Landuse in Ambadi (2009). (Area in hectare)

Sr.No.	**Landuse**	1991	2001	2009
1	Forest	100.00	21.22	14.01
2	Net Sown Area	33.19	108.00	177.00
3	Culturable waste	64.35	-	34.84
4	Not available for cultivation	9.85	21.00	17.5
5	Fallow	-	-	7.97

Source: Village Records, Panchayat Office, Ambadi **Table 8.7**

Agricultural Landuse :

A very small area of 177 ha. is available for cultivation. Most of it is located between in the western part of the village. Some patches under cultivation are also observed along the banks of the stream and foot hill area. Hill slopes have thin soil cover but soil is thicker in the foot hill zone. Moderate black soils are common in the cultivable areas, while coarse shallow varieties occupy the hill slopes. Table 8.7 indicates the share of each crop in the total cropped area.

It is obvious that in an area receiving rainfall about 2000 mm., rice should dominate the cropping pattern (Fig. 8.3). Rice alone accounts for about 52.25 per cent of the cultivated area followed by grass and fruits and vegetables. Generally better agricultural lands are under rice, whereas inferior lands are given to grass. Fruits and vegetables cover a comparatively smaller area. Among the fruits, chiku occupies 2.82 per cent of the gross cropped area. Vegetables grown on 15.19 per cent of cropped area.

Proportion of G.C.A. Under Different Crops in Bandhan (2009).

Sr. No.	Crop	Gross Cropped Area	Percent of G.C.A.
1.	Rice	92.49	52.25
2.	Fruits	5.00	2.82
3.	Vegetables	26.89	15.19
4.	Grass	74.10	41.86

Source : Village Records, Panchayat Office, Ambadi **Table 8.8**

Socio-economic background of farmers:

The information collected from personal interviews with farmers relates to the size of holding, attitudes towards application of new methods, techniques, the type of implements used,

investment in the farm, nature of agricultural operation, credit facilities, marketing of agricultural produce and problems and prospects of agriculture in that village.

Land Holdings and Fragmentation:

In order to understand the structure of land holdings resulting from interaction between physico-socio-economic elements and its impact on agricultural patterns, data for the total land holders, size of landholdings, location of the holdings, and number of fragments were collected from the village records available at the village level from revenue and Panchayat Office. It is generally understood that a small farmer is a farmer, holding less than five acres of land (Govt. of Maharashtra, 1976). A medium farmer holds between five and ten acres of land and a big farmer is one who owns more than ten acres of land. These categories are broad generalizations, but for the matter of convenience, these classes were adopted with three sub-divisions, in the first category, viz. size classes of 0-1, 1-3 and 3-5 acres.

In Ambadi, 16.90 per cent of the total area is cultivated by 61 per cent of the holders. In contrast, only 20.72 per cent holders own 64.29 per cent area. In Ambadi, like the rest of the coastal Villages, the proportions of area under grass and area not available for cultivation are very high in the case of large size holdings.

The problem of fragmentation has been recognised long back. As the farmer's total holdings are in many instances divided into several pieces far apart from one another, efficient cultivation of all these pieces is always a problem. Fragmentation has occurred in Ambadi where the size of fragments increases with the increase in

the size of holding. The numbers of fragments, it is also observed, increase with the larger sizes of holdings.

The size of fragments and the number of fragments in different classes of holdings reflect the influence of the nature of the terrain, productivity of the land and the choice crops to be grown. As paddy is generally grown in small fields, the size of the individual fragment tends to be relatively small in Ambadi.

Land Holding and Fragmentation – Ambadi - 2009

	Size Classes (acres)					
	0-1	1-3	3-5	0-5	5-10	above 10
Area of the Holding %	1.13	8.83	7.34	16.90	18.81	64.29
Land holders %	15.32	32.43	13.51	61.26	18.02	20.72
Size of fragments	0.29	0.79	1.01	0.76	0.92	1.72
Number of Fragments	4.94	13.83	0.05	27.82	25.43	46.75

Source:Village Revenue Records, Panchayat Office, Ambadi.

Table- 8.9

Farm Operation and Implements

A plough, a blade, harrow, and planker are the common implements used by farmers. Small holders are economically too weak to own all these implements. It is a usual practice to share these implements among three to four farmers. Rice being the major crop grown, the farm size is very small i.e. the total cultivated area is divided and subdivided into numerous small paddy fields of the size of 00.00.10 ha. This small size alone explains the emphasis on human and animal labour. Not only ‘Ambadi’, but the farmers in the whole area along the eastern transition zone of coastal plain do not possess any mechanized tillers like tractor.

The farmers appeared to be conservative in their attitudes towards the adoption of new techniques, use of chemical fertilizers and improved seeds. Experiments in the recent past being unsuccessful, most of the farmers do not use improved varieties of

rice. Urea and superphosphate are the chemical fertilizers generally used while farm manure accounts for a major proportion of the total fertilizer application. Pesticides are not used and oil engines or electric pumps are rare.

Farmers require capital for purchases of farm inputs like fertilizers, seeds and other implements. Two co-operative banks located at Palghar, Central Co-operative Bank Ltd. and Land Development Bank Ltd., provide the farmers with credit facilities. Ambadi has a school (upto 10^{th} std.) and a small provision store. Agricultural produce in this area is transported to Palghar and navi Mumbai market centre.

Input-Output structure of rice cultivation :

Rice being the most important crop of this village, information regarding the crop calender and input structure of rice was collected from the personal interviews with a few farmers. The following table gives the inputs per acre of an average farmer in Ambadi.

Major Inputs and Yield of Rice – Ambadi.

Sr. No.	Farm Operation	Imple-ments	Labour Male/ Female	Cost (Rs.) (2009)
1.	Ploughing	Tractor/ Plough	1(M)	500.00
2.	Collection and burning of litter (Jan. Feb.)		5(F)	500.00
3.	Preparation of nursery plot (May- June) Seed	Harrow 15 to 20 kg.	2(M)	200.00 400.00
4.	Burning of litter		1(M)	100.00
5.	Farm yard Manure	15 to 20 carts		1500.00
6.	Harrowing (before rains)	Harrow	2(M)	200.00
7.	Ploughing (After rains)	Plough	1(M)	500.00
8.	Sowing of Nursery	by hand	1 (M or F)	100.00
9.	Transplanting (July–August)	by hand	20 (M & F)	2000.00
10.	Fertilizers: (September)	50 to 60 Kg		600.00
11.	Weeding (Sept. – Oct.)	by hand	6(M)	600.00
12.	Harvesting and Transport to house / farm yard (November)	By hand	5 (M or F)	500.00
13.	Threshing of paddy, Winnowing etc. (Jan.–Feb.)		10 (M)	1000.00
Total Input			**Rs**.	**8700.00**

Source: Compiled by Author **Table 8.10**

Output

Yield: Average 12 quintals/acre

Transport cost: Transportation charges to Navi Mumbai, Bhivandi Market Rs. 30 /- per quintal by truck.

Problems and Prospects:

The farmers are facing a variety of problems ranging from very limited scope for expansion of land under cultivation to lack of capital for investment in implements and infrastructure. Ambadi receives adequate rainfall from south west monsoon in the Kharif season, so there is enough of water required for rice cultivation. Soils deposited in the low-lying areas or depressions have moisture retaining capacity, and are, thus, used for raising two crops in year rice in the kharif season followed by vegetables.

For small holders land is limited and capital is scarce. If the land owned is just one acre, the farmer has to work as an agricultural labourer or other worker to earn his living. A small holder is neither in a position to own the implements he requires for tillage nor can he purchase better seeds and chemical fertilizers. This finally leads to inefficient use of both, labour and land.

Ambadi has a large area under grass. Proper utilization of available fodder would certainly lead to a supplementary income for farmers in the form of surplus milk production. At present about 450 ltrs. of milk is sent daily to Palghar. Area under grass, accounting for 42 per cent of total land of the village, indicates a very high potential for further development of milk production through a better organized livestock raizing and better organized marketing facilities such as milk cooperatives.

To sum up, Ambadi represents the characteristics of the low crop diversification. It receives heavy rainfall, the area available for cultivation is still low but some what higher than Bandhan. Grass dominates the landscape and rice is the most important crop among the crops grown. The hill millets are not as significant as they were in Bandhan.

3. MOKHADA

A Profile of the Village

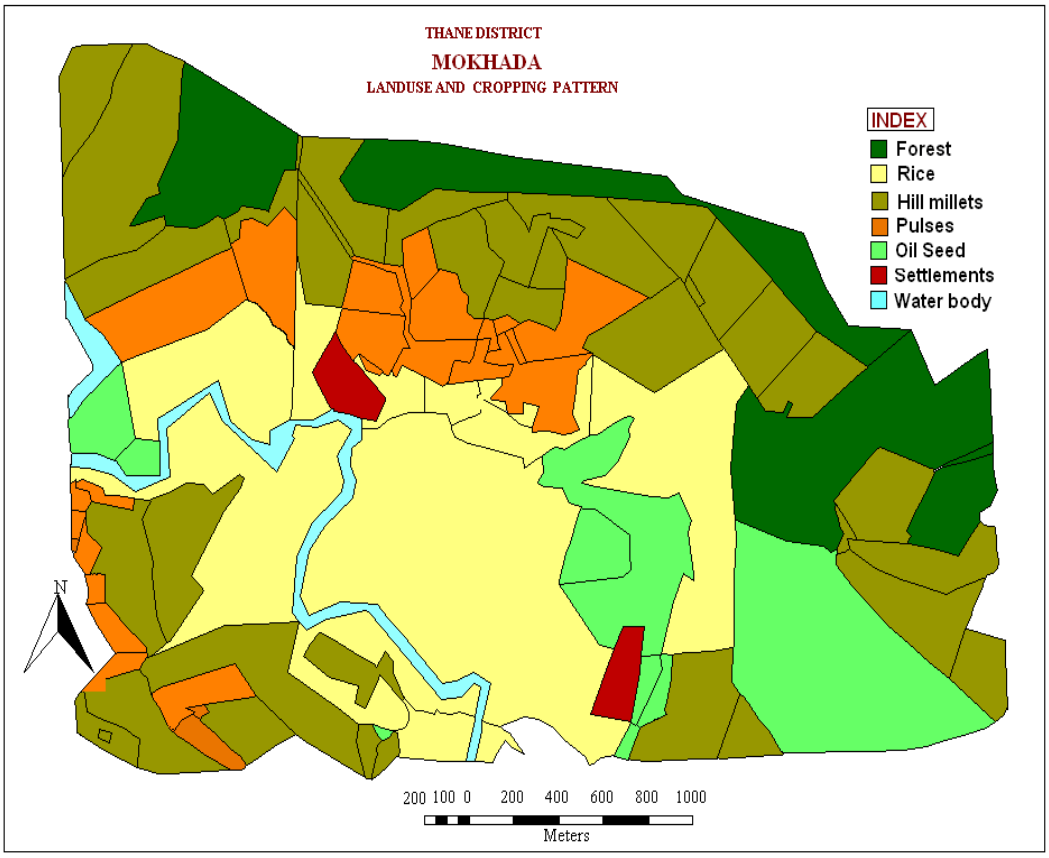
About 95 km. from Thane city in north-east part of Thane district, on the Jawhar–Mokhada plateau region, is located Mokhada a big village (1441.45 ha.) and in remote area, nearly cut off from development of any kind. It is located in the zone of heavy annual rainfall, receiving more than 2000 mm of rainfall. Except for the area around the village settlement, rest of the village area is a part of a hill range. Mokhada represents high crop diversification and the crop association region. Available facilities at Mokhada include a primary school, secondary school, college, dispensary, a health center, electric power supply, well water for drinking, pucca road post office and bus stop.

Mokhada's population has increased steadily i.e.14.79 per cent over the decade. Density of population is also higher (540 persons per hundred hectare in 2001). Agriculture is the main occupation in the village absorbing about 60 percent per cent of the total working force (Table 8.6). Amongst the farm workers, 21.13 per cent are farm owners and 78.86 percent agricultural labourers. Proportion of cultivators to farm workers shows gradually decline from 1991 to 2001 by 22.37 per cent. Proportion of agricultural labourers to farm workers has increased by 22.37 percent. Livestock and orchard workers account for a negligible share.

Characteristics of Working Population in Mokhada.

Population Characteristics	1991	2001
Total Population	6785	7789
Density of Population (per hundred hectares.)	470	540
Total Workers	2394	3048
Percentage of Total Worker	35.28	39.13
Total farm workers	1609	1935
Percentage of Total farm workers	67.72	63.48
Cultivators	700	409
Percentage of Cultivators to Farm workers	43.50	21.13
Agriculture Labourers	909	1526
Percentage of Agriculture Labourers to Farm workers	56.49	78.86
Livestock & Orchard workers	38	-

Source : District census hand book (1991, 2001). **Table 8.11**



Map - 8.4

General Landuse

Mokhada, through situated on the plateau region, is surrounded by uplands and valleys in the surrounded part. The rugged topography and nature of soil cover have contributed to the present land utilization for cultivation.

Net sown area covers a large area in the village (Map - 8.2). It is observed that areas of southern side suitable for cultivation are given to various crops. Forest occupies an insignificant position in the village; it shows stable condition since 1991. Rest of the area comes under the category of area occupied by houses, huts, road and barren rock exposures.

Rest of the village area could be classified as belonging to higher categories of slope and major portion of higher slopes is given to hill millets. Only a small portion i.e. 7.97 per cent of the village area is under fallows.

Proportion of Total Area Under Different Categories of Landuse in Mokhada (2009). (Area in hectare)

Sr.No.	**Landuse**	1991	2001	2009
1	Forest	134	135	134.85
2	Net Sown Area	1374.9	1376.0	1374.82
3	Culturable waste	-	45.00	29.00
4	Not available for cultivation	290.90	244.00	290.04
5	Fallow	-	-	7.97

Source:Village Revenue Records, Panchayat Office, Mokhada

Table 8.12

Agricultural Landuse

Cropping pattern of Mokhada to a large extent has been influenced by terrain, slopes, soil conditions and rainfall characteristics. All the peculiarities of crop association are represented here; rice which is otherwise an important crop in heavy rainfall region occupies a secondary position (Table 8.7.) Hill millets like Vari, and Nagali (Nachani) dominate the cropping pattern. Rice fields are located between the river streams and the uplands and also along the tributary of the river. Obviously, best agricultural lands are under rice while areas not suitable for rice are given to hill millets. Nachani and Vari are grown in the same field in alternate years. Generally, on the higher slopes cultivation is not attempted without terracing. However, it has been observed during the field work that hill millets like Nagali are grown on slopes up to 20-25 degrees without terracing. Only one crop during the kharif season is taken and it is a common belief among the farmers that because the soils are not moisture retentive, double cropping is not possible.

Proportion of G.C.A. Under Different Crops in Mokhada (2009)

Sr. No.	Crop	Gross Cropped Area	Percent of G.C.A.
1.	Rice	297.70	21.60
2.	Nagali	262.10	19.06
3.	Vari	287.42	20.90
4.	Pulses	168.32	12.24
5.	Oil seeds	122.27	8.89
6	Grass	237.01	17.23

Source: Village Revenue Records, Panchayat Office, Mokhada.

Table 8.13

Socio-Economic Background of The Farmers

A majority of the farmers in Mokhada are small holders. They own a patch of rice field and an acre or two under Nagali or grass. This holding again is divided and subdivided in small fragments. A small holding below five acres of land generally owns one or two bullocks, a few poultry birds and one or two cows or buffaloes. Among the farm implements owned and used by a small farmer are a wooden plough, and blade harrow along with many small implements. Some of them who own about an acre of land are economically too weak to own these implements and therefore they share these implements among a group of farmers. Owing to the small size of paddies, mechanization is not possible barring the use of oil engines, electric pumps and tractors.

The farmers are conservative in their attitudes toward changes in agriculture. Very few farmers had adopted the new system of rice cultivation but the experiment has not proved to be a success, probably because of inadequate information regarding new techniques. New varieties too was not much of a success. It matures earlier and the maturity coincides with a rainy spell, therefore, farmers have gone back to traditional varieties. Improved seeds and pesticides are less commonly used due to similar reasons. At present farmers use only farm yard manures and cow dung.

Credit facilities are locally available to the farmers by co-operative banks. Mokhada, tahsil headquarter to avail himself of this facility. Money lenders at Mokhada used to provide credit to the farmers.

Input-Output Structure of Rice Cultivation :

Rice being the most important crop of this village, information regarding the crop calendar and average input structure (per acre) of rice was collected from the personal interviews with a few farmers. The following table gives the inputs per acre of an average farmer in Bandhan.

Major Inputs and Yield of Rice – Mokhada

Sr. No.	Farm Operation	Implements	Labour Male/ Female	Cost (Rs.) (2009)
1.	Ploughing	Plough/Tractor	1(M)	500.00
2.	Collection and burning of litter (Jan. Feb.)		5(F)	400.00
3.	Preparation of nursery plot (May- June) Seed	Harrow 15 to 20 kg.	2(M)	200.00 400.00
4.	Burning of litter		1(M)	100.00
5.	Farm yard Manure	15 to 20 carts		1000.00
6.	Harrowing (before rains)	Harrow	2(M)	200.00
7.	Ploughing (After rains)	Plough	1(M)	400.00
8.	Sowing of Nursery	By hand	1 (M or F)	100.00
9.	Transplanting (July-August)	By hand	20 (M& F)	2000.00
10.	Fertilizers: (September)	50 to 60 Kg		600.00
11.	Weeding (Sept. – Oct.)	By hand	6(M)	600.00
12.	Harvesting and Transport to house / farm yard (November)	By hand	5 (Mor F)	500.00
13.	Threshing of paddy, Winnowing etc.(Jan.-Feb.)		10(M)	1000.00
Total Input Rs.				**8000.00**

Source: Compiled by Author **Table 8.14**

Output

Yield: Average 10 quintals/acre

Transport cost: Transportation charges to Navi Mumbai, Bhivandi Market Rs. 40 /- per quintal by truck.

Problems and Prospects

This village has surplus grass which is more than enough for consumption by its own cattle throughout the year. If a permanent link with the markets (Bhivandi, Kalyan and Thane) is provided, this potential could be effectively harnessed and milk production centre developed.

Due to adverse topography, there is little scope for expansion of the land under cultivation. The soils are devoid of moisture retentive capacity, but if water is provided a second crop is a possibility which cannot be ruled out.

Capital is a scarce commodity. Capital is needed especially for bunding the nallaha (Small tributary stream) and converting a part of it into paddies. Secondly, small farmers cannot afford to purchases improved seeds and pesticides. Which credit facilities made available, farmers could practice improved techniques.

About 40 per cent of the small farmers in the village placed "jobs" as their only requirement. Some already have left this village in search of jobs as they think that agriculture is not a rewarding occupation. A few farmers, in fact were repenting for their decision to love jobs in Western coastal region, Thane, Mumbai and come back to agriculture.

Village Mokhada, thus, represents most of the distinguished characteristics of the high crop diversification region with four crop combination. Mokhada has moderate rainfall, hilly topography adverse for agricultural development, agricultural landuse dominated by hill millets, poor accessibility and lack of irrigation facilities.

4. VANGAON

A Profile of the Village

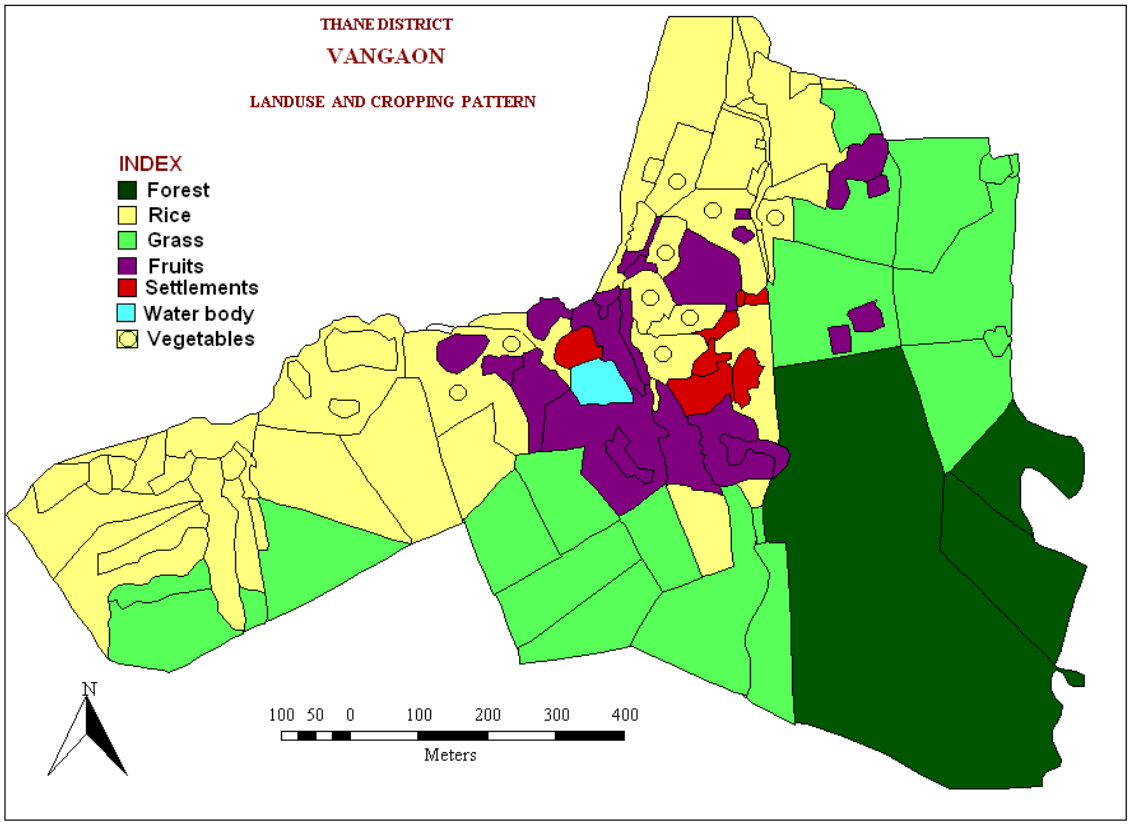
Vangaon a small village (524.46 ha.) located in the north east part of Thane district, about 81 km from Thane city, low crop diversification well represented here. This village is connected to Palghar, Dahanu and Thane by road and railway. Other services available at Vangaon include a primary school, a secondary school, Junior college, a dispensary, a health center, electric power supply, well water for drinking, pucca road, railway station, bus stand, post office etc.

Vangaon has experienced a steady growth of population during the last decade (total increase 32.66 per cent). Table 8.9 described population growth density of population and changes in the occupational structure. Dominance of agriculture sector in occupational structure is shown in table.8.9. Among those gainfully employed in agriculture, Agricultural labourers form a major portion (84.11 per cent in 1991 and 82.37 per cent in 2001) while cultivators account for 15.88 per cent and 17.09 per cent respectively to total farm workers. The number of total farm workers has gone down in the last decade by 19.02 per cent. The proportion of cultivators among the farm workers has not significantly change. Though the total population has increased, the number of total workers has slightly increased, proportion of farm workers have declined (27.77 per cent in 2001), a fact which throws light upon the unemployment and under employment problems in the region.

Some Characteristics of Working Population in Vangaon

Population Characteristics	1991	2001
Total Population	4865	6454
Density of Population (per hundred hectares.)	928	1232
Total Workers	1964	2654
Percentage of Total Worker	40.36	41.121
Total farm workers	919	737
Percentage of Total farm workers	46.79	27.77
Cultivators	146	126
Percentage of Cultivators to Farm worker	15.88	17.09
Agriculture Labourers	773	610
Percentage of Agriculture Labourers to Farm worker	84.11	82.37
Livestock & Orchard workers	-	-

Source: District Census Hand Book (1991, 2001). **Table - 8.15**



Map - 8.5

General Landuse

Vangaon, through situated on the western coastal plain of Thane district, is surrounded by plain areas (Fig. 8.5). Small stream rises from the eastern tip and flows westwards, finally to the seawards. The moderate slope in the western side and nature of soil cover have contributed to the present land utilization for cultivation. Forest occupies 85.21 ha. area in the year 2009, it shows decline since 1991. Net sown area in the village shows decline and increase in fallow in the year 2009.

Forest covers a large area in the eastern half of the village (Table 8.16). It is observed that areas not suitable for cultivation are given to grass. rest of the area comes under the category of area occupied by houses, huts, road, railway and current fallow and other fallows.

Proportion of Total Area Under Different Categories of Landuse in Vangaon (2009). (Area in hectare)

Sr.No.	**Landuse**	1991	2001	2009
1	Forest	113.62	104.55	85.21
2	Net Sown Area	318.23	368.38	284.59
3	Culturable waste	58.05	28.29	11.04
4	Not available for cultivation	34.54	22.65	31.55
5	Fallow	-	-	112.60

Source : Village Records, Panchayat Office, Vangaon **Table 8.16**

Agricultural Landuse :

Nearly half of the area (285 ha.) is available for cultivation. Most of it is located in the western part of the village. Some patches under cultivation are also observed along the eastern margins. In the coastal plain area soil is thicker. Moderate black soil is common in the cultivable areas, while coarse shallow varieties occupy the

eastern part. Table 8.17 indicate the share of each crop in the total cropped area.

It is obvious that in an area receiving rainfall about 2000 mm., rice should dominate the cropping pattern (Fig. 8.3). Rice alone accounts for about 36.61 per cent of the cultivated area followed by grass, fruits and vegetables. Generally better agricultural lands are under rice, whereas inferior lands are given to grass. Fruits and vegetables cover a comparatively smaller area. Among the fruits, chiku occupies 7.96 per cent of the gross cropped area. Vegetables grown on 9.76 per cent of cropped area.

Proportion of G.C.A. Under Different Crops in Vangaon (2009)

Sr. No.	Crop	Gross Cropped Area	Percent of G.C.A.
1.	Rice	104.20	36.61
2.	Grass	121.39	42.65
3.	Vegetables	27.80	9.76
4.	Fruits	31.21	10.96

Source : Village Records, Panchayat Office, Vangaon.**Table 8.17**

Socio-Economic Background of Farmers:

A major proportion of total farm workers in Vangaon comprises of small holders. Among the small holders many farmers own less than three acres of land which is divided into fragments. The information collected from personal interviews with farmers relates to the size of holding, attitudes towards application of new methods, techniques, the type of implements used, investment in the farm, nature of agricultural operation, credit facilities, marketing of agricultural produce and problems and prospects of agriculture in that village.

Small farmers cannot afford to use improved seeds, fertilizers and pesticides. Those who own lands above 10 acres with irrigation

facilities are more enthusiastic about new techniques. They own at least two bullocks, tractor and all implements essential for farming like plough, harrow, seed drills, oil engines or electric pumps. Some farmers have successfully implemented new techniques in the farm; this indicates the progressive attitude of the farmers.

Land Holdings and Fragmentation:

In order to understand the structure of land holdings resulting from interaction between physico-socio-economic elements and its impact on agricultural patterns, data for the total land holders, size of landholdings, location of the holdings, and number of fragments were collected from the village records available at the Village level Revenue and Panchayat Office. It is generally understood that a small farmer is a farmer, holding less than five acres of land (Govt. of Maharashtra, 1976). A medium farmer holds between five and ten acres of land and a big farmer is one who owns more than ten acres of land. In Vangaon, 20 per cent of the total area is cultivated by 60 per cent of the holders. In contrast, only 21 per cent holders own 65 per cent cultivable area. In Vangaon, like the rest of the coastal villages, high proportions of area is under grass.

The problem of fragmentation has been recognised long back. As the farmer's total holdings are in many instances divided into several pieces far apart from one another, efficient cultivation of all these pieces is always a problem. Fragmentation has occurred in Vangaon where the size of fragments increases with the increase in the size of holding. The number of fragments, it is also observed, increases with the larger sizes of holdings.

The size of fragments and the number of fragments in different classes of holdings reflect the influence of the nature of the terrain, productivity of the land and the choice of crops to be grown.

As paddy is generally grown in small fields, the size of the individual fragment tends to be relatively small in Vangaon.

Farm Operation and Implements

A plough, a blade, harrow, and planker are the common implements used by farmers. Small holders are economically too weak to own all these implements. It is a usual practice to share these implements among three to four farmers. Rice being the major crop grown, the farm size is very small i.e. the total cultivated area is divided and subdivided into numerous small paddy fields of the size of 00.00.10 ha. This small size alone explains the emphasis on human and animal labour. Not only 'Vangaon', but the farmers in the whole area along the eastern transition zone of coastal plain do not possess any mechanized tillers like tractor.

The farmers appeared to be conservative in their attitudes towards the adoption of new techniques, use of chemical fertilizers and improved seeds. Experiments in the recent past being unsuccessful, most of the farmers do not use improved varieties of rice. Urea and superphosphate are the chemical fertilizers generally used while farm manure accounts for a major proportion of the total fertilizer application. Pesticides are not used and oil engines or electric pumps are rare.

Farmers require capital for purchases of farm inputs like fertilizers, seeds and other implements. Two co-operative banks located at Dahanu, Central Co-operative Bank Ltd. and Land Development Bank Ltd., provide the farmers with credit facilities. Vangaon has a banks and agricultural service centres and small provision store. Agricultural produce in this area is transported to Thane and Navi Mumbai market centre.

Input-Output Structure of Rice Cultivation:

Rice being the most important crop of this village, information regarding the crop calender and input structure of rice was collected from the personal interviews with a few farmers. The following table gives the inputs per acre of an average farmer in Vangaon.

Major Inputs and yield of Rice – Vangaon.

Sr. No.	Farm Operations	Implements	Labour Male/ Female	Cost (Rs.) (2009)
1.	Ploughing	Plough/ Tractor	1(M)	500.00
2.	Collection and burning of litter (Jan. Feb.)		5(F)	600.00
3.	Preparation of nursery plot (May- June) Seed	Harrow 15 to 20 kg.	2(M)	250.00 500.00
4.	Farm yard Manure	15 to 20 carts		1500.00
5.	Harrowing	harrow	2(M)	500.00
6.	Transplanting (July-August)	by hand	20 (M & F)	2000.00
7.	Fertilizers: Urea and Super Phosphate (September)	50 to 60 kg.		450.00
8.	Weeding (Sept. – Oct.)	by hand	6(M)	720.00
3.	Harvesting and Transport to house / farm yard (Nov.)	By hand	5 (MorF)	600.00
10.	Threshing of paddy, Winnowing etc (Jan. – Feb.)		10(M)	1200.00
	Total input		**Rs**.	**8820.00**

Source: Compiled by Author **Table - 8.18**

Output

Yield : Average 15 quintals/acre

Transport cost: Transportation charges to Navi Mumbai, Bhivandi Market Rs. 50 /- per quintal by truck.

Major Inputs and Yield of Chiku – Vangaon.

Sr. No.	Farm Operations	Implem-ents	Labour Male/ Female	Cost (Rs.) (2010)
1.	Preparation of Plot	Tractor	20(M)	2000.00
2.	Preparation for plantation: Digging squares (1 x 1 x 1 meter)	By hand	40 (M)	4000.00
3.	Compound		40(M)	4000.00
4.	Fertilizers:(Before Plantation) Farm yard manure 20 carts Super phosphate 200 kg.		10(M)	1000.00 2000.00 1800.00
5.	Cost of Plant: Rs.30/-per plant x 40			1200.00
6.	Plantation	By hand	20 (M)	2000.00
7.	Fertilizers 50 kg to 60 kg	By hand	5 (M)	500.00
8.	Weeding and inter cultivation		10(M)	1000.00
9.	Irrigation (Dec. To May)	By hand or Pump	25 (M)	2500.00
First Year Total			**160 (M /F)**	**22000.00**
8.	Inter cultivation	By hand	5 (M or F)	500.00
9.	Fertilizers:	By hand	10(M or F)	1000.00
10.	Cost of Fertilizers: 200 Kg			1800.00
11.	Weeding	by hand	10(M)	1000.00
12.	Irrigation (Dec. To May)	By hand or Pump	25 (M)	2500.00
Second Year Total			**50(M or F)**	**6800.00**
15.	Fertilizers and inter cultivation Cost of Fertilizers: 200 kg		20 (M or F)	2000.00 1800.00
16	Crop Conservation		10(M or F)	1000.00
17.	Irrigation (Dec. To May)	By hand or Pump	25 (M or F)	2500.00
Third Year Total			**55 (M or F)**	**7300.00**
Total Input Rs.				**36100.00**

Source: Compiled by Author **Table 8.19**

Output

Yield: Average 115 quintals/acre

Transport cost: Transportation charges to Navi Mumbai, Market Rs. 60/- per quintal by truck.

Problems and Prospects:

The farmers are facing a variety of problems ranging from very limited scope for expansion of land under cultivation to lack of capital for investment in implements and infrastructure. Vangaon receives adequate rainfall from south west monsoon in the Kharif season, so there is enough of water required for rice cultivation. Soils deposited in the low-lying areas or depressions have moisture retaining capacity, and are, thus, used for raising two crops in year rice in the Kharif season followed by vegetables.

For small holders land is limited and capital is scarce. If the land owned is just one acre, the farmer has to work as an agricultural labourer or other worker to earn his living. A small holder is neither in a position to own the implements he requires for tillage nor can he purchase better seeds and chemical fertilizers. This finally leads to inefficient use of both, labour and land.

Vangaon has a large area under grass. Proper utilization of available fodder would certainly lead to a supplementary income for farmers in the form of surplus milk production. At present about 450 ltrs. of milk is sent daily to Palghar. Area under grass, accounting for 42 per cent of total land of the village, indicates a very high potential for further development of milk production through a better organized livestock raizing and better organized marketing facilities such as milk cooperatives.

To sum up, Vangaon represents the characteristics of the low crop diversification. It receives heavy rainfall, the area available for

cultivation is still low but some what higher than Ambadi. Grass dominates the landscape and rice is the most important crop among the crops grown. The hill millets are not as significant as they were in Bandhan.

5. SHIVALE

A Profile of the Village

About 46 km. east of Thane city, in the remote offshoots of Sahyadris, is located Shivale a small (725.34 ha.) village, nearly cut off from development of any kind. It is located in the zone of heavy annual rainfall, receiving more than 2500 mm of rainfall. Except for the area around the village settlement and on the bank of river Murbadi, rest of the village area is a part of a hill range and uplands. Shivale represents low crop diversification region. Available facilities at Shivale include a primary and secondary school, pucca road and well water for drinking.

Shivale has experienced a steady growth of population during the last two decade. Table No. 8.4 shows population growth, density of population and changes in the occupational structure. Agriculture shares 28.25 per cent of the total working force (2001). Among those gainfully employed in agriculture, cultivators form a major portion (68.26 per cent) while agriculture labourers account for 31.78 per cent of total farm workers (2001). The proportion of agricultural labourers among the farm workers has decreased nearly twenty five percent during the last decade. Though the total population has increased, the number of total workers has also increased, a fact which could be attributed to out migration of potential workers either to Kalyan, Thane or Mumbai, the nearest industrial metropolitan centre, in search of employment

opportunities. It's also a fact which throws light upon the unemployment and under employment problems in the region.

Some Characteristics of Working Population in Shivale

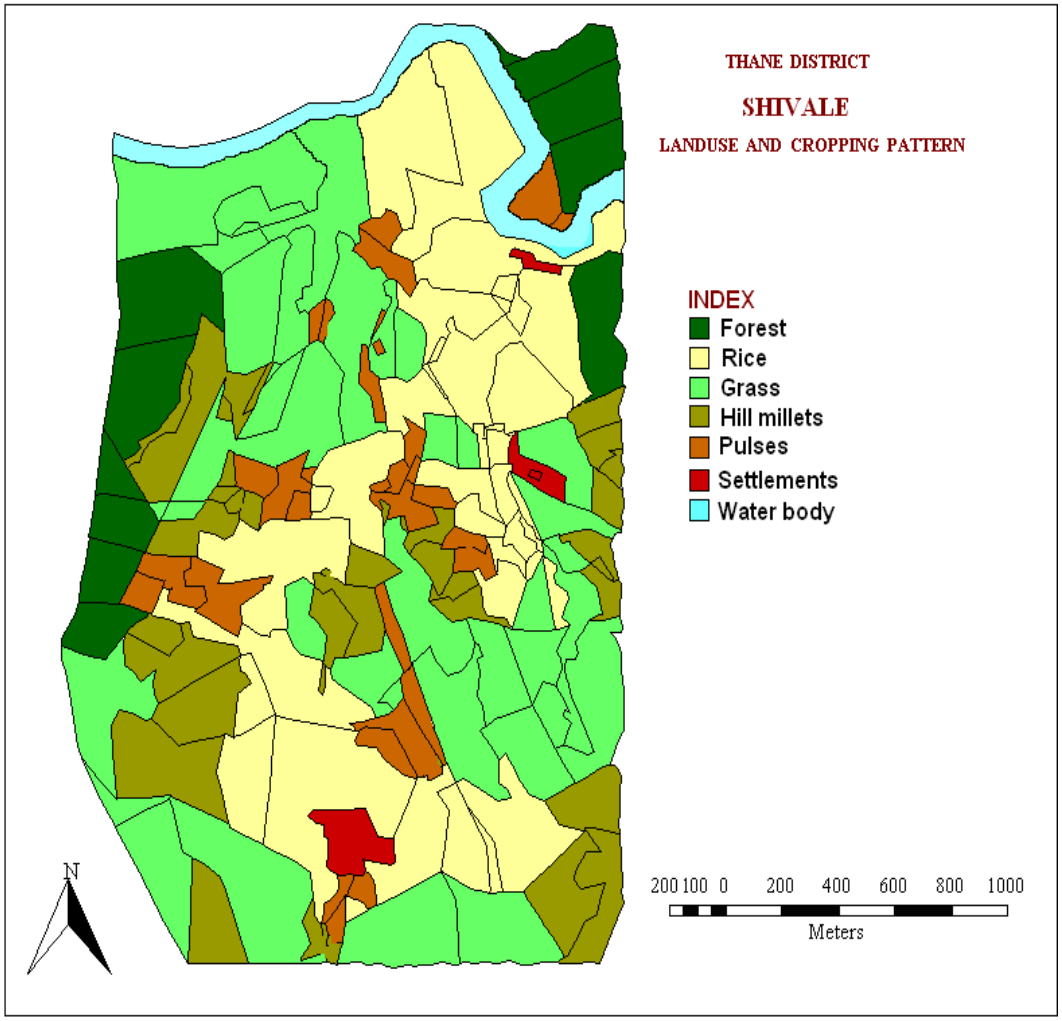
Population Characteristics	**1991**	**2001**
Total Population	1711	2063
Density of Population (per hundred hectares.)	235	284
Total Workers	659	1026
Percentage of Total Workers	38.51	49.73
Total farm workers	446	583
Percentage of Total farm workers	26.06	28.25
Cultivators	194	398
Percentage of Cultivators to Farm worker	43.49	68.26
Agriculture Labourers	252	185
Percentage of Agriculture Labourers to Farm worker	56.50	31.78
Livestock & Orchard workers	4	-

Source : District census hand book (1991,2001). **Table - 8.20**

General Landuse

Forest area has gradually declined in the last decade and there was increase in NSA and area not available for cultivation. Grass covers a very large area in Shivale (Table 8.10, Fig. 8.9). This could be attributed to its location and site on hill slope. Though river Murbadi forms the southern boundary of the village, a very small area on the northern bank of the river is flat or gently sloping. Rest of the village area could be classified as belonging to higher categories of slope and major portion of higher slopes is given to grass. Only a small portion i.e. 166.18 ha. of the village area is under crops. This cultivated land is mainly located between the settlement and the river, and to some extent up the hills along a tributary of river Murbadi. About 99.39 per cent area is not available

for cultivation, mostly due to higher slopes and thin soil cover, Categories of culturable waste and fallow are absent in Shivale.



Map - 8.6

Proportion of Total Area Under Different Categories of Landuse in Shivale (Area in hectare)

Sr.No.	**Landuse**	1991	2001	2009
1	Forest	100.43	100.00	10.41
2	Net Sown Area	565.27	565	615.79
3	Culturable waste	-	-	-
4	Not available for cultivation	59.66	60.00	99.39
5	Fallow	-	-	-

Source: Village Revenue Records, Panchayat Office, Shivale

Table 8.21

Agricultural Landuse

Cropping pattern of Shivale to a large extent has been influenced by terrain, slopes, soil conditions and rainfall characteristics. All the peculiarities of crop association are represented here; rice which is otherwise an important crop in heavy rainfall region occupies a secondary position (Table 8.3.) Hill millets like vari, and nagali dominate the cropping pattern. Rice fields are located between the river murbadi and the settlements and also along the tributary of the river. Obviously, best agricultural lands are under rice while areas not suitable for rice are given to hill millets. Nagali and vari are grown in the same field in alternate years. Generally, on the higher slopes cultivation is not attempted without terracing. However, it has been observed during the field work that hill millets like nagali are grown on slopes up to 20 degrees without terracing. Only one crop during the kharif season is taken and it is a common belief among the farmers that because the soils are not moisture retaintive, double cropping is not possible.

Proportion of G.C.A. under different crops in Shivale (2009)

Sr. No.	Crop	Gross Cropped Area	Percent of G.C.A.
1.	Rice	151.00	36.61
2.	Grass	385.17	42.65
3.	Hill millets	48.41	9.76
4.	Pulses	31.21	10.96

Source : Village Records, Panchayat Office, Shivale. **Table 8.22**

Socio-economic background of the farmers

A majority of the farmers in Shivale are small holders. They own a patch of rice field and an acre or two under hill millets or grass. This holding again is divided and subdivided in small fragments. A small holding below five acres of land generally owns

one or two bullocks, a few poultry birds and one or two cows and bufalloes. Among the farm implements owned and used by a small farmer are a wooden plough, and blade harrow along with many small implements. Some of them who own about an acre of land are economically too weak to own these implements and therefore they share these implements among a group of farmers. Owing to the small size of paddies, mechanization is not possible barring the use of oil engines, electric pumps and tractors.

The farmers by and large are conservative in their attitudes toward changes in agriculture. Few farmers had adopted new system of rice cultivation but the experiment has not proved to be a success, probably because of inadequate information regarding this method, new variety too was not much of a success. It matures earlier and the maturity coincides with a rainy spell, therefore, farmers have gone back to traditional varieties. Improved seeds and pesticides are less commonly used due to similar reasons. At present farmers use chemical fertilizers, farm yard manures and cow dung.

Credit facilities are locally available to the farmers. One has to Murbad, tahsil headquarter. to avail himself of this facility. Money lenders at Shivale used to provide credit to the farmers.

Major Inputs and Yield of Rice – Shivale

Sr. No.	Farm Operation	Imple-ments	Labour Male/ Female	Cost (Rs.) (2009)
1.	Ploughing	Plough/ tractor	1(M)	500.00
2.	Collection and burning of litter (Jan. Feb.)		3(F)	360.00
3.	Preparation of nursery plot (May- June) Seed	Harrow 15 to 20 kg.	2(M)	250.00 400.00
4.	Burning of litter		2(M)	250.00
5.	Farm yard Manure	15 to 20 carts		1500.00
6.	Harrowing (before rains)	Harrow	2(M)	250.00
7.	Ploughing (After rains)	Plough	1(M)	500.00
8.	Sowing of Nursery	by hand	1(Mor F)	120.00
9.	Transplanting (July–August)	by hand	20 (M& F)	2000.00
10.	Fertilizers: (September)	50 to 60 Kg		600.00
11.	Weeding (Sept. – Oct.)	by hand	6(M)	600.00
12.	Harvesting and Transport to house / farm yard (November)	By hand	5 (M or F)	600.00
13.	Threshing of paddy, Winnowing etc. (Jan.–Feb.)		10(M)	1200.00
Total Input			**Rs**.	**9130.00**

Source: Compiled by Author **Table 8.23**

Output

Yield: Average 15 quintals/acre

Transport cost: Transportation charges to Murbad, Bhivandi, Navi Mumbai Market Rs. 35 /- per quintal by truck.

Problems and Prospects

This village has surplus grass which is more than enough for consumption by its own cattle throughout the year. If a permanent link with the markets (Kalyan and Thane) is provided, this potential could be effectively harnessed and milk production centre developed.

Due to adverse topography, there is little scope for expansion of the land under cultivation. The soils are devoid of moisture retaintive capacity, but if water is provided, a second crop is a possibility which cannot be ruled out.

Capital is a scarce commodity. Capital is needed specially for bunding the nallaha (Small tributary stream) and converting a part of it into paddies. Secondly, small farmers cannot afford to purchases improved seeds and pesticides. Which credit facilities made available, farmers could practice improved techniques.

About 50 per cent of the small farmers in the village placed "jobs" as their only requirement. Some already have left this village in search of jobs as they think that agriculture is not a rewarding occupation. A few farmers, in fact were repenting for their decision to leave jobs in Kalyan, Thane or Mumbai and come back to agriculture.

Village Shivale thus, represents most of the distinguished characteristics of the crop combination and diversification region. Shivale has heavy rainfall, hilly topography adverse for cultivation, very low N.S.A. high proportion of grass, agricultural landuse dominated by rice and hill millets, poor agricultural development and lack of irrigation facilities.

Chapter - IX

CONCLUSION AND FINDINGS

In this Chapter an attempt is made to bring together the main findings and to arrive at some conclusion, apart from providing a brief summary of the entire work, includes a decision of the problems and prospects of agriculture in Thane district. The work it is hoped will have served its purpose if it can at least provide a basis for planning changes in agricultural landuse for the optimum utilization of the regions resources. The regional frame developed and the model agricultural location may together be useful for making policy decisions, especially for the allocation of resources with respect to the potential and problem regions, delineated in terms of the existing agricultural patterns.

The study is concerned with the spatial analysis of agricultural landuse

in Thane District with a view to evaluate the influence of certain physical and cultural factor on the distribution pattern. It is very difficult to offer an exhaustive explanation of the location of agricultural landuse, but the approaches made in that direction and the finding together with the perspectives on the dynamics of agricultural landuse are summed up here. The observations, analyses and findings of the preceding chapters are presented as follows:

In order to analyses the influence of physiographic factors on agricultural patterns, the areal unit of study has to be based on some aspects of physiography. In view of the general variation in agricultural landuse over the area of the district, slope, relief and soil were selected as the significant factors of the physical environment for the identification micro level study.

The spatial analysis of agricultural landuse needs to understand the characteristics of some cultural variables which influencing current landuse pattern. A study of population reveals some significant variations of population characteristics in the study area. The region has shown a consistent growth of population from the beginning of the 20th century. The relative importance of agriculture in the economic activities is indicated by the size of working population engaged in agricultural (21.96 percent to total workers) in the district as a whole. This lower percentage could be attributed to the process of urbanization and industrialization. However, in the rural areas agriculture is the main source of livelihood. In the western hilly parts of the district above ninety per cent workers are engaged in agricultures and elsewhere about eighty per cent of the work force is still in agriculture. The proportion of owner cultivators in the total farm workers is more in the northwestern and southeastern parts and the proportion of agricultural laboure is more in the western parts and irrigated tracts. In equality in agricultural income basically has stemmed from the inequality in the distribution of land holdings. The average size of holdings in the district is 2.023 ha. (small holders less than 2.023 ha.).

The district has a relatively lower proportion of NSA under irrigation (5.4 per cent) as compared to Maharashtra. The western part of the district has larger irrigated areas as compared to the eastern hilly tracts. Availability of irrigation facilities is a very significant factor influencing the productivity as well as the progress from subsistence to commercial level of economy. An analysis of temporal variations in the irrigated areas under different crops reveals very insignificant position that the future of agricultural

development mainly lies in the proper and optimum utilization of available water resources.

The increase is accessibility is mostly linked with the extension of road system in the district. Many villages, particularly in the eastern and northeastern hilly parts are partly or totally cutoff in the monsoons. In the eastern mountainous areas with high rainfall, market centres are absent or less frequent on account of low marketable surplus, poor accessibility and low purchasing power of the farmer. In the irrigated tracts an increase in the number and size of weekly markets and regulated markets is observed.

The temporal analysis of general land utilization indicated clearly that the landuse pattern has remained the same since 1981. Land under forests, NSA and area not available for cultivation account for a major share of the total area and these categories do not display considerable fluctuations. The significant changes observed in case of area under cultivable waste, pastures and grazing lands, fallows and areas sown more than once can be attributed to the variations in the human response to the various aspects of land. The marginal changes in the landuse are associated with the cultural factors like urbanization and industrialization. Remarkable changes in the area sown more than once can be attributed to the human efforts in the direction of intensification of agriculture.

Spatial variations in land utilization bring to the fore the influence of certain physical and cultural attributes, particularly relief. Variations in the net sown area indicate a strong influence of relief and slope. The proportion of NSA is very small in the central north-south hill ranges running parallel to the Arabian Sea and eastern hilly parts with steep slopes. It increases progressively westwards in the broad open valleys and western coastal plain. The

spatial distribution of cultivable wastes and forests exhibit a concentration in the eastern hilly tracts and decreasing proportion in the western coastal plain and northern parts. Land not available for cultivation does not show much variation in the different parts of the district.

A temporal variation of agricultural landuse gives past and present position of principal crops grown in the district. The cereals which occupy about forty five per cent of the NSA have experienced a noticeable decline in the volume of change in the three decades. Rice and Hill Millets both have lost some areal strength, pulses and fruits have shown some positive change in the volume. Pulses show fluctuating trends but fruits and vegetables show a high positive volume of change. The groundnuts and total oilseeds do not show a noticeable increase in the last three decades. These trends clearly indicate a shift from traditional Pulses and Hill Millets pattern to the increase in importance of the cash crops.

A study of crop ecology helps understand the spatial patterns of crops. The choropleth maps demarcate clearly the areas of concentration of a crop. Distribution of Hill Millets is largely governed by relief, nature of slope and type of soil i.e. the moisture retaining capacity of the soil. Heavy rains are disastrous to both Pulses and Hill Millets. This explains their absence in the western coastal plain. In the south east and north east zone Pulses and Hill Millets compete with each other for area1 spread but in the western parts the soils do not support Hill Millets. The distribution of oilseeds and pulses is strongly influenced by rainfall and temperature conditions during growth period. Both are spread over small areas in the eastern, northeastern and southeastern part. Pulse crops like tur (kharif) and gram (rabi) are taken along with major crops, generally in alters the rows. Besides the physical environmental

factors, irrigation and the farmer's economic strength are other two major factors influencing the distribution of cash crops. Rainfall is the main limiting factor in case of rice followed by temperature and type of soil, whereas, The hill millets are concentrated in the eastern parts of the district and generally are grown on sloping lands with poor soils as better lands are given to rice in this part. Thus the spatial distribution of crops shows a strong influence of climatic and edaphic factors except for the cash crops which show strong association with irrigation and economic strength of the farmer.

The location of agricultural landuse is further analysed with the help of correlation and multiple regression techniques and time series analysis. In all fifteen variables were included in the analysis. NSA, grass, rice, pulses, hill millets, and fruits and vegetables were treated as dependent variables. Irrigation, accessibility, owner cultivators, population density, slope > 3^0, slope > 6^0, < 6^0, distance from coast and distance from stream were the independent variables. The simple bivariate correlations are useful in the initial stages of locational analysis. These correlations tell us what are the relationships. The correlation analysis brings out clearly the importance of physical factors like slope and distance from coast (rainfall) and economic factors like irrigation and accessibility as factors influencing the landuse patterns. The higher proportion of cultivators in the hilly tracts and higher proportion of agricultural labour in the irrigated tracts is clearly brought out. However, the distance from major streams which differentiates between valley and divide locations does not show significant relationships with the landuse types except for hill millets. The multiple regression model.

$Y = a+b1x1 + b2x2 + b3x3 +\ldots\ldots\ldots\ldots\ldots\ldots + bm\ xm + e$ brings out the functional relationships between the variables. In all six regression equations were derived for six landuse types. The partial

correlation coefficients derived indicate the relative importance of each independent variable in explaining the total variance. The multiple regression analysis reveals that among the set of selected independent variables those related to physical environment like slope > 3^0, slope > 6^0, < 6^0 , distance from coast and distance from stream to be more important than the factors chosen to represent the socio-economic environment like irrigation, accessibility, owner cultivators and population density. Only in case of cash crops the most important variable contributing to the total explained variation is irrigated area. Accessibility does not appear in any of the regression equations. The total variation explained (R^2) is maximum (69 percent) in case of NSA, for rice, hill millets and cash crops it is between 50 to 60 per cent, for grass it is 48 per cent and is minimum in case of pulses (26 per cent).

The time series analysis to the temporal data for the observations of (1981-2008) is aimed at investigation the temporal changes of agricultural landuse and general landuse. Time series analysis helps us to predict future condition with help of forecast trend. Forecast trend explain that there is growth in the areas of area sown more than once. Based on the loading of the fourteen variables on the seven components the following seven dimensions are identified.

Delimitation of crop association region is done in three steps i.e. analysis of areal strength of crop by arbitrary choice method, crop combination analysis using Doi's method and lastly demarcation of crop diversification regions. Ranking by arbitrary choice method reveals dominance of rice and grass in the western part of the district, of hill millets in the eastern transitional zone and of pulses in the northeastern parts as first rank crops, Rice and hill millets are found to be associated with each other in the eastern

parts, pulses and oilseeds in the transitional and eastern parts, rice and cash crops in the irrigated area and hill millets and pulses or fruits in some isolated patches. Pulses, grass and cash crops are important as third rank crops to define one hundred fourteen villages. The combinational analysis reveals that thirty villages are identified as monoculture areas, with rice as important crop; hill millets, pulses and rice appear in various combinations with each other to define one hundred thirty two crop combination regions. Three hundred fifty five villages have three crop combinations where rice, hill millets and fruits and vegetables continue to be the main constituents. All crops appear in various combinations to identify three hundred fifteen villages in four crop combination regions. Lastly, two hundred fifty eight villages have five crop combinations. The generalized spatial pattern of crop combinations from west to northeast is patches of monoculture – two crop combination – three, crop combinations are in various patches – four, five crop combinations along eastern margin and some patches in the central and northwestern part. The spatial variation in the number of crops in combination reflects their relationship with the physico-socio-economic attributes. Monoculture is practiced in the western coastal plain and central low land parts but the transitional zone moderate slope offers a variety of crops that can be successfully grown. This analysis results into identification of crop association regions.

The sample villages selected from each crop diversification region exhibit some characteristics which are common to all of them but in other aspects they differ from one village to other. In all the sample villages there is not much scope for further expansion of the area under cultivation. The only possibility of raising the production is through Intensification of agriculture. The small farmers (holding

below 5 acres of land) do not possess all the implements needed for agricultural operations. They have to borrow some of them (including even bullocks) at crucial periods. Medium (5 to 10 acres) and big (above 10 acres) farmers generally possess all the necessary implements. In the irrigated areas medium and big farmers own some mechanized equipment including electric pumps and tractors. Among the agricultural workers proportion of owner cultivators is very high in the villages where agriculture is predominantly of the subsistence nature. In the irrigated tracts (e.g. Vangaon) the higher productivity and intensification of agriculture leads to a higher demand for agricultural labourers and, at times, labour migrates to these areas.

The input-output structures of the crops grown in different parts of the district bring out the importance of irrigation, the size of holding, and the economic strength of farmers. The inputs for the crops grown with irrigation are two times that for the same crops grown in un irrigated area. The inputs in case of vegetable and fruits are comparatively higher, for these crops the fertilizers and manures account for about 30 to 35 per cent of total input and irrigation charges vary between 5 to 20 per cent of total inputs. The yields also differ with respect to differences in inputs and quality of land. The yield of rice varies from 12 quintals / acre in the case of small holders with fewer inputs to 20 quintals / acre in the case of big farmers with higher inputs. Yields of hill millets and pulses in the eastern tracts are very low i. e. 4 quintals and 5 quintals per acre respectively.

In the hilly tracts and unirrigated areas farmers are by and large conservative in their attitudes towards adoption of new techniques. In the irrigated tracts, however, even small farmers are progressive in their attitudes. In general the landless labourers and small

farmers placed “Jobs” as their first priority whereas the big farmers needed capital to carry out various agricultural operations. In the irrigated tracts even the small and medium farmers asked for capital inputs and an efficient distribution system to avail themselves of the improved seeds, pesticides and fertilizers at proper time.

The observations and results of the analysis summed up above indicate that the objective with which the research project was taken up has been fulfilled. Though the general landuse pattern has not changed significantly over the last three decades, the spatial variations in land utilization being to the fore the strong influence of physical environmental factors. This is reflected in the farmer’s decision making process leaving not much room for choice of crops. The process of commercialization has begun but is mainly confined to the irrigated tracts. The farmers operating unirrigated lands are still at the subsistence level and are likely to remain in as subsistence farmers unless a breakthrough in the methods of cultivation brings about any significant change. The quantitative techniques like simple correlation, multiple regression and time series analysis used here further substantiate the strong influence of physical factors upon agricultural landuse. This quantitative analysis has helped to find out the contribution of each independent variable in the explanation for locational variation in agricultural landuse, and time series forecast trend helps to analyse temporal variation and predict future condition.

It can be stated that in the conclusion, present study brings out clearly the relationships between the factors of physical environment and the spatial and temporal variations in the agricultural landuse in a developing region as well as the general landuse. Also it can stated that the temporal variations in socio-economic conditions. The initial hypothesis is strong influence of

physical environment on agricultural patterns which formed the basis of regionalization using physiographic and climate as the major influencing factors, has been validated by the quantitative analysis of these spatial and temporal variations.

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