"AGRICULTURAL LANDUSE IN NASHIK DISTRICT"

A thesis Submitted to

TILAK MAHARASHTRAVIDYAPEETH, PUNE

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Moral and Social Sciences

By
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October-2011

DECLARATION

I hereby declare that the thesis entitled, **"Agricultural Landuse in Nashik District"** completed and written by me has not previously formed the basis for the award of any Degree or other similar title upon me of this or any other University or examining body.

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Place: Malegaon

Date: Oct. 2011

CERTIFICATE

This to certify that the thesis entitled "**Agricultural Landuse in Nashik District"** which is being submitted herewith for the Degree of Vidyavachaspati (Ph.D.) in the subject of Geography of Tilak Maharashtra Vidyapeeth, Pune is the result of original research work completed by **Shri. Pralhad Y. Vyalij** 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 upon him.

Dr. N. M. Kadam
[Research Guide]

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Mr. Pralhad Yashwant Vyalij

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Chapter 1

INTRODUCTION

Agriculture continues to sustain millions of people in India. This is despite the rapid industrialization which is acquiring significant properties in many regions of the country. The twin process of industrialization and urbanization is transforming the traditional economic relations between the rural and the urban cements of population. Agriculture is perhaps the most complex phenomenon. This is because of the large number of geo-hydrological, environmental, biological and socio-economic variables influencing the agricultural production. As a result, diversities abound, not only in the cropping system but also in the farming system as well.

Agriculture is one of the oldest economic activities of man. Generally it is understood to mean both, cultivation of food and fiber crops and the rising of livestock's. It has remained an important source of livelihood even today over the years in spite of growing industrialization and urbanization in the world and nearly fifty percent working population is still engaged in agriculture (Gigg, 1974). In the developing countries, agriculture sector has been a principal source of employment and largest source of income. However, it provides raw material to industry and much of export items (Davis, 1982). Agriculture in India is a major source of economy. It contributes fifty percent to national income and gives direct employment to about 68 percent of total population and nearly 90 percent population to rural area (India, 1983) and provides nearly 35 percent of country's export, besides supplying of wage goods required the non-agricultural section in industry. Hence it is not surprising that agriculture in India has

been receiving much attention in the sectoral allocation of inputs in the Five Year Plans in India and therefore top priority has been assigned to develop agriculture sector in our country.

The intensive efforts in India have been made during the Five Year Plans to make agriculture self-reliant through increase in area under plough, yield per hectare and total production by providing schemes, subsidy and many concessions to improve the food production and stress was, primarily, given on improved tillage, adoption of better cultivation and methods, use of fertilizers and improved seeds and a more plentiful and assured supply of water. Despite several attempts through Five Year Plans in India, the processes of agricultural growth has not yet been properly channelized due to lack of proper understanding of basic characteristics , its scientific evaluation and landuse.

Demographic characteristics change as the time passes and this gives rise to changes in agricultural pattern. Agricultural phenomena is analyzed and synthesized for a particular area. Even in a smallest area marked degree of variations in agricultural phenomena. This is because of the interrelated factors and the complexity of the entire system. These can be classified as independent factors. These vary from location to location in a region. The regional approach is widely used in Europe. It is more suitable to India because major economic problems and policies have been concerned with the development of area and improvement of agriculture. It is also adopted in Australia where it is used in regional planning of the country.

1.1: PREVIOUS STUDIES

The study of land and agriculture from geographical point of view gained importance only after fifties in the context of

regional planning. Though more than 150 years ago Von Thunon's famous theory of location was concerned with agriculture, the era is new concept in agricultural geography started only with the works of Johnson (1925) and Baker (1926), later on, Hartshorne and Dicken (1935), Whittlesey (1936). The interest shown in landuse and agriculture by Weaver (1944), Peter Scot (1957), Johnson (1958), Stamp (1962), Kostrowick (1957), Lee (1963) and Powel (1969), further opened new vistas of agriculture geography. In India, agriculture geography started rather late. Dr. B.N. Mukharjee (1942) form Agricultural region of Utter Pradesh was the first to attempt in this direction within forty years. After this, many studies in this field were completed and notable contribution was made by Dayal (1950), Shafi (1960), Bhatia (1965), Ayyar (1961), J.Singh (1967), Saxena (1968) and Joshi (1972).

In the field of land utilization and agricultural problems a few attempts have been made in Maharashtra by Kumbhar (1978), Shinde (1989), More (1980), Powar (1984), Sargarh (1986), Karmarkar (1981) and Datye (1984). These studies have evaluated landuse patterns and agricultural problems of Western Maharashtra.

Regional analysis were first attempted by economist in the 1950's and 1960's to review the past experience and future prospects of regional development with an accent of regional planning (Mukhopadhyay 1976).The regional study of agricultural geography (Singh and Dhillon, 1984) and an impressive corpus has piled up on the space-time perspective of the changes in agricultural landuse and crop productivity during the last three or four decades. Among the notable exceptions are

the few studies by Singh (1974-75, 1974, 1976) the volume edited by Mohammad (1984), and Mohammad (1981), and the monograph by Shafi (1984), all of which provide a good insight into the regional profile of agriculture, though the emphasis in all is still on regional identification and description rather than on the process of spatial dynamics.

1.2: STUDY AREA

Nashik district is situated partly in the Tapi Basin and partly in the upper Godavari Basin. It lies between $19^0$35' 18" North latitude to 20^0 53' 07" North latitude and 73^0 16' 07" East longitudes to 74^0 56' 22" East longitudes. It is surrounded by Dhule district in the North, Jalgaon and Aurangabad district in the East, Ahemadnagar district in the South, Thane district in the South-West and Gujarat state in the North-West (map 1.1).

Nashik district has an area of 15530 square km and a population is 4987923 (2001 Census). It ranks third in terms of area and fourth in terms of population amongst the district of the state. The main stream of hills in the Sahyadri which is runs north-south in the western proportion of the district. From the main Sahyadrian range, three prominent spurs Stretch out of the east. In the extreme north is the Selbari range which approximately forms the boundary between Nashik and Dhule district. Next in the Satmala and Ajanta range which runs right across the district. It acts as a watershed between the Girna and its tributaries which drain towards the Tapi to the north and the Godavari and its tributaries to the south. Some of the ranges are flat topped and regular in height and slope, while others are conical and irregular.

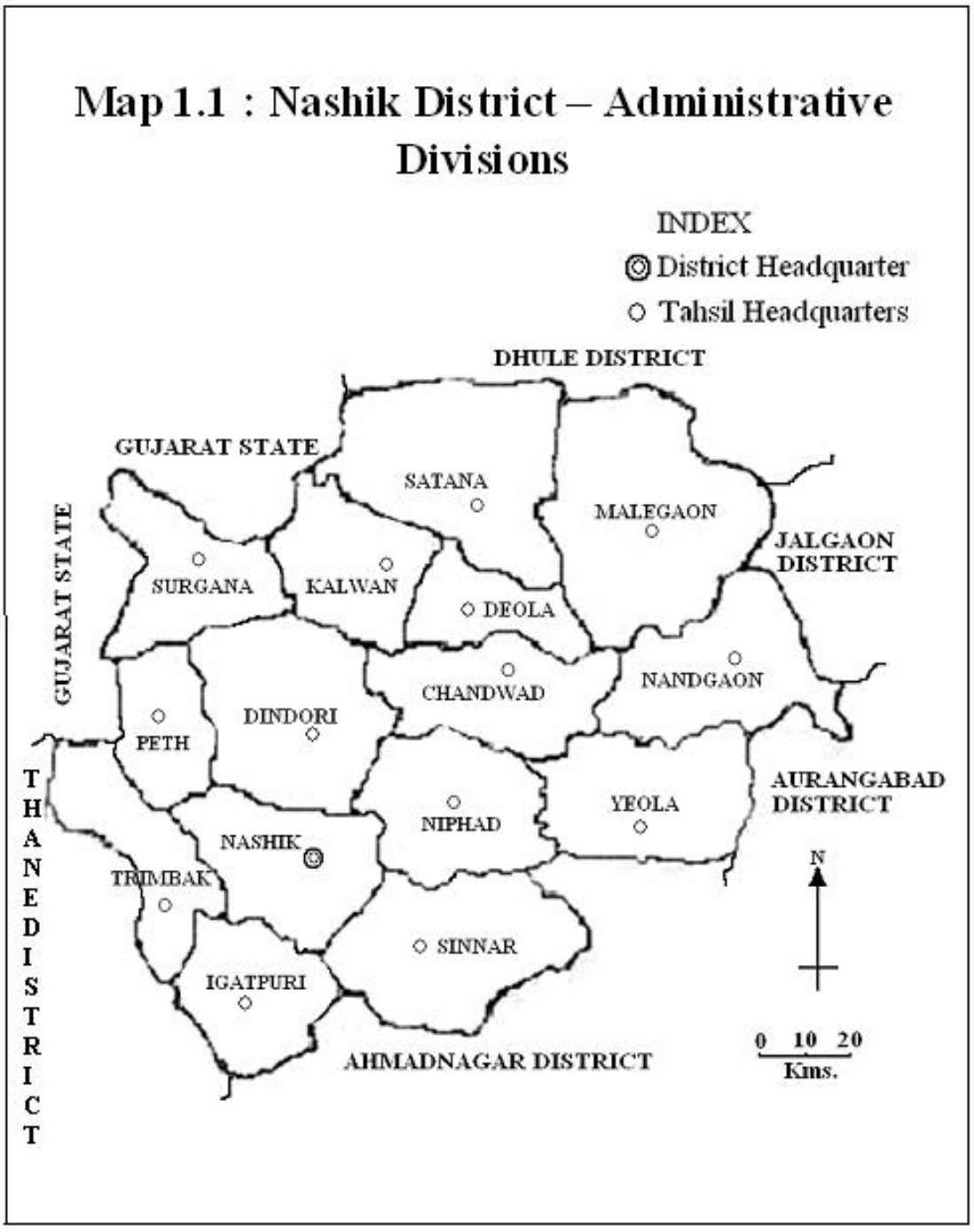
The district is broadly divided into three major geographical regions: I) Downghat Konkan Tract, II) The Girna Basin and III) The Godavari basin. The district is drained by two main rivers, viz. Girna and the Godavari and their tributaries.

The climate of the district is generally dry except during the South-West monsoon season. The average annual rainfall for the district as a whole is 1035.5 mm. Within the district there are considerable variations in rainfall. The rainfall in generally decrease as one proceeds from West to East. Temperature begins to increase rapidly from the latter half of February. May is the hottest month with the mean daily maximum temperature at 40.6°C at Malegaon and 37.4°C at Nashik. December is the coldest month with the mean daily minimum temperature at 11.3°C at Malegaon and 10.2°C at Nashik.

The soil of the district is essentially derived from the Deccan Trap which is the predominant rock formation of the district. The soil formation is mainly affected by the climatic condition and topography of the district. The soil in the Godavari, Kadava, upper reaches of the Girna and the Mosam Valley is quite deep and fertile. The relief in the rest of the district is undulating and susceptible to erosion. Light shallow soil is found on hill slopes and very coarse soils at higher elevation.

1.3: CHOICE OF STUDY AREA AND TOPIC

Nashik district is my homeland. I am interested to do some work for my region. I think this is good opportunity for me to investigate some new for the community where I born and where I am on the way of progress.


Map 1.1 : Nashik District – Administrative Divisions
INDEX
District Headquarter
Tahsil Headquarters
DHULE DISTRICT
GUJARAT STATE
GUJARAT STATE
SATANA
MALEGAON
JALGAON DISTRICT
SURGANA
KALWAN
DEOLA
CHANDWAD
NANDGAON
DINDORI
PETH
THANE DISTRICT
AURANGABAD DISTRICT
NIPHAD
YEOLA
NASHIK
TRIMBAK
SINNAR
IGATPURI
AHMADNAGAR DISTRICT
N
0 10 20
Kms.

Agriculture continues to sustain millions of people in India. Agriculture has always occupied an important place in Indian economy. The proportion of cultivable land has been decreased considerably during the recent past. This situation is observed in Nashik district. As I am the son of a farmer, therefore, I am interested to investigate the trend of agriculture in Nashik district.

1.4: AIMS AND OBJECTIVES

The precise aim of this study is to assess and analyze geographically, describe and interpret the pattern of agricultural land use in the Nashik district from the year 1961 to 2001 with a view to investigate certain physical and socio-economic variables involved in landuse patterns and provide meaningful investigation for making suitable, proper and efficient landuse to meet demands of food for the increasing population and to map, describe and interpret the variations in agricultural landuse patterns with ranking of crop, crop-combinations and diversifications.

Putting it more clearly, present investigation has covered following objectives for detailed and exhaustive study as:

1) To highlight the profile of physical and cultural setting of the region.

2) To highlight the profile of irrigation status of the region.

3) To know how the changing landuse pattern and landuse cover change scenario from one decade to another.

4) To know how the land changing from one major use to another and the factors responsible for it.

5) To find out the levels of agriculture development of the district.

6) Attempt the spatial as well as temporal landuse of agricultural patterns in the Nashik district and investigate the factors

influencing on the distribution of agricultural landuse from 1961 to 2001.

7) To present existing cropping patterns and crop combination regions by applying methods of crop combination and diversification towards the regionalization of agricultural landuse for the Nashik district.

8) To find out the relationship between selected landuse variables and environmental variables by quantitative techniques, namely correlation coefficient, regression and to examine the role of these variables in the agricultural landuse patterns in the Nashik district.

9) To find out the planning regions of the district.

1.5: METHODOLOGY

Talukawise monthly maximum, minimum and average temperature, monthly average rainfall, annual rainfall, total area, forest area, total population, population growth, density, occupational structure of population, irrigation, markets, route length, land holding, general landuse, agricultural landuse etc. data of the district collected from unpublished and published record of the Revenue and other Departments. Individual data of crop area converted into percentage to net sown area and used for mapping. This cartographic method throws light on landuse for particular crops and the strength of each crop. The percentage of each crop will be placed in depending order for ranking. The following statistical procedures used/adopted in the present study:

1. Weaver's method is used for identifying dominant relative individual crop combination.
2. Bhatia's method is used for identifying the crop diversification.

3. Jasbir Singh's method is used for identifying intensity of irrigation and index of intensive irrigation.

4. The correlation coefficient method is used for identifying relationship between selected landuse and environmental variables.

5. Statistical methods and cartographic techniques are used wherever it is necessary.

1.6: SOURCE OF DATA

The primary data collected by face to face interviews of farmers, using questionnaires.

The secondary data collected by published and unpublished materials from various offices/departments as Revenue and others. The tahsil office is the prime source for area under individual crops for 1961-2001 of taluka level. Besides this, published records and abstracts such as socio-economic review of Nashik district, District Census Handbook, District Statistical Report of Nashik District, Crop and Seasons Report, Nashik District Gazetteer, Agricultural Bulletin Published by Agriculture Department, Maharashtra State, and Pune. Periodicals and other documents used for obtaining relevant data information bearing on the theme.

The delimitation of the Nashik district will attempted by marking out the watershed of river for which following Indian topographical maps published by Survey of India used for the study.

The format of questionnaires incorporate all aspects of agricultural practices, general landuse, existing cropping pattern, various means and intensity of irrigation, socio-economic

conditions of farmers, problems and prospects of agriculture and it become useful for getting basic information about agriculture.

1.7: DESIGN OF WORK

The present investigation consists of seven chapters.

Chapter 1 deals with the background of study covering its objectives, source of data, methodology used in processing data, analysis and interpretation problems encountered, limitations restricting the scope of this study.

Chapter 2 deals on the physical and cultural setting of the district. It includes its relief, drainage, climate, soil, vegetation and delineating population, transportation, irrigation, and marketing facilities etc.

Chapter 3 present the nature of irrigation situation in Nashik district covering sources of irrigation, types of irrigation i.e. canal irrigation, well and tub well irrigation, variation of irrigation, intensity of irrigation and index of intensive irrigation.

Chapter 4 present the nature and features of the general landuse and agricultural landuse pattern of Nashik district covering net sown area, forest, cultivable waste, fallow land and land not available for cultivation while in the agricultural landuse pattern of all crops grown in the area undertake for study. This includes rice, bajra, wheat, Jawar, maize, pulses, oil seeds, sugarcane, vegetables, fruits, nachani, fodder crops ,fiber crops etc.

Chapter 5 presents the levels of agricultural development covering the Cluster Analysis for the year 1980-81 and 2000-01, Temporal Variations of Hierarchical Clusters and Classification of tahsils According to the levels of Agricultural Development.

Chapter 6 deals on mere rationalization of crops grown in the study regions by crop ranking, crop combination, crop

diversification as well as relationship of selected landuse variables and environmental variables. The significance of these variables will be determined by the use of statistical methods, namely Correlation-co-efficient and multiple regressions etc.

Chapter 7 present the resume based on the preceding indepth and meaningful exposition, analysis and interpretation of the factual information's and data bearing on the whole theme and conclusion, planning regions and suggestions are occurs in this last chapter.

The bibliography of all the books referred to is providing along with the photographs for the present research work.

Chapter 2

PHYSICAL AND CULTURAL SETTING

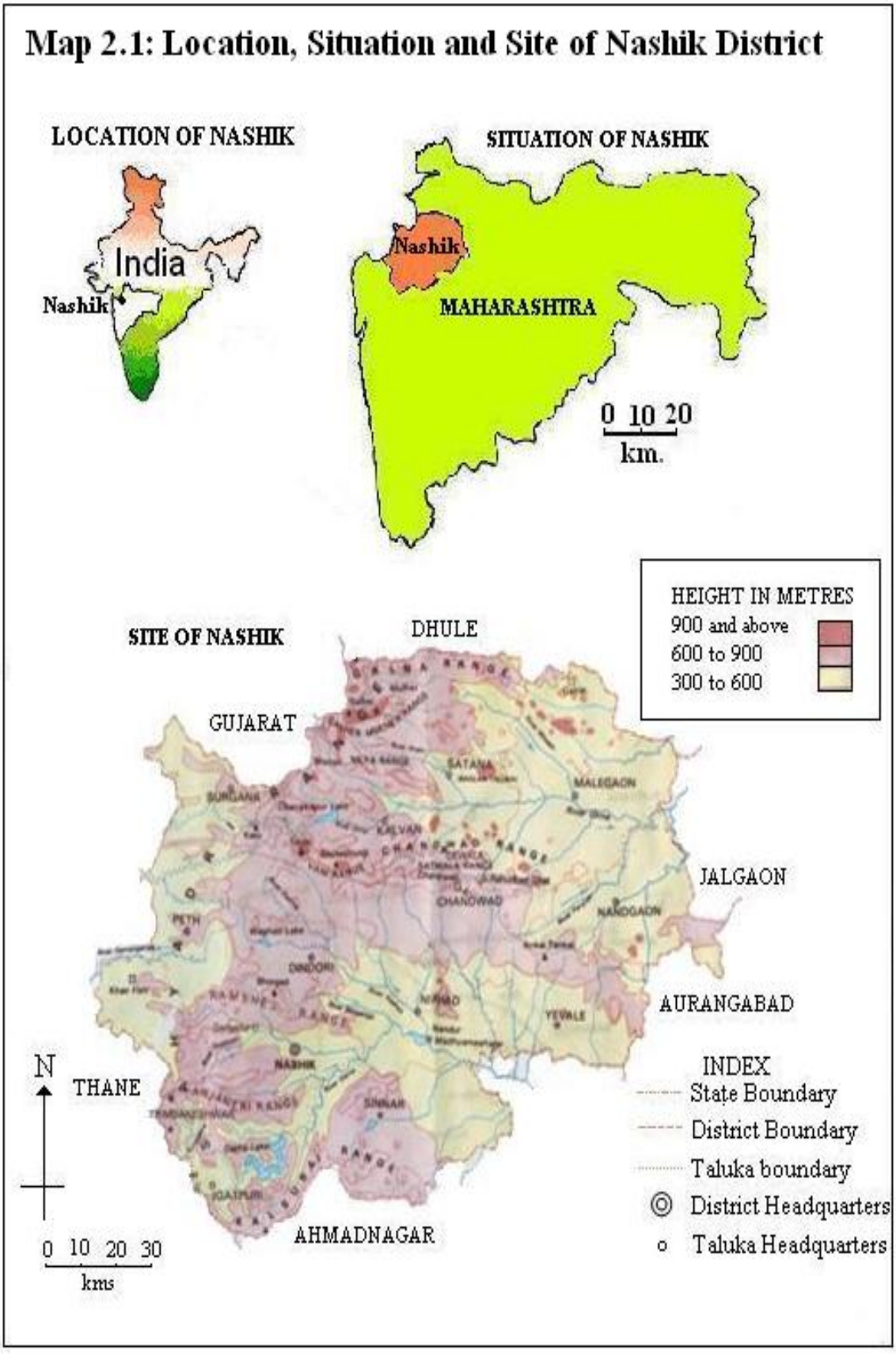
2. A: PHISICAL SETTING

2. A.1: INTRODUCTION

Land is the basic resource of human society. Its utilization shows a reciprocal relationship between ecological conditions of a region and man. Visher (1932) has rightly put forward the theory that a specific field of geography concerns itself with the study of the influence of natural environment on the nature and distribution of men's activities. The varied nature namely, Soil, water, climate provides different area with variety of possibilities of development (Hettnerr, 1947).It is therefore, necessary to evaluate the agricultural land use of the study region, needs to unfold the nature of ecology of the Nashik District. This chapter covers the profile of physical background of the district, i.e. Relief, Geology, Climate, Drainage, Soil and Vegetation.

2. A.2: LOCATION, SITUATION AND SITE

Nashik district lying between $19^0$35'18" North latitude to $20^0$53'07" North latitude and $73^0$16'07" East longitude to $74^0$56'27" East longitude, with an area 15530 sq.km (map2.1).The total population of the district was 4987923 as per the census of 2001. Rhomboidal in the shape with the longer diagonal of about 170 km. from South-West to North-East and an extreme breadth of about 170 km. from North to South. Nashik is bounded on the North-West by the Dangs and Surat districts of Gujarat state, on the North by the Dhulia district, on the East by the Jalgaon and Aurangabad district, on the south by the Ahmadnagar district and towards South-West by the Thane district.


Map 2.1: Location, Situation and Site of Nashik District
LOCATION OF NASHIK
India
Nashik
SITUATION OF NASHIK
Nashik
MAHARASHTRA
0 10 20
km.
HEIGHT IN METRES
900 and above
600 to 900
300 to 600
SITE OF NASHIK
DHULE
GUJARAT
JALGAON
AURANGABAD
THANE
AHMADNAGAR
N
0 10 20 30
kms
INDEX
State Boundary
District Boundary
Taluka boundary
District Headquarters
Taluka Headquarters

The district derives its name from that of its headquarters town of Nashik, for the origin of which two interpretations are given. The town is sited on the nine peaks or navashikhara and hence its name.

Nashik district comprises 13 Talukas before 2000, after 2001 there is 15 talukas like Nashik, Peth, Surgana, Trimbak, Igatpuri, Sinner, Niphad, Dindori, Kalvan, Satana, Malegaon, Chandvad, Nandgaon and Yeola. Nashik district covers 5.05% area of Maharashtra (map 1.1). Table 2.1 shows Talukawise area and population of the district.

2. A.3: GEOLOGY

Deccan Traps comprising pahoehoe and Aa lava flows of basaltic composition of Late cretaceous to palaeogene age (68 to 62) occupy the entire area of the district. Thin beds of volcanic tuff are found between the flows along the contacts at a few places. The entire lava pile has been classified into three formations, like Salher Formation, Lower Ratangarh Formation and Upper Ratangarh Formation in the ascending order of megacryst flows M1 and M2 developed on the top of Salher and Lower Ratangarh Formations respectively. Salher Formation comprises 6-7 flows, which shows predominantly pahoehoe flow characteristics. This formation has a maximum thickness of 300 mts. and is exposed along the river valleys and lower elevations in the western part of the district. The upper part of the Salher Formation is marked by a megacryst (M1) pahoehoe flow containing giant size (1-5 cm.) phenocrysts of plagioclase felspar.This megacryst horizon is regionally quite extensive and serves as an excellent marker horizon in the lava succession.

Table 2.1: Area and Population in Nashik District

Sr. No	Tahsil	Area (sq. km.)		Population		% of Area		% of Population	
		1991	2001	1991	2001	1991	2001	1991	2001
1	Nashik	1266.5	807.6	895000	1317081	8.1	5.2	23.2	26.5
2	Peth	934.4	559.1	128000	96755	6.0	3.6	3.3	1.9
3	Dindori	1320.0	1320.0	208000	264731	8.5	8.5	5.4	5.3
4	Surgana	838.6	838.6	109000	145036	5.4	5.4	2.8	2.9
5	Kalwan	1052.2	869.7	199000	165437	6.8	5.6	5.2	3.3
6	Satana	1616.0	1475.3	296000	311148	10.4	9.5	7.7	6.2
7	Malegaon	1937.7	1832.5	672000	788961	12.5	11.8	17.5	15.8
8	Chandwad	962.9	962.9	165000	205145	6.2	6.2	4.3	4.8
9	Nandgaon	1102.6	1102.6	203000	236359	7.1	7.1	5.3	4.8
10	Yeola	1071.6	1071.6	188000	235379	6.9	6.9	4.9	4.7
11	Niphad	1056.0	1056.0	357000	436330	6.8	6.8	9.3	8.8
12	Sinner	1351.1	1351.1	228000	291025	8.7	8.7	5.9	5.8
13	Igatpuri	1020.8	854.1	202000	228363	6.6	5.5	5.2	4.6
14	Trimbak	---	854.3	---	136160	---	5.5	---	2.7
15	Deola	---	574.6	---	130023	---	3.7	---	2.6
	Total	15530	15530	3850000	4987923	100	100	100	100

(Source: District Census Handbook of Nashik 1991 and 2001)

Lower Ratangarh Formation has an exposed thickness varying from 300-450m and comprises seven compound pahoehoe flows. This formation is predominantly exposed around Dindori, Satana, Nashik and Kalwan. The rocks are fine to medium grained, hard, compact and phyric. A megacryst (M2) flow containing phenocryst of plagioclase ranging in the size from 3-7 cm marks the upper contact of the lower Ratangarh Formation. This marker flow is exposed North, East and southern part of the district, comprises six compounds pahoehoe flows

containing olivine phenocryst. This formation shows a maximum exposed thickness of 530m in the area South-West of Nandgaon. Thin beds of tuff varying in the thickness from 0.2 to 1m are found at place at the flow contacts. This tuff is radish brown to dark brown, fine grained and contains angular fragments of basalts and laths of plagioclase feldspar.

The dense and compact basalt of both flows and dykes is extensively quarried and used as road metal, building in the vesicles of pahoehoe flow near Shirsondi. Well developed and transparent crystals of quartz are seen in geodes and vugs in the Southern spur of hillock Δ618. Well developed crystals of amethyst occur in small cavities and geodes in hillock, 2.5 km NE of hillock Δ866, hillock near Girnare, NNE of Chandwad and West Rahud.

2. A.4: RELIEF

Topographical features directly influence agriculture. Altitude, angle of slope, aspect of slope, Relative Relief control size and shape of forms and types of crop grown. In general agriculture is rarely found above 3500 meters of altitude. Decrease in temperature and pressure, low humidity, thin soil cover limit agriculture.

Physiographically, the western part of the district is represented by highly rugged and dissected terrain of the Western Ghats with peaks like Kalsubai (1646 m) and Trimbak (1294 m.). Low –lying plains mark the eastern southern parts. The highest elevation in the district is 1567 meter near Salher fort and the lowest elevation of 454 meter above MSL is observed South of Bhruj. The easterly flowing Godavari and Girna rivers with their tributaries constitute the main drainage system in this district.

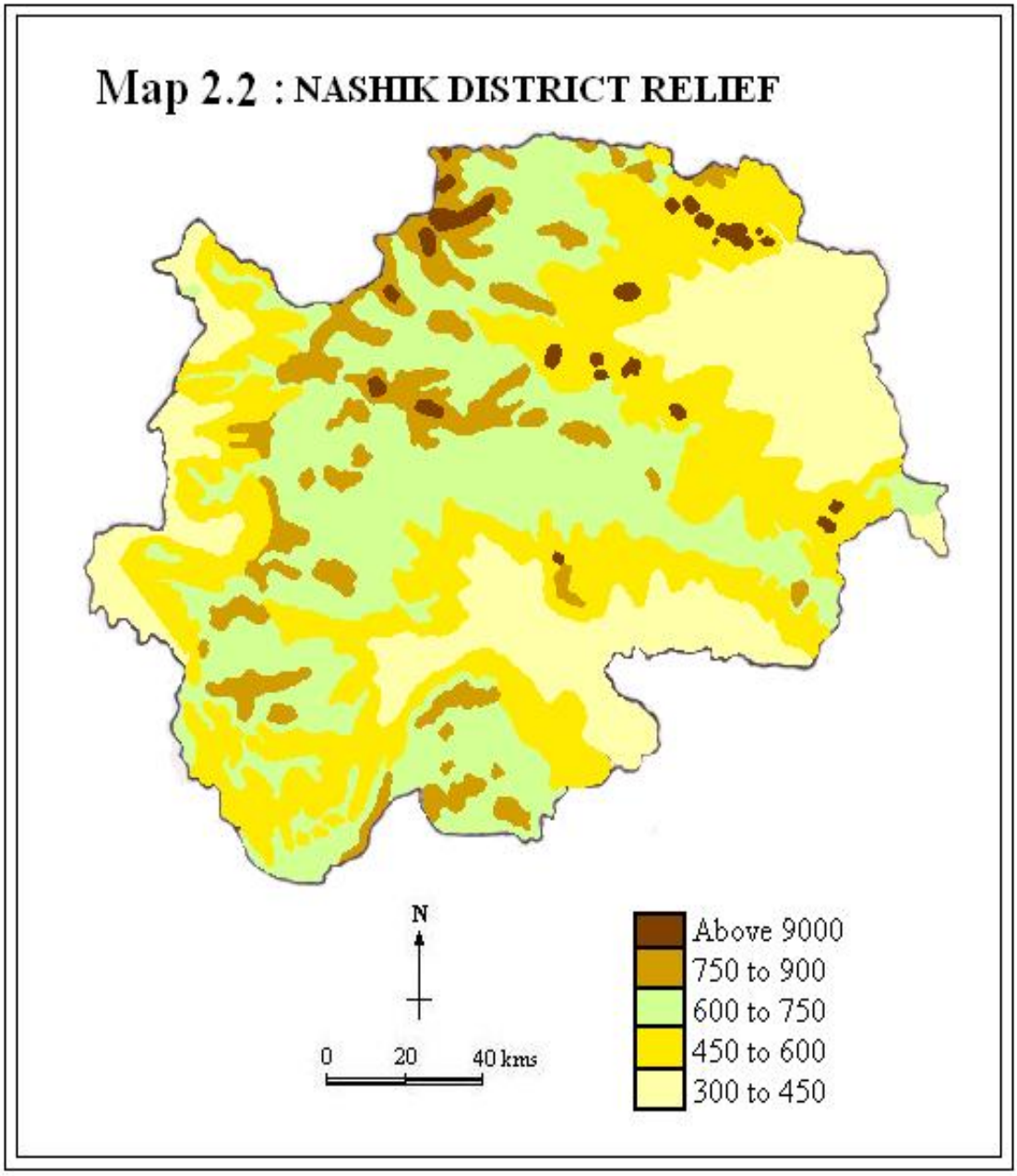
According to relief this district classified into five categories:

1. Area under 300 to 450 meter height: 3980 square km area comes under this group and covers 25.63 % area of the district.
2. Area under 450 to 650 meter height: 4889 square km area comes under this section and covers 31.48 % area of the district.
3. Area under 600 to 750 meter height: 4066 square km. area comes under this group and covers 26.18 % area of the district.
4. Area under 750 to 900 meter height: 1989 square km. area comes under this group and covers 12.81 % area.
5. Area above 900 meter height: 606 square km. area (3.9%) comes under this group. (Table No.2.2 and map 2.2).

Table 2.2 Relief: Height and total area

Sr. No.	Height (in meters.)	Total Area (Square km)	% Area
1	300 to 450	3980.0	25.63
2	450 to 600	4889.0	13.48
3	600 to 750	4066.0	26.18
4	750 to 900	1989.0	12.81
5	Above 900	606.0	3.9
	Total	15530.0	100

(Source: Research Student)


Map 2.2 : NASHIK DISTRICT RELIEF
N
0
20
40 kms
Above 9000
750 to 900
600 to 750
450 to 600
300 to 450

The district is divided into three major geographical regions (map 2.3 and Table 2.3).

Table 2.3: Geographical divisions and Total Area.

Sr.No.	Geographical Division	Total Area (Square km)	Percentage Area
1.	Downghat Konkan	2171.00	13.98
2.	Girna Basin	6346.00	40.86
3.	Godavari Basin	7013.00	45.16
	Total	15530.00	100

(Source: Research Student)

1) Downghat Konkan Tract:

The much dissected region lying to the West of Sahyadri edge of the Deccan plateau in the district partakes of the Nature of the Konkan and may be described as downghat Konkan tract. It includes the whole of Peth, Trimbak, and the North Western part of Dindori and Surgana except a small area of Igatpuri Taluka. It is a series of valleys and interfluves resulting from dissection by streams running in very deep beds. The hills are in many cases higher than those of the plateau edge of Sahyadries, Downghat Konkan Tract covers the total area is 2171 square km (13.98 %) of the district.

2) Girna Basin:

This geographical region covers 6346.00 sq.km (40.86) area of the district. This is the second geographical region; lying to the east of the Sahyadrian scarp and north of the Satmalas may be broadly described as the Girna basin. However it would be more appropriate to style it as the basin of the Tapi Tributaries.

This region is characterized by the occurrence of several eastward and southward trending off-shoots from the sahyadries, as remnants left behind as a result of dissection by several eastward trending streams belonging to the Tapi system. As the topography is rugged, the soils are generally light, which respond well to irrigation.

3) Godavari Basin:

Godavari basin lies to the South of the Satmalas and East of the Sahyadrian scarp. It occupies 7013.00 sq.km (45.16 %) total area of the district. This may be divided into four sub-regions viz. I) The Godavari valley II) the region of lighter soil sloping away from the Satmalas towards the Godavari and drained by innumerable tributaries. III) The upper Darna Basin and IV) Sinner plateau.

The sub region of Godavari valley proper comprising the talukas of Trimbak, Nashik, and Niphad is the zone of high fertility which increases downwards towards the East. Then the second sub region area sloping away from the Satmalas drained by innumerable streams from them towards the Godavari comprises the talukas of Dindori, Chandwad and most of Yeola. The third sub region Upper Darna basin along with that of its tributaries, the Unduhol and the Dadva, comprises nearly the whole of Igatpuri Taluka. The last sub region of plateau of Sinner is one of the light reddish brown soils on rough slopping ground with consequent emphasis on the bajra cultivation.

With the exception of the Sahyadris, the general direction of mountain ranges is from the West to East or South-West to North-East, the higher portion being near the West.

In the extreme North of the district is the Selbari range, the higher points in which vary from about 1300 mts. in the West to half that height in the East. The highest peak up to 1331 mts. is to be found in the Mangi-Tungi hill. Near the Eastern extremity of this range within the district is situated the Galana fort (710 m.).

A few km. to the South and nearly parallel to and divided from the former by the Mosam river, runs another line of heals which though much shorter in length contains higher peaks. Starting from the Sahyadris, it immediately attain a height of 1613mts. in the peak of the Salher fort and continues eastward South of the Kanjari Nala and decreasing in the elevation ends by broadening into a scattered group of hill to the West and South-West of Nampur. This range is known as the Dholbari hills.

The Satmalas, chandwad or Ajanta range runs right across the district. It differs from the rest of the mountains in the North by number and shape of its peaks, and by the narrowing down of flat summits. These peaks are visible from a greater part of the district and form prominent landmarks. The highest of them is Dhodap (1451 m.). Several other peaks approach this height. Amongst these are Saptshringi (1420 m.), Chandwad (1217 m.). Further to the South-East are the twin fort of Ankai and Tankai (960 m.).

The Trimbak-Anjaneri range stretches nearly eastward from Bhaskargad is Harish fort (1113 m.), and Bramha Dongar (1201 m.). However as in other ranges the greatest heights are attained some distance away from the Sahyadrian scarp at Trimbak (1294 m.) and Anjaneri (1300 m.).

2. A.5: NATURAL DRAINAGE

The drainage pattern and the trend lies of the ridges depend upon the structure of the underlying basaltic rocks of the district. These rocks interceded with ash layers, have developed three sets of master joints, running approximately directions North-South, North-West, South-East and North-Northeast, South-Southwest. The streams of the region have taken advantage of these planes of weakness in carving their valley as in shown by the following features; streams generally run in one or other of these three sets of directions; the bends at the confluence of almost every rill with its main stream generally rectangular; and the courses of most valley are almost straight.

The district is drained by two chief rivers the Girna and the Godavari and their tributaries the watershed between these being the Satmalas range. Apart from these there are a number of small Konkan Rivers draining westwards into the Arabian Sea. (Map 2.3)

1) Konkan Rivers:

Innumerable small streams flow down the Western scarp of the Sahyadris draining towards the Arabian Sea. Nar, Par, Damanganga, Vaitarna, Bhima etc. are the most important Konkan Rivers. This region receives maximum rainfall during the rainy season. These rivers are non-perennial rivers because of physiography and shortest length of the rivers.

2) Girna River Basin:

The Girna rises just South of Cherai village at about 8 km. South-West of Hatgad in the Sahyadris and flow nearly East along a wide bed with high banks in the same parts, but as a rule, low enough to admit of the use of water for irrigation. The stream


Map 2.3 : Nashik District
DRAINAGE AND GEOGRAPHICAL DIVISIONS
River Mosam
River Aram
River Girna
Chankapur
2
1
River Kadva
River Panjhan
River Damanganga
Waghad
River Banganga
3
Nandur
River Godavari
River Parna
Darna lake
N
0
20
40 kms
Geographical Divisions
1 Downghat Konkan
2 Girna Basin
3 Godavari Basin

of water during this portion of its course in comparatively small, and confined during eight months of the year to narrow strip of sandy bed. Several dams have been built across the main stream, irrigating large areas of garden land. Further its course through Kalvan, Deola, Satana, Malegaon talukas, it winds its way North-Eastwards as it nears the Jalgaon frontier. The Girna in its upper course receives several rivers of nearly equal size as it-self and equally useful for irrigation.

Total catchment area of Girna basin in Nashik district is 6346 square km. In this catchment Punad, Aram, Mosam, Panjan, maniad etc. tributaries joins river Girna. These are the main tributaries of River Girna.

3) The Godavari River Basin:

The Godavari is the most celebrated river not only of this district, but of the whole of the peninsular India. The principle course lies just below the scarp of Western side of the Trimbak amphitheatre, A larger and more distance branch takes its rise in the ridge that joins the Trimbak and Brahma mountains in a region of higher rainfall owing together exposure to moisture bearing winds. After passing the town of Trimbak the Godavari turns to the west, cutting deep and rocky bed through the ghatmatha country. The catchment area of Godavari basin is 7013 square km. Kashypi, Darna, Valdevi; Banganga etc. are the well known tributaries of Godavari.

It is to be noted that many of the streams flowing eastwards from the scarp in Desh have too wide valleys to have been formed by the river now flowing through them. The anomaly of the wide valleys can be attributed to the fact that the rivers that flow down in their midst formerly rose much further west then they now rise,

and that to the broad plains were at considerable distance from the sources of the rivers. The crest of the Sahyadris may be considered to have been much farther west than it now is. This is also born out by the occurrences of remnant higher peaks west of the main Sahyadrian scarp indicating the retreat eastwards of the scarp. This explanation is to be found in the much greater energy of the west flowing streams already referred to in the case of the Vaitarna as compared to that of the east flowing rivers.

2. A.6: CLIMATE

The climate of the district is characterized by dryness except in the south-west monsoon season. The year may be divided in to four seasons. I) The cold season from Dec. to Feb. followed by the II) hot season from March to May, from III) June to Sept. Monsoon season followed by the IV) post monsoon season during Oct. to Nov. The climate in Nashik district is typical monsoonal in character with a small range of rainfall and temperature. The study region experience intensive heat in summer and intensive cold in winter. The intensive heat in summer is drier and affects the vegetation in stopped its growth.

Temperature:

Malegaon is situated in the eastern part of the district which is at a slightly lower elevation than the rest of the Nashik district. The temperature at this station is about 3˚C higher than at Nashik in summer and about 1˚C or 2˚C higher in the cold season. In the region of the Western Ghats the temperature much lower than Nashik depending on the elevation. Temperature increases rapidly from about the latter half of February. May is the hottest month with the mean daily maximum temperature is 40.6˚ c. at Malegaon and 37.4˚ c. at Nashik. The heat is increase

in the height of summer and on same days the maximum temperature may goes above 46˚ c. in the eastern part of the district with comparatively lower elevation. Night temperature during June is slightly higher than May. With the onset of the south-west monsoon early in June day temperature decrease appreciably and

Table 2.4: Monthly average temperature (degree centigrade)

Months	1971	1981	1991	2001
Jan.	19.9	19.00	19.0	20.0
Feb.	20.9	22.7	19.7	23.0
Mar.	25.2	25.4	22.5	25.3
April	29.0	29.3	28.1	29.0
May	30.8	30.5	29.8	30.8
June	28.3	29.8	28.2	27.0
July	25.9	25.3	25.8	24.9
Aug.	25.3	24.6	23.9	24.4
Sept	25.1	25.9	23.6	25.5
Oct.	23.8	25.6	23.6	24.2
Nov.	22.1	21.1	21.3	21.9
Dec.	19.3	20.2	18.8	23.3
Annual	24.8	24.9	23.3	24.9

(Source: Regional Meteorological Department, Nashik)

The weather south-west monsoon season is pleasant. The south-west monsoon withdraws early in the October from the district and the day temperatures increase by 2 or 3˚C on the average in October. However highly temperature decrease after September. The temperature decrease rapidly from November. December is the coldest month with the mean daily minimum temperature at 11.3˚ c. at Malegaon and 10.2˚ c. at Nashik. The mean daily maximum temperature in this month is 29.5˚ c. at Malegaon and 28.3˚ c. at Nashik. Table 2.4

Table 2.5: Monthly Maximum and Minimum Temperature

(Temperature in degree centigrade)

Months	1971		1981		1991		2001	
	Maxi.	Mini.	Maxi.	Mini.	Maxi.	Mini.	Maxi.	Mini.
Jan.	29.2	10.7	27.6	10.4	30.1	7.9	29.4	10.6
Feb.	31.0	10.9	33.0	12.4	30.1	9.3	34.8	11.2
Mar.	35.5	15.0	35.6	15.3	30.4	14.6	34.8	15.9
April	37.9	20.2	38.6	20.0	37.7	18.5	38.1	19.9
May	39.0	22.7	38.5	22.5	38.5	21.1	38.3	23.3
June	34.2	22.4	35.9	23.8	34.4	21.6	31.8	22.2
July	29.4	22.4	28.9	21.8	30.6	21.1	28.2	21.6
Aug.	29.2	21.5	28.1	21.2	28.1	19.7	27.9	20.9
Sept.	29.8	20.5	30.5	21.3	29.6	17.6	30.8	20.3
Oct.	31.4	16.2	32.4	18.8	31.3	15.9	31.1	17.3
Nov.	30.6	13.7	30.4	11.8	30.8	11.8	30.8	13.0
Dec.	28.9	9.7	28.8	11.6	29.1	8.6	30.8	11.8
Annual	39.0	10.7	38.5	10.4	38.5	7.9	38.3	10.6

(Source: Regional Meteorological Department, Nashik)

shows monthly average temperature in Nashik district while table 2.5 shows monthly maximum and Minimum temperature in Nashik district. As well as figure 2.1 (A and B) shows the real condition of maximum, minimum and mean temperature in Nashik district.

The highest maximum temperature was recorded 46.7˚C in 23rd May, 1916 at Malegaon and it was 42.4 ˚C on May 12, 1960 in Nashik. The lowest minimum temperature at Malegaon was 0.1˚C on 1st February, 1929 and at Nashik it was 0.6˚C on 7th January, 1945.

Fig.2.1a: Monthly Average Temperature

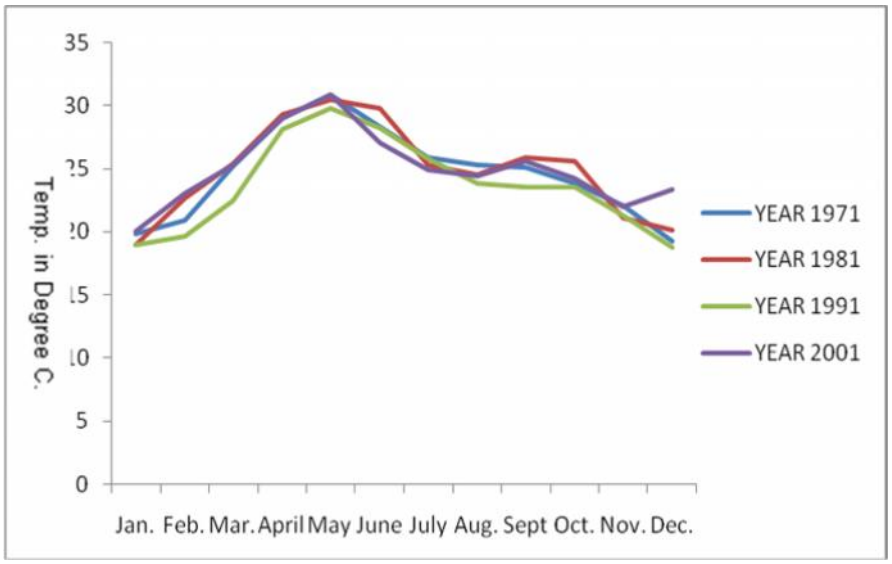


Fig.2.1b: Monthly Maximum & Minimum Temperature

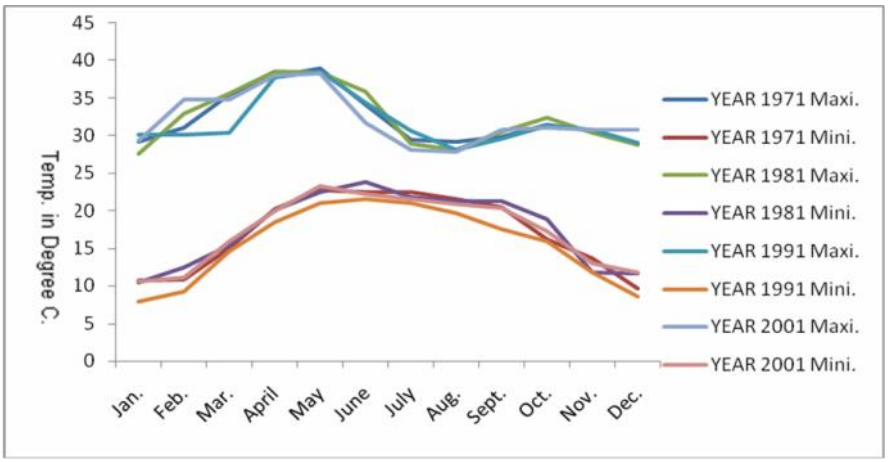
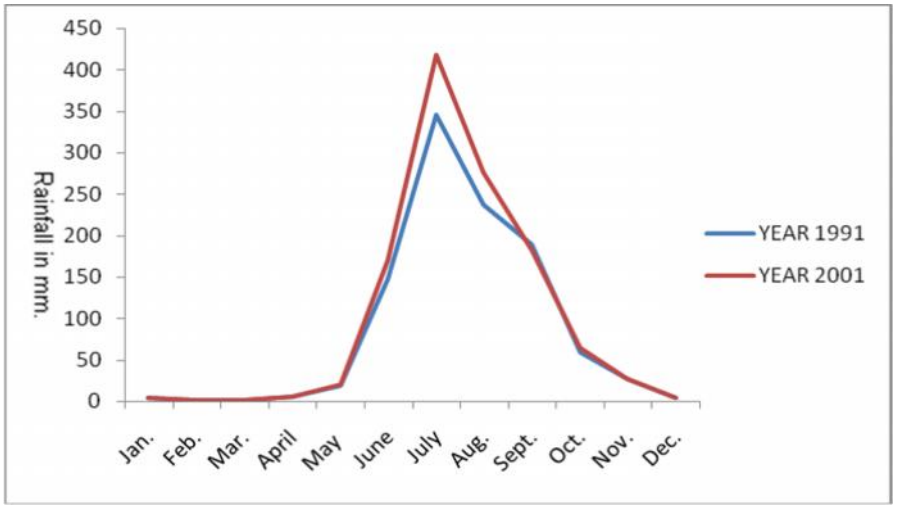


Fig.2.2: Monthly Average Rainfall.



Rainfall:

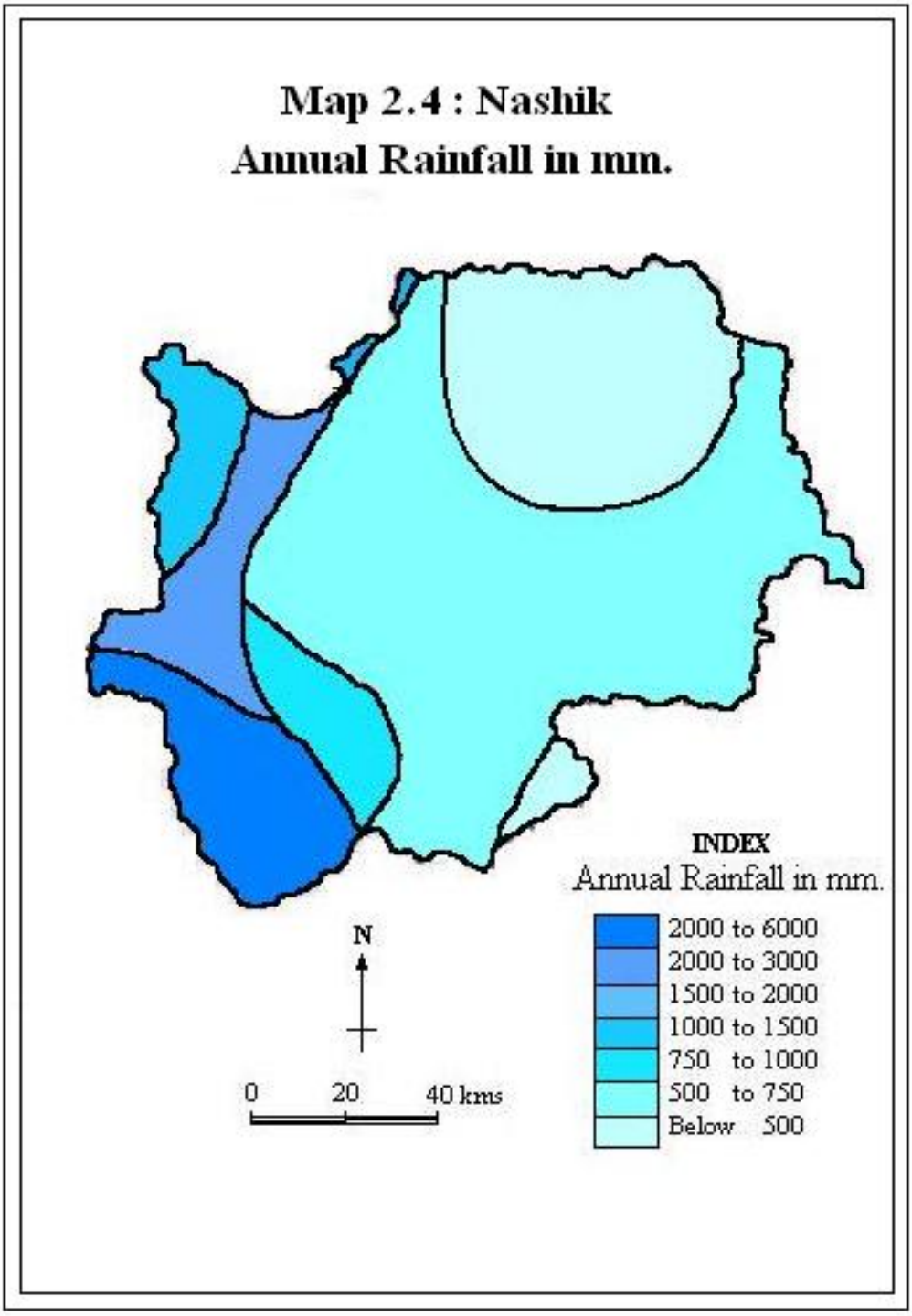
Tahsilwise rainfall of Nashik district is given in table no. 2.6 and 2.7 with the help of 15 rainfall station in the district. The average annual rainfall in the district is 1035.5 mm. In the narrow strip of the district to the close proximity of the Western Ghats the rainfall is very much heavier than the rest of the district. On an average, the rainfall in this narrow strip is increasing from 2365.6 mm. at Peth in the north and 3012.5 mm. at Igatpuri in the south. In the plateau region to the east of the Western Ghats the Rainfall is generally decreases from the west towards the east, with some local variations due to topography. The rainfall in the regions varies from 543.6 mm. at Satana to 772.2 mm. at Dindori. 88 percent of the annual rainfall in the district is received during the south-west monsoon season from

Table 2.6: Monthly Average Rainfall in Nashik District

(Rainfall in mm.)

Months	1991	2001
Jan.	3.6	3.5
Feb.	1.4	1.4
Mar.	1.9	1.8
April	5.1	5.5
May	19.0	19.7
June	146.9	169.7
July	345.4	418.1
Aug.	236.9	276.7
Sept.	188.7	182.0
Oct.	58.5	64.7
Nov.	26.7	27.0
Dec.	4.7	4.5
Total	1038.8	1174.6

(Source: Regional Meteorological Dept., Nashik)


Map 2.4 : Nashik
Annual Rainfall in mm.
INDEX
Annual Rainfall in mm.
2000 to 6000
2000 to 3000
1500 to 2000
1000 to 1500
750 to 1000
500 to 750
Below 500
N
0
20
40 kms

June to September. July is the rainiest month. During May and the post-monsoon months of October and November some rainfall occurs, mainly in the form of thunder-showers.

Highest rainfall receives in the month of July (Fig. 2.2). Map 2.4 shows the annual rainfall in the Nashik district. Maximum rainfall (more than 3000 mm.) at Igatpuri and south

Table 2.7: Talukawise Annual rainfall (1961 to 2001)

Taluka	1961	1971	1981	1991	2001
Nashik	507.2	751.5	784.0	696.9	741.7
Peth	2335.6	2095.3	2097.0	2352.6	2365.4
Dindori	788.9	733.3	733.0	753.1	772.2
Surgana	2916.7	1857.2	1960.0	1863.1	1854.8
Kalwan	741.2	795.6	795.0	693.0	692.6
Satana	498.6	552.6	552.0	470.3	543.6
Malegaon	536.1	548.1	547.0	544.6	572.2
Chandwad	654.1	799.4	780.0	645.2	755.2
Nandgaon	566.9	654.8	564.0	584.7	591.5
Yeola	550.4	519.9	592.0	555.4	548.9
Niphad	567.7	566.7	567.0	548.7	545.3
Sinner	567.7	593.8	558.0	556.7	582.1
Igatpuri	3712.7	3440.8	3341.0	3441.6	3012.5
Trimbak	---	---	---	---	2566.7
Deola	---	---	---	---	741.2

(Source: Regional Meteorological Dept., Nashik)

Trimbak, rainfall between 2000 to 3000 mm. receives at the Trimbak and east Surgana talukas, while remaining Surgana tahsil receives 1500 to 2000 mm. rainfall. West Nashik , West Sinner and east Trimbak receives 1000 to 1500 mm. rainfall while

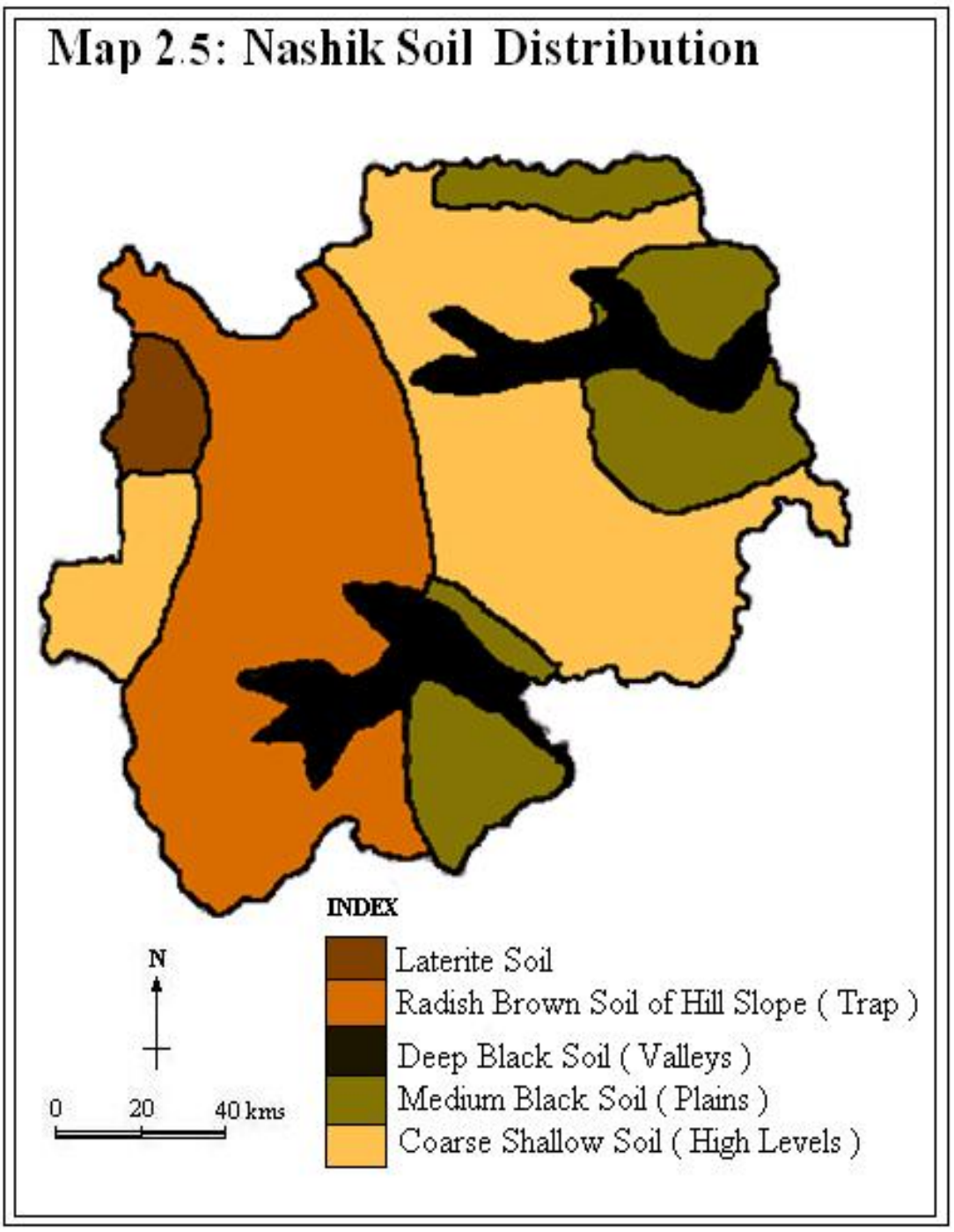
Dindori, Niphad, Chandwad, Kalwan, Deola, Yeola, Nandgaon receives 500 to 750 mm. rainfall and east sinner , Malegaon and Satana Taluka receives less than 500 mm. rainfall.

2. A.7: SOILS

Although soil has a profound effect on agriculture it is a derived factor of rocks, climate, vegetation and time together. Soil is the fundamental medium for crops. It acts as a bond or link between biotic and a biotic components. Soil has certain physical chemical and biological elements in it, which determine the thickness, structure and fertility of the soil. Jainedra Kumar (1985) has rightly pointed out the need for careful study of soil in order to make efficient landuse as soil provides basic nutrients to plants for longer than chemical fertilizers.

The present material all over the district is Deccan Trap. The soil formation is mainly affected by the climatic condition and topography of the district. In Igatpuri, Trimbak, Surgana and Peth soils have developed under humid conditions, with some laterite soil being observed at higher altitudes of the hills. The soils in the Godavari, the kadva and upper reaches of the Girna and Mosam valleys are quite deep and fertile. The soil in the rest of the district is undulating and susceptible to erosion. Light shallow soils are noticed on hill slops and very coarse textured soils on still higher reliefs.

The soils in the heavy rainfall zone are neutral in reaction, contain higher amount of organic matter and are low in their base status. In between lie the soils in the transitional zone. They are slightly alkaline in reaction and contain moderate amounts of organic matter. Lastly the soils in the scarcity area are alkaline and are low in their content of organic matter and nitrogen.


Map 2.5: Nashik Soil Distribution
INDEX
Laterite Soil
Radish Brown Soil of Hill Slope (Trap)
Deep Black Soil (Valleys)
Medium Black Soil (Plains)
Coarse Shallow Soil (High Levels)
N
0
20
40 kms

Map 2.5 shows the soil distribution in Nashik district. Five soil types are observed in the district these are I) Laterite soil, II) Radish Brown soil of hill slope (Trap), III) Deep Black soil (Valleys), VI) Medium Black soil (Plains) and V) Coarse

Table 2.8: Soil Distribution in Nashik District

Sr. No.	Soil Type	Total Area (sq.km.)	% Area
1	Laterite Soil	403.8	2.6
2	Radish Brown Soil of Hill Slope	4985.1	32.1
3	Deep Black Soil (Valleys)	1615.1	10.4
4	Medium Black Soil (Plains)	3059.4	19.7
5	Coarse Shallow Soil (High Level)	5466.6	35.2
	Total	15530.0	100.

(Source: Research Student)

Shallow soils (High level). Table 2.8 shows the perfect distribution of soil in Nashik district. Laterite soil covers 403.8 square km. (2.6%) total area of the district, this type of soil observed in Surgana taluka. Radish brown soil of hill slope occupies 4985.1 square km. (32.1 %) areas, it observes in hill slope area of Surgana, Kalwan, Dindori, Chandwad, Nashik, Igatpuri and Trimbak taluka. while deep black soil covers 1615.1 square km. (10.4%) area in the river valleys of Godavari and Girna. Medium black soil occupies 3059.4 square km. (19.7%) area of the district. It observes in the plain areas of Sinner, Niphad, Chandwad, Nandgaon, Satana and Malegaon talukas. The Coarse shallow soil covers 5466.6 square km. (35.2%) area

of Peth, Trimbak, Yeola, Niphad, Dindori, Chandwad, Deola, Kalwan, Satana, Malegaon and Nandgaon talukas.

2. A.8: NATURAL VAGETATION

The forest areas mainly covered by the sloping hills to the eastern and western parts of the district and are known as below ghat forests consisting of Dindori, Surgana, Peth and Trimbak. The forests spread on the plateaus in Nashik, Sinner, Igatpuri, Kalwan, Deola, Satana, Chandwad, Malegaon, Nandgaon, Niphad and Yeola talukas are called above ghat forest.

The forest in the district falls into three different types, viz., 1) Deciduous forest tending towards monster type, found in western and north-western parts of the district. 2) The Evergreen type forest observed along the terraces of the Western Ghats and 3) The Dry deciduous forest.

The total forest area in the district is 928.9 square km. situated below the ghat region. The remaining forest cover observed on the ghat tract with three distinct ranges of hills running in an easterly direction. These three ranges of hills are intensively cultivated and populous basin of the Girna and the Godavari rivers. The eastern zone bears nothing but a scrubby growth and the major portion of the reserved forest is barren and devoid of any growth. The vegetation is generally found along the terraces and sheltered belts which have escaped the destructive propensities of the local inhabitants.

Table 2.9: Forest Area in Nashik District (1961 to 2001)

Years	Total Area under forests (in hectors)	Percentage Area of Forest
1961	337805	21.75
1971	336644	21.68
1981	334859	21.56
1991	321281	20.69
2001	327979	21.12

(Source: Socio-Economic Abstract, Nashik District 1961 to 2001)

Table 2.9 shows forest covered area in Nashik District. According to this information there is no more change in the percentage of forest area in the district from 1961 to 2001. From last 50 years generally 21 percent area under forest.

2B: CULTURAL SETTING

2. B.1: INTRODUCTION

After studying the background of physical setting of the Nashik District including relief structure, climate and soil, it would be relevant to understand the role of cultural aspects in shaping agricultural landuse pattern in area under study. Both the physical and cultural variables show their impact on agriculture practice and its production. The traditional system of agriculture and decision making have their bearing on the regional variations in agricultural landuse in Nashik district. This has been elaborated and discussed in this section. Jasbir Singh and S. Dhillon (1987) have rightly stressed the necessity of the evolution 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 objectives of this section is to highlight the cultural background of the region or district , namely, population, occupational structure, irrigation, marketing, transportation and their impact on landuse pattern of the area under study.

The data of population from 1961 to 2001 have been collected from Nashik district Census Handbook, Nashik. The data of occupational structure have been collected from the socio-economic abstract of Nashik district, while the data of irrigation, marketing and transportation collected from Nashik district Gazetteer and socio-economic handbook of Nashik district. The suitable cartographic methods are used to depict the density of population, occupational structure etc. of the district.

2. B.2: POPULATION

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 agricultural force. It also forms the workforce, as cultivators, agriculture labours.

As per 2001 census, the population of the Nashik district is 4987923 persons. It accounts for 5.15 percent in the Maharashtra state. The density of population in the area under study is 321 persons per square km. 20.5 percent working population to total has engaged in agricultural activity and rest is involved in household industry, trade and transport in the area under study.

Table 2.10 shows the population since 1951 with its decadal variations and percentage of growth. It is observed from the table that the population in Nashik district has been stable increasing

Table 2.10: Population Growth and Decade Variation

Year	Population	Decade Variation	Growth in %
1951	1429916	---	---
1961	1855246	+425330	+29.75
1971	2369221	+513975	+27.7
1981	2991739	+622518	+26.27
1991	3851352	+859613	+28.73
2001	4987923	+1136571	+29.51
from 1951 to 2001		+3558007	+71.33

(Source: District Census Handbook, Nashik)

from 1951 to 2001(it is increased nearby 26 to 29 percent per decades). The population has been in 1951 was 1429916 while it increased and attained 4987923 persons in 2001. The total increase of population during the mention period is 3558007 with higher rate. However from 1951 to 2001 the population increased with constant rate. In 1961 the population growth was 29.75 percent while in 2001 it is 29.51 percent. It has decreased by 27.7 percent growth in 1971 and 26.27 percent in 1981.

2. B.3: 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 area under study has 20.5 percent working population which is directly involved in agriculture (2001). The population density value calculated as ratio of total

population to the total area from 1951 to 2001 and is shown in table 2.11.

Table 2.11: Density of Population (Years 1951 to 2001)

Year	Population	Area (sq.km.)	Density (Persons per sq.km.)
1951	1429916	15530	92
1961	1855246	15530	119
1971	2369221	15530	152
1981	2991739	15530	193
1991	3851352	15530	248
2001	4987923	15530	321

(Source: District Census Handbook and Gazetteer, Nashik)

It is revealed from the table that density of population in the Nashik District is increasing since 1951 from 92 persons per sq. km. to 321 persons in 2001. The interesting fact regarding the density of population increased 3.5 times during 50 years. The population growth is almost constant (nearby 29 percent per decade) but the population density in the district increased rapidly.

2. B.4: THE SPATIAL DISTRIBUTION OF POPULATION DENSITY

Map 2.6 and table 2.12 shows the population density in the Nashik district from 1961 to 2001. Total area of each taluka is shown in table 2.1 in physical setting. It is observed from the map 2.6and table 2.12 that there are considerable spatial variations in the density distribution within the district. In 1961 the highest density in the district is 259 persons in Nashik tahsil and lowest density in Surgana tahsil (70 persons). The density of population is rapidly increasing at Nashik, Malegaon and Niphad tahsils (Map 2.6 A, B, C, D&E). In 1971 the density was 336 persons observed in Nashik tahsil only. This is because of industrial development. The density is less than 100 persons in the north-

west part of the district, viz. in Peth (88) and Surgana (83) due to the less fertile soil and hilly or tribal area. The population density group between 201 to 250 persons recorded at Malegaon (220) and Niphad (205). 101 to 150 person's density was observed in the remaining tahsils.

The population density pattern in Nashik district for 2001 has rapidly changed than 1961. Map 2.6/E shows the density was less than 100 persons have been replaced by 151 to 200 and 201 to 250 person's density group. In downghat Konkan area the density occurs from 151 to 200 persons per square km. The density between 101 to 150 persons has been replaced by 201 to 250, 251 to 300 and 401 to 450. The talukas included in this category are Nandgaon (214), Chandwad (213), Niphad (413) and Igatpuri (267). The density between 151 to 200 persons has been replaced by 430 persons per square km. The density group between 251 to 300 persons replaced by 1631 persons per square km in Nashik taluka.

In 2001, the density of Peth, Surgana, Kalwan, Dindori and Trimbak tahsil comes under 151 to 200 persons group while Satana, Deola, Chandwad, Nandgaon, Yeola and sinner tahsils having the density between 201 to 250 persons per square km. Malegaon and Niphad observes between 401 to 450 persons. And in Nashik tahsil having maximum density i.e. 1631 persons in 2001.

Map 2.6 : Nashik- Density of Population

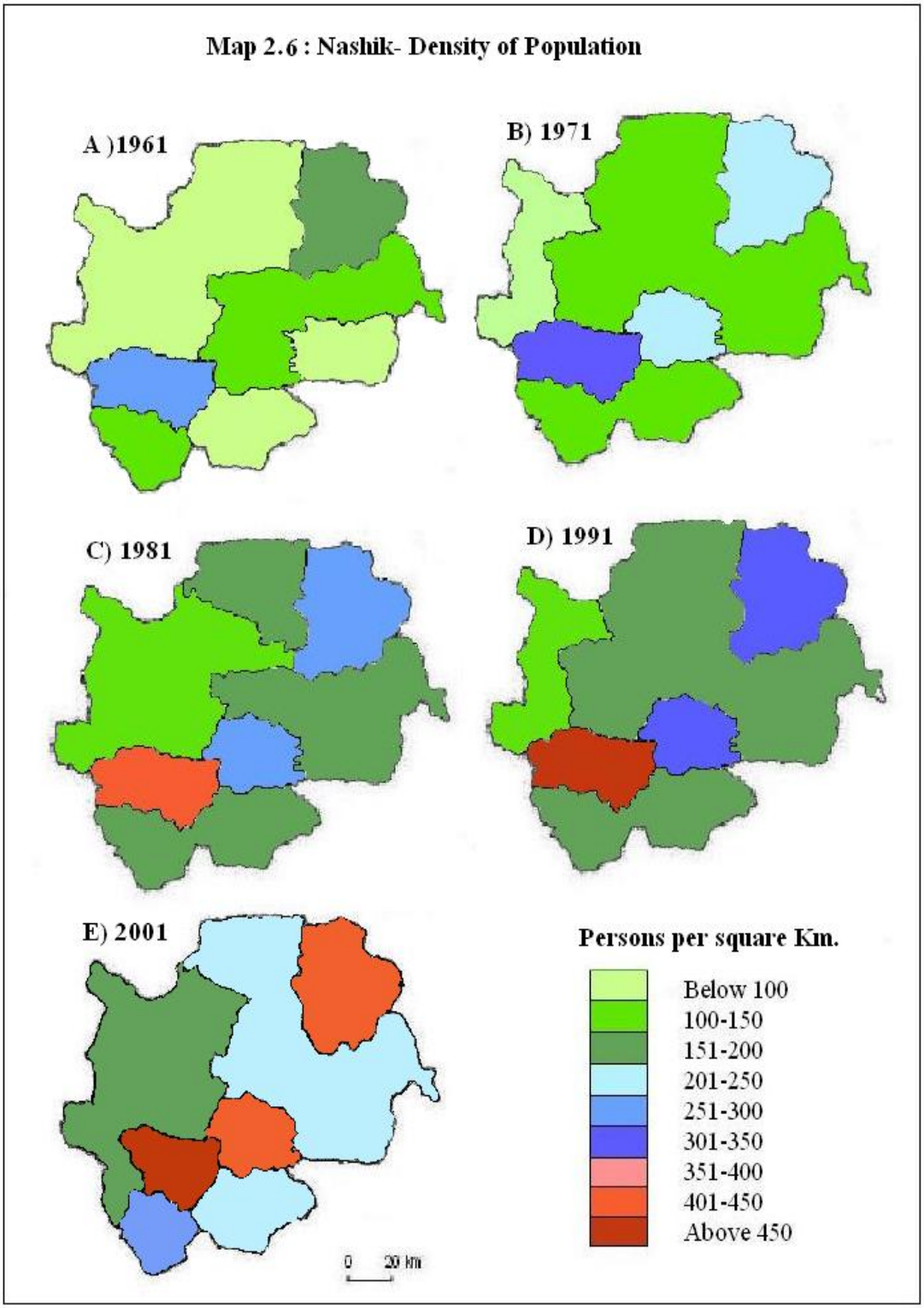


Table 2.12: Nashik District: Talukawise Population Density Per sq.km. (1961 to 2001)

Sr.No.	Taluka	1961	1971	1981	1991	2001
1	Nashik	259	336	423	707	1631
2	Peth	74	88	112	137	173
3	Dindori	86	104	131	158	200
4	Surgana	70	83	107	130	173
5	Kalwan	95	119	148	189	190
6	Satana	96	122	154	183	211
7	Malegaon	163	220	278	347	430
8	Chandwad	102	121	152	171	213
9	Nandgaon	110	132	168	184	214
10	Yeola	97	118	151	175	220
11	Niphad	138	205	258	338	413
12	Sinner	99	121	153	169	215
13	Igatpuri	111	133	170	198	267
14	Trimbak	---	---	---	---	159
15	Deola	---	---	---	---	226
	Total	119	152	193	248	321

(Source: Nashik District Census Handbook)

2. B.5: OCCUPATIONAL STRUCTURE

The availability of labour resource and its involvement in varies activities in agriculture represents the scenario of development of the region. The proportion of people engaged in agriculture decreasing from 1961 to 2001. In 1961, 71.6 percent people was engaged in agriculture to total population, while in 2001 it become 20.5 percent as working force in agriculture. The population can generally, be grouped

into two groups i) working population and ii) Non-working population. The working population means participation in economically productive activity either physical or mental in nature. Thus is involves not only actual work but also supervision and direction; whereas non-working population means, those who did not work at all during the proceeding years (Census of India).The working population owes spatial significance as it is directly involved in economic productive activity.

Table 2.13: Occupational Structure (1961 to 2001)

Categories	1961	1971	1981	1991	2001
Total population	1855246 (100)	2369221 (100)	2991739 (100)	3851352 (100)	4987923 (100)
Total Workers	1457634 (78.6)	914100 (38.6)	874600 (29.2)	1678804 (43.6)	1732900 (34.7)
Total Cultivators	965970 (52.0)	380339 (16.1)	380600 (12.7)	685923 (17.8)	664400 (13.3)
Agricultural Labour	363069 (19.6)	266213 (11.2)	296200 (9.9)	382696 (9.9)	358500 (7.2)
Farm Workers	1329039 (71.6)	646552 (27.3)	676800 (22.6)	1068619 (27.7)	1022900 (20.5)

[(1) Farm workers = Cultivators + Agricultural labour,
(2) Bracket figure indicate the percentage of total population]
(Source: By the research student)

The proportion of population, demographic characteristics and economic composition has a bearing on the landuse pattern (Forasat Ali Sidddique, 1988).

There are 1732900 (34.74 % of total population) worker in Nashik district. Table 3.4 shows the population structure and table 3.5 exhibits occupational structure from 1961 to 2001. The

occupational structure of the district has been studied under five groups as fallows;

1. Percentage of total workers to total population,
2. Percentage of agriculture labour to farm workers,
3. Percentage of cultivators to farm workers,
4. Percentage of farm workers to total workers and
5. Percentage of farm workers to total population.

Table 2.14–Variation in occupational Structure (1961 to 2001)

Decades	Occupational Variation Categories				
	1	2	3	4	5
1961	78.6	72.7	27.3	91.2	71.6
1971	38.6	58.8	41.2	70.7	27.3
Increase/Decrease	-40.0	-13.9	+13.9	-20.5	-44.3
1981	29.2	56.2	43.8	77.4	22.6
Increase/Decrease	-9.4	-2.6	+2.6	+6.7	-4.7
1991	43.6	64.2	35.8	63.6	27.7
Increase/Decrease	+14.4	+8.0	-8.0	-13.8	+5.1
2001	34.7	64.9	35.1	59.0	20.5
Increase/Decrease	-8.9	+0.7	-0.7	-4.6	-7.2

(Source: By the research student)

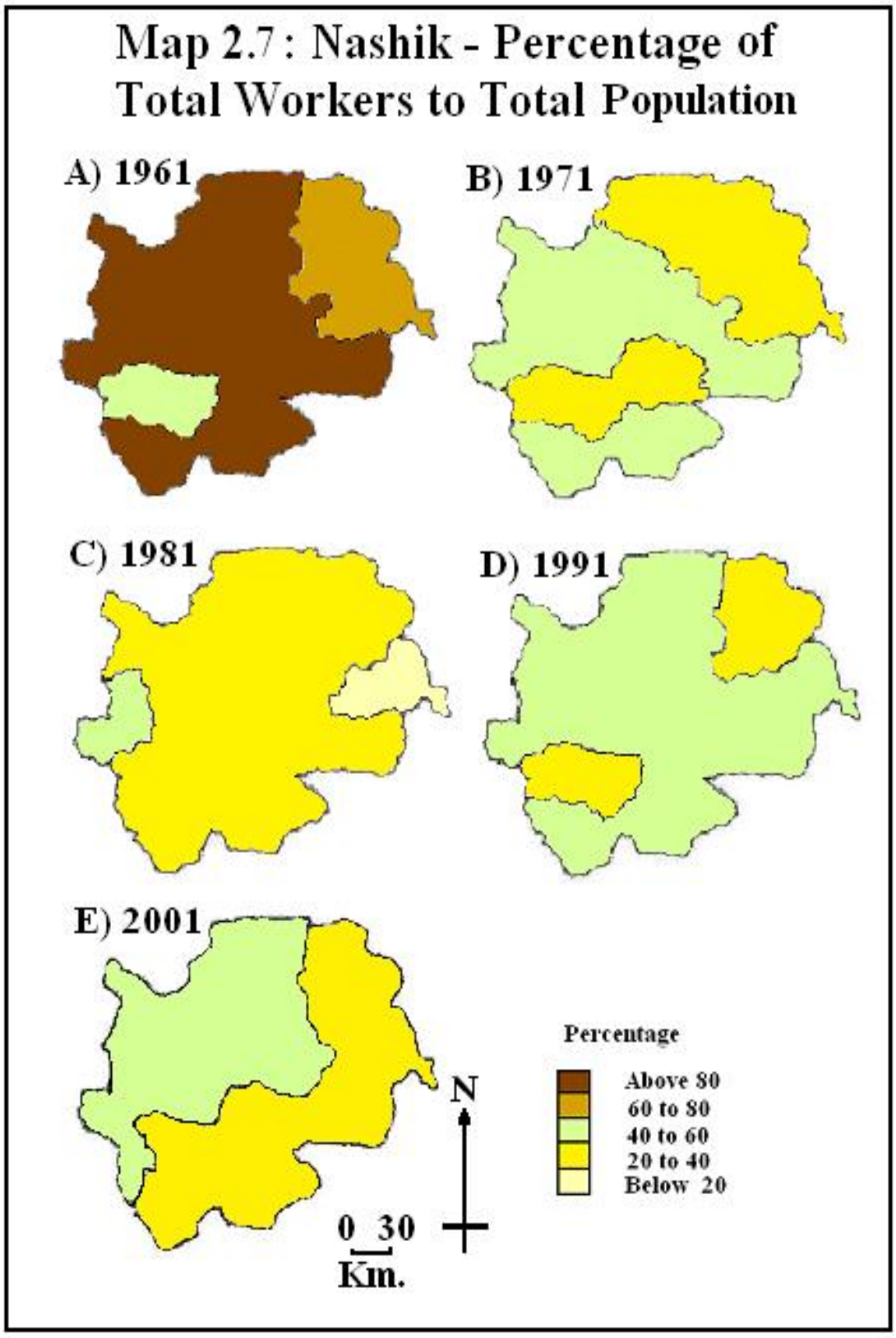
In 1961, there was a 78.6 percent worker out of the total population while 52 percent people were the cultivators, and 19.6 percent was agricultural labour. The occupational structure is changed from 1961 to 2001. The percentage of various categories of occupational structure rapidly decreases in 2001. Total workers are observed 34.7 percent, while total cultivators are 13.3 and agricultural labours are only 7.2 percent (table 2.13).

2. B.6: PERCENTAGE OF TOTAL WORKERS TO TOTAL POPULATION

The spatial distribution of percentage of total workers to total population in Nashik district for 1961 to 2001 are shown in map 2.7(table 2.14). In 1961, there were 1457634 persons in the working population category (78.6 percent to the total population) in the district. Map 2.7/A shows the spatial distribution of percentage of total workers to total population in 1961. It is observed that the total working population is high (more than 80 percent) all over the district except Nashik (48.8%), Malegaon (64.6 %) and Nandgaon (64.4%).

The working population in 1971 was 914100 (38.6 percent to the total population) in the district and it is decreased by 40 percent after ten years (from 1961 to 1971). Map 2.7/B shows spatial distribution of working population for 1971 in the area under study. It is obvious from the map that the structure of working population has changed considerably in 1961 to 1971. The remarkable decrease in working population from more than 80 percent to 40 to 60 and 20 to 40 percent. This change is attributed to decreasing number of persons in agriculture.

Another noteworthy change is occurred in the district from 1981 to 2001. The working population in 1981 was 29.2 , in 1991 it was 43.6 and in 2001 it was 34.7 percent to the total population (table 2.14). Map 2.7/C, D and E shows spatial distribution of working population for 1981, 1991 and 2001 in the district. Working population was increased by 14.4 percent in the decade 1981 to 1991. Then it is again decreased by 8.9 percent in the decade 1991 to 2001.

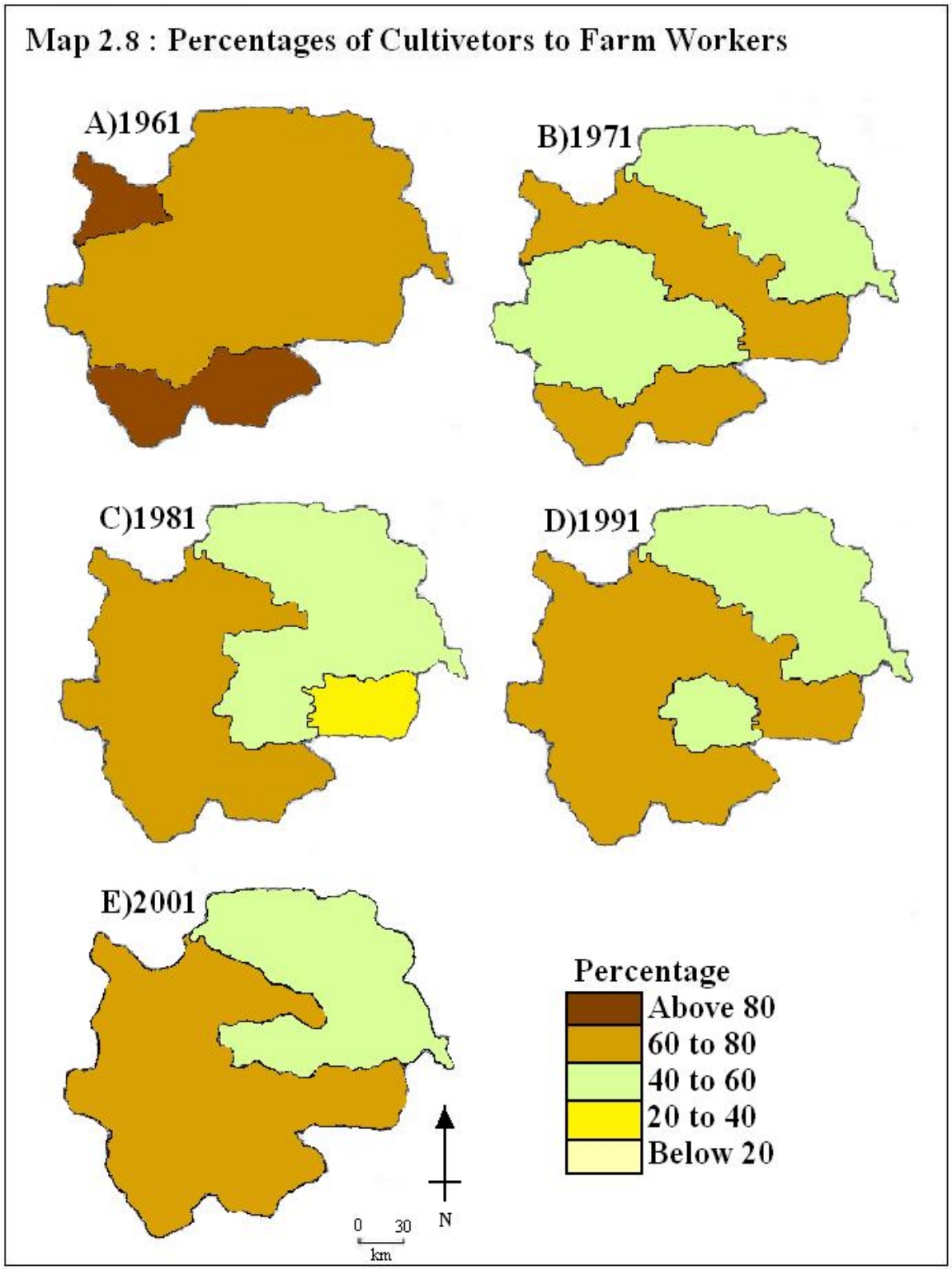

Map 2.7 : Nashik - Percentage of Total Workers to Total Population
A) 1961
B) 1971
C) 1981
D) 1991
E) 2001
Percentage
Above 80
60 to 80
40 to 60
20 to 40
Below 20
N
0 30
Km.

The working population in 2001 was 1732900 persons (34.7 percent to the total population). Map 2.7 shows the spatial distribution of working population for 2001 in the area under study. The remarkable changes in working population are observed as, 20 to 40 percent working population was in Malegaon (30.6%), Nandgaon (35.2%), Yeola (39.8%), Nashik (21.5%), Sinner (38.9%) and Igatpuri (38.1%) and reaming area observed the working population was 40 to 60 percent.

2. B.7: PERCENTAGE OF CULTIVATORS TO FARM WORKERS

Map 2.8 and table 2.14 gives comparative exposition of spatial distribution of percentage of cultivators to farm workers from 1961 to 2001 in the district. The involvement of farm workers in agriculture is significant in the district. It is a major activity. The total cultivators was 965970 persons (72.7 %) in 1961, 380339 (58.8%) in 1971, 380600 (56.2%) in 1981, 685923 (64.2%) in 1991 and 664400 (64.9%) in 2001, shows that the cultivators are decreasing 13.9 percent between 1961 to 1971, 2.6 percent between 1971 to 1981, but the 8 percent cultivators increased between 1981 to 1991 and 0.7 percent increased between 1991 to 2001 in the study area (table 2.13&2.14).

The spatial distribution of cultivators to farm workers in 1961 is shown in map 2.8/A. Surgana, Sinner and Igatpuri have more than 80 percent cultivators to farm workers where as remaining talukas have 60 to 80 percent cultivators to farm workers in the district.


Map 2.8 : Percentages of Cultivetors to Farm Workers
A)1961
B)1971
C)1981
D)1991
E)2001
Percentage
Above 80
60 to 80
40 to 60
20 to 40
Below 20
0 30
km
N

Map 2.8/B, C, D and E display the spatial distribution of percentage of cultivators to farm workers in 1971, 1981, 1991 and 2001 in the district. In 1971, 40 to 60 percent cultivators to farm workers are observed in Satana, Malegaon, Nandgaon, Nashik, Peth, Dindori and Niphad talukas. The high cultivators in percent (40 to 60%) occurred in Nashik (58.8%) , less occurred in Malegaon (48.1%) while 60 to 80 percent cultivators to farm workers are observed in the remaining talukas (map 2.8/B). In this category high cultivators are observed in Igatpuri (77.1%) and less cultivators are observed in Chandwad (61.1%).

In 1981, 36.3 percent cultivators to farm workers are observed in Yeola (map 2.8/C). 40 to 60 percent cultivators to farm workers are observed in Niphad (52.9%), Chandwad (57.5%), Nandgaon (51.1%), Malegaon (47.1%) and Satana (47.6%). While 60 to 80 percent cultivators to farm workers are observed in remaining talukas where high percentage in Igatpuri (75%) and less percentage in Sinner (61.0%).

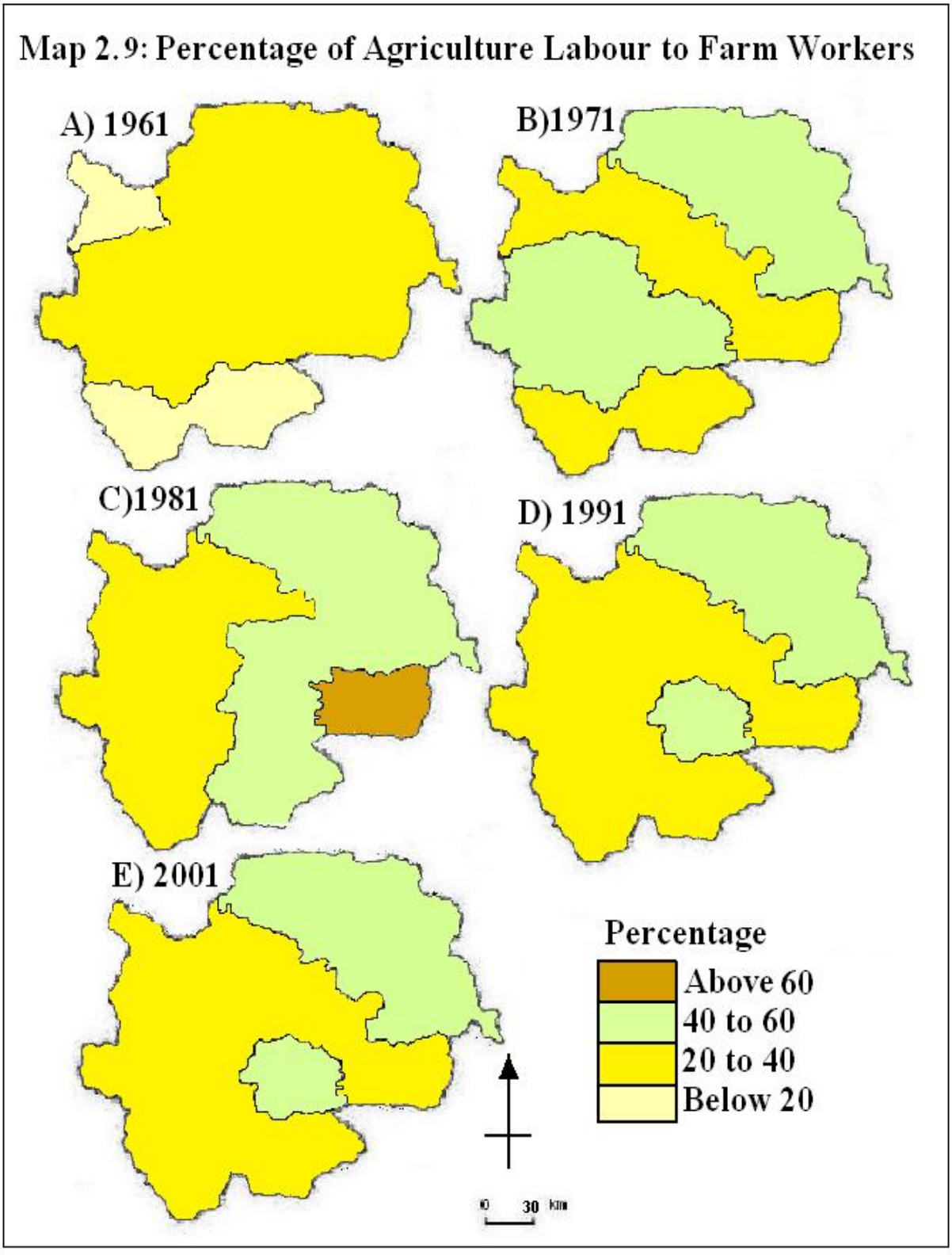
For the year 1991, 40 to 60 percent cultivators to farm workers are observed in Niphad(56.6%), Nandgaon(58.3%), Malegaon (59%) and Satana (58.8%) while remaining talukas observed 60 to 80 percent cultivators to farm workers (map 2.8/D). In this category high percentage are observed in Surgana (75.5%) and less percentage are observed in Kalwan (62.2%). In 2001 (map 2.8/E) shows the similar condition which is observed in 1991. There is no change in the percentage of cultivators to farm workers in the decade 1991 to 2001.

2. B.8: PERCENTAGE OF AGRICULTURAL LABOURS TO FARM WORKERS

The percent of agricultural labours to farm workers have been worked out at taluka level for the district and it was then shown in map 2.9 and table 2.14 for showing spatial distribution of percent of agricultural labour to farm workers from 1961 to 2001. The agricultural labour in percent decreased considerably during study period by 8 percent from 1981 to 1991 and 0.7 percent in 1991 to 2001. The percentage of agricultural labour to total population decreased from 1961 to 2001 (table 2.13).

The spatial distribution of agricultural labour to farm workers is shown in map 2.9/A for 1961 for the district. Surgana, Sinner and Igatpuri have less than 20 Percent agricultural labour to farm workers. Where as remaining talukas have 20 to 40 percent agricultural labour to farm workers. In the group of (20 to 40 percent) high percent of agricultural labours observed in Malegaon (36.3%) and less percent is observed in Kalwan and Yeola (23.5%).

Map 2.9/B, C, D and E display the spatial distribution of agricultural labour to farm workers in 1971, 1981, 1991 and 2001. In 1971, 20 to 40 percent agricultural labours to farm workers are observed in Surgana, Kalwan, Chandwad, Yeola, Sinner and Igatpuri. While 40 to 60 percent agricultural labours to farm workers are observed in the remaining talukas (map 2.9/B). In 1981 more than 60 percent agricultural labor to farm workers are observed in Yeola (63.7%), 40 to 60 percent agricultural labor to farm workers are observed in Sinner, Niphad, Chandwad, Nandgaon, Malegaon and Satana, while in remaining tahsils

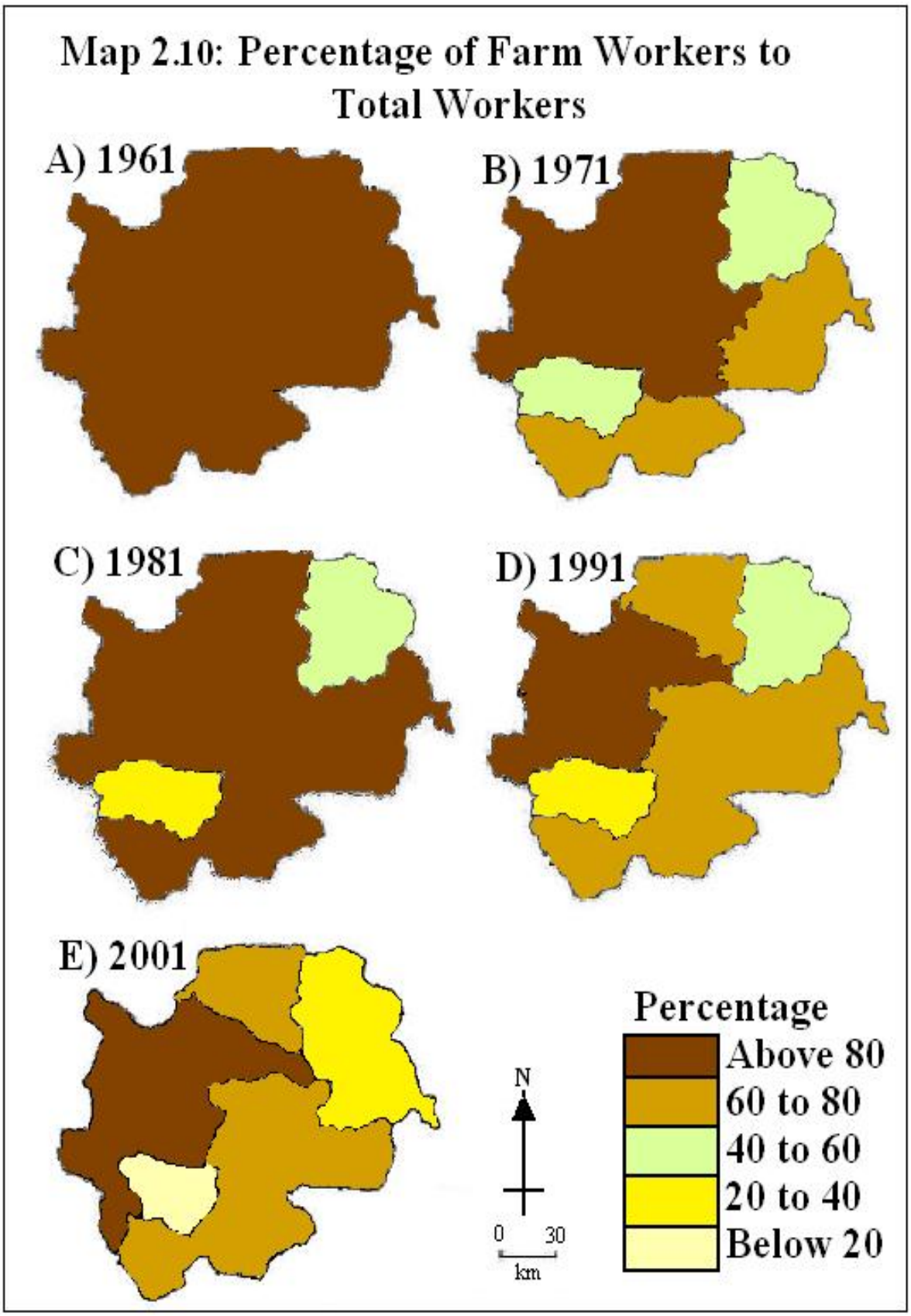

Map 2.9: Percentage of Agriculture Labour to Farm Workers
A) 1961
B)1971
C)1981
D) 1991
E) 2001
Percentage
Above 60
40 to 60
20 to 40
Below 20
0 30 km

are observed 20 to 40 percent agricultural labor to farm workers (map 2.9/C). In the years 1991 and 2001, shows similar condition of the percentage of agricultural labor to farm workers (Map 2.9/D&E). Niphad, Nandgaon, Malegaon and Satana shows 40 to 60 percent agricultural labour to farm workers while remaining part shows 20 to 40 percent agricultural labour to farm workers.

2. B.9: PERCENTAGE OF FARM WORKERS TO TOTAL WORKERS

The Nashik district is predominantly agricultural in nature. More than 60 percent working population is engaged in agricultural activity (table 2.14). The percentage of farm workers to total workers is observed 91.2 percent in 1961, it decrease up to the 20.5 (70.7 %) percent in 1971, in 1981 it was increased 6.7 percent (77.4%) but in 1991 and 2001 the percentage of farm workers to total workers goes on decreased by 13.8 and 4.6 percent. The spatial distribution of farm workers to total workers is shown in map 2.10 and table 2.14. The farm workers including the cultivators and agricultural labours whereas; workers refer to participation in economically productive activity (mental and physical) as well as supervision and direct work.

Map 2.10/A shows the spatial distribution of farm workers for 1961 in the area under study. There 1329039 farm workers in the region (91.2 percent to total workers).It is observed from this map that more than 80 percent farm workers to the total workers are in agricultural practice in the district.


Map 2.10: Percentage of Farm Workers to Total Workers
A) 1961
B) 1971
C) 1981
D) 1991
E) 2001
N
0
30
km
Percentage
Above 80
60 to 80
40 to 60
20 to 40
Below 20

In 1971, the district has 646552 (70.7 %) farm workers. The percentage of farm workers has decreased up to 20. 5 percent. More than 80 percent farm workers to total workers has found in seven talukas in the district (map 2.10/B). There are 40 to 60 percent farm workers in Nashik and Malegaon tahsils and 60 to 80 percent are in Yeola, Sinner and Igatpuri tahsils.

In 1981 and 1991, 20 to 40 percent farm workers were in Nashik and 40 to 60 percent farm workers in Malegaon tahsil for the same year (map 2.10/ C&D). In 1981 Nandgaon observed 71.2 percent farm workers while remaining talukas have more than 80 percent farm workers to the total workers. In 1991 Peth, Surgana, Dindori and Kalwan found more than 80 percent farm workers while remaining talukas observed 60 to 80 percent farm workers to the total workers.

In 2001, the district has 1022900 farm workers. The percentage of farm workers to total workers has decreased 32.2 percent from 1961 to 2001 (table 2.14). Map 2.10/E shows the spatial distribution of farm workers to total workers for 2001. Nashik has observed less than 20 percent farm workers to the total workers while Malegaon and Nandgaon found 20 to 40 percent farm workers to total workers. Yeola, Chandwad, Niphad, Sinner and Igatpuri has 60 to 80 percent while Deola, Kalwan, Dindori, Surgana, Peth and Trimbak found more than 80 percent farm workers to the total workers.

2. B.10: PERCENTAGE OF FARM WORKERS TO TOTAL POPULATION

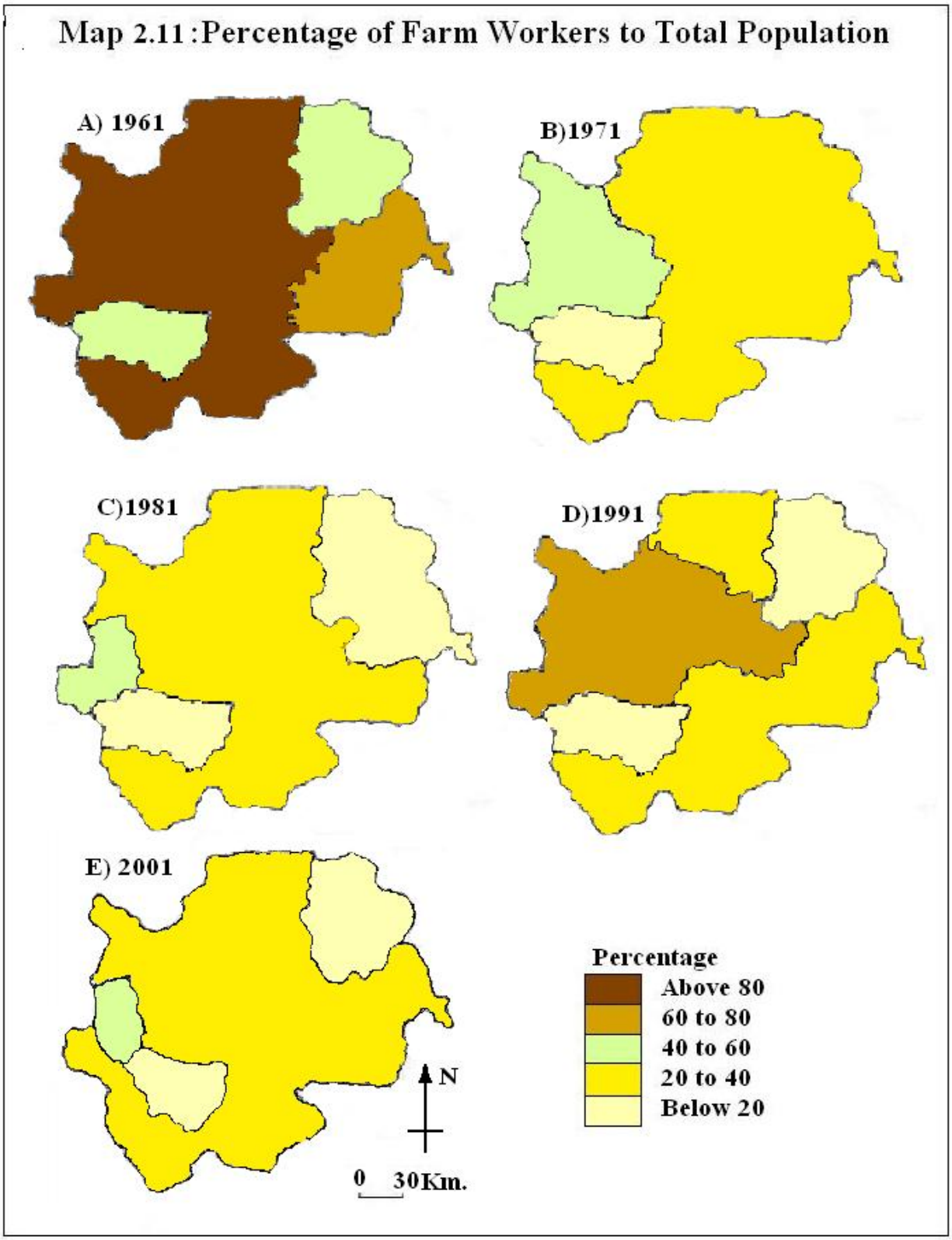
Map 2.11 shows the comparative exposition of spatial distribution of percentage of farm workers to total population from 1961 to 2001. In 1961 the percentage of farm workers to

total population was 71.6. In 2001 the percentage of farm workers to total population is only 20.5 and it decreased by 51.1 percent (table 2.14).

In 1961, 40 to 60 percent farm workers to the total population observed in Nashik and Malegaon while Nandgaon and Yeola has 60 to 80 percent farm workers and remaining part observed more than 80 percent farm workers to the total population (map 2.11/A). In 1971 Nashik has less than 20 percent farm workers while Dindori, Peth and Surgana observed 40 to 60 percent farm workers and remaining area shows 20 to 40 percent farm workers to the total population (map 2.11/B).

Map 2.11/C show less than 20 percent farm workers to the total population in Nashik, Nandgaon and Malegaon (1981), Peth has 40.3 percent farm workers while remaining talukas observed 20 to 40 percent farm workers to the total population . Same changes are found in 1991 as compared to 1981. Nashik and Malegaon has less than 20 percent farm workers while Peth, Surgana, Dindori, Kalwan and Chandwad has 40 to 60 percent farm workers and remaining talukas found 20 to 40 percent farm workers to the total population in 1991 (map 2.11/D).

In 2001, there was only 20.5 percent farm workers to the total population have observed in the study area. Map 2.11/E shows the clear picture of farm workers to the total population in 2001. In this year Peth have maximum percentage (40.2 %) of farm workers, while Nashik (3.3%) and Malegaon (14.4%) shows very less percentage of farm workers to the total population. Remaining part of the district has found 20 to 40 percent farm workers to the total population in 2001.


Map 2.11 :Percentage of Farm Workers to Total Population
A) 1961
B)1971
C)1981
D)1991
E) 2001
Percentage
Above 80
60 to 80
40 to 60
20 to 40
Below 20
N
0 30Km.

2. B.11: IRRIGATION

The importance of water-supply in agriculture to achieve the goal of increased food production. The irregular and uneven rains prove the major obstacles towards self-sufficiency in food production. Hence there is need of irrigation facilities in the agricultural pattern. Irrigation is not only helps to increase food production but also enables to bring more barren land under wet crops and facilitates double cropping.

Wells and cannel irrigation depends on local rainfall. In 1961Well and cannel irrigation extends over 43748 hectors. It is rapidly increased up to 170800 hector in 2001. It is pretty general throughout the plains especially in Satana, Sinner, Nashik, Chandwad and Niphad. Table 2.15 shows the types of irrigation and area under irrigation from 1961 to 2001.

Table 2.15: Irrigation in Nashik District from 1961 to 2001

(Area in hectors)

Sr.No.	Category	1961	1971	1981	1991	2001
1	Cannel	16957	26000	25000	18000	11523
2	Well	26791	57000	71000	104000	136830
3	Total	43748	83000	96000	122000	148353
	NSA	920210	859501	845709	858333	837793

NSA = Net Sown Area (Source: Socio-Economic Abstract: Nashik)

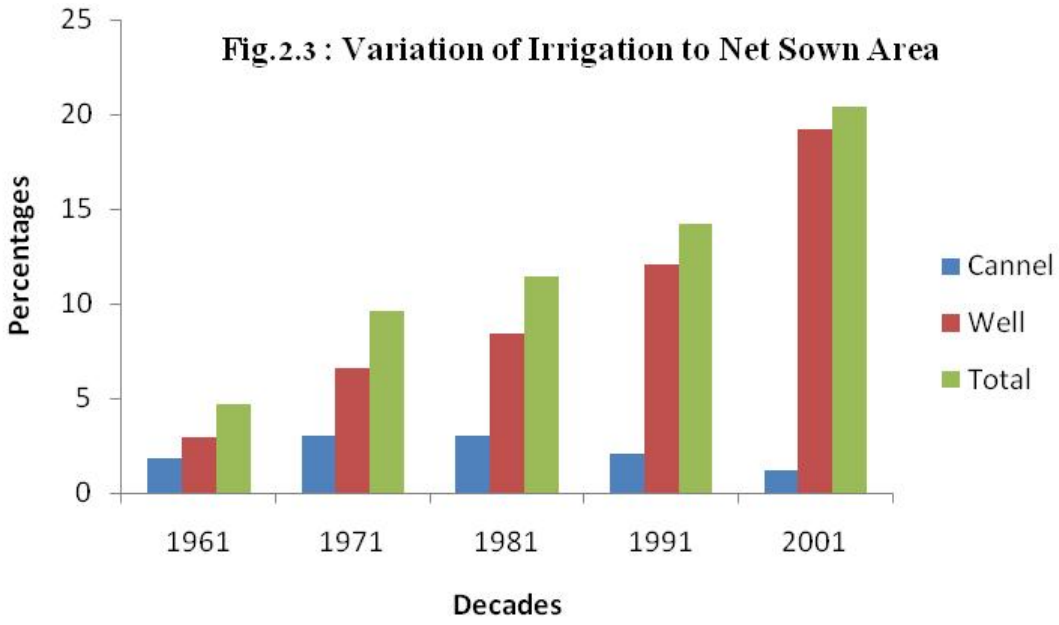
In 1961, total irrigated area was 43748 hectors; it reaches up to 148353 hectors in 2001. Table 2.16 shows the spatial variation of irrigation to net sown area in the district from 1961 to 2001. Cannel irrigation not increased as compared to well

Table 2.16: The Variation of Irrigation to Net Sown Area

Sr.No.	Category	1961	1971	1981	1991	2001
1	Cannel	1.8	3.0	3.0	2.1	1.4
2	Well	2.9	6.6	8.4	12.1	16.3
3	Total	4.7	9.6	11.4	14.2	17.7

(Source: By the Researcher)

irrigation. In 1961, 1.8 percent cannel irrigation observed to net sown area. It increased 1.2 percent in 1971 and 1981. But in 1991 and 2001 this type of irrigation goes on decreased. While well irrigation gradually



increased from 1961 to 2oo1 (fig. 2.3) as well as total irrigation area is increased throughout the study area and period. In 1961 the percentage of total irrigation area to net sown area is 4.7 percent (43748 hectors); it increased up to 17.7 percent to the net sown area in 2001.

The chief irrigated crops in the district are sugarcane, rice, wheat, millet, gram, lentils, groundnuts, chilies, grapes, guavas, pomegranates, plantains and vegetables etc. The small works,

mostly under the collector and managed by the people, are 906 weirs, bandharas on the Godavari's and Tapi's tributaries. Out of them 274 are permanent and the rest are renewed every year. Most of these weirs were made by the villagers from 50 to 150 years ago. In most villages where there are cannels, there is under the headman, a hereditary officer called a channel-keeper, or patkari who regulates the supply of water.

2. B.12: MARKETING

The study of marketing is imperative in agriculture geography. It extends selling and purchasing facilities to agricultural commodities. The numerous activities in agriculture seed purchasing and selling goods there is need of market facility. Multifunction is imperative in modern commercial economy because it reflects the surplus and deficit of total agriculture products. Hence, an attempt has been made to examine the spatial distribution of market in the Nashik district.

Generally, there are two types of market, i.e. weekly and daily/regulated market. The district has been wide distribution of weekly and daily markets. The ratio of daily market to weekly market is up to 1:5. Map 2.12 shows the location of daily markets in Nashik district and it spreads throughout the region. Maximum daily markets are located in Niphad taluka (8 places), then Malegaon (5 places), Sinner (places 4), Chandwad (3 places), Nandgaon (3 places) as well a s Nashik, Dindori, Kalwan, Satana, Yeola, Igatpuri observed two each daily market centers while Deola and Trimbak has one each regulated market.

Table 2.17: Weekly and Regulated Markets

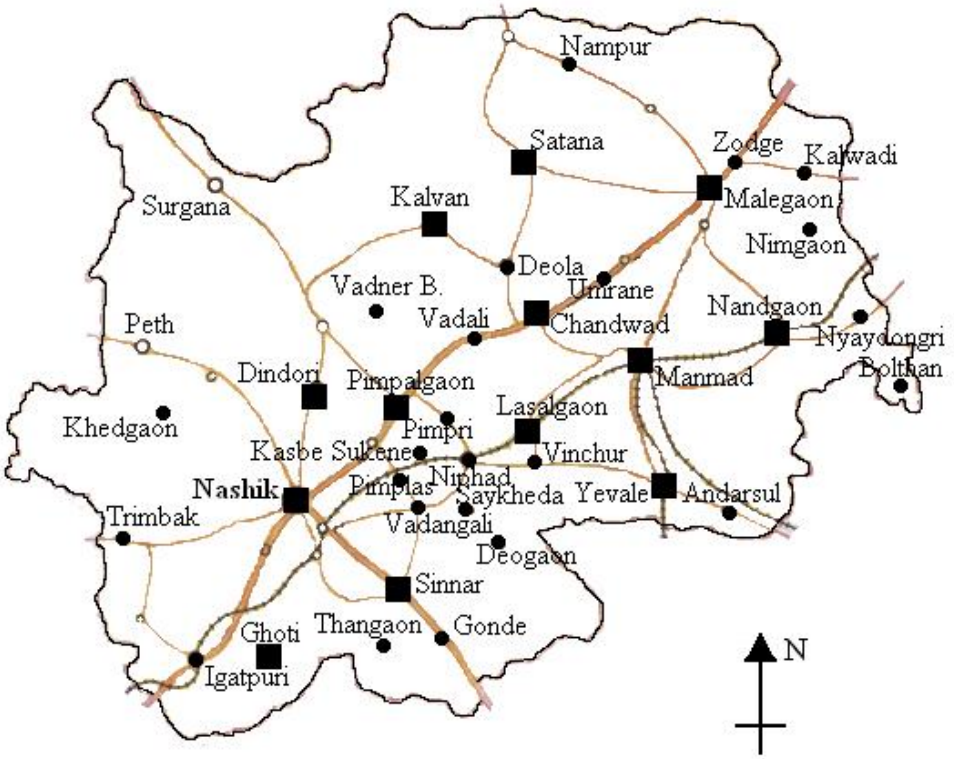
Sr. No.	Type of Market	Days	No. of Villages/ Places
A	Weekly Markets	1.Monday	19
		2.Tuesday	26
		3.Wednesday	19
		4.Thursday	21
		5.Friday	16
		6.Saturday	14
		7.Sunday	43
		Total	158
B	1. Daily /Regulated Markets		13
	2. Sub-Markets (Daily /Regulated)		24
		Total	37

(Source: Research Student)

Nashik district has not lagged than the other districts in western Maharashtra in the field of regulation of agricultural markets. Lasalgaon was the first market to be regulated in the district in 1947. This was followed by Malegaon (1948), Satana (1948) and Nandgaon (1948). At present there are 13 regulated markets and 24 sub regulated markets (map 2.12).

Table 2.17 shows the distribution of weekly markets in Nashik district and it spread all over the region. The weekly market performs socio-economic function. The main function that is served by weekly market is to distribute goods to consumers in the surrounding villages. There are 158 places holding such markets nearly three to five km area. The sequence

MAP 2.12: NASHIK- MARKET CENTRES.



of market days among the villages is best adjusted so as to reduce the competition in the surrounding area in the district. It is obvious from table 2.17 that Sunday is fixed for 43 places, followed by Tuesday is fixed by 26 places, while Monday and Friday 16 and Saturday is fixed for 14 places.

2. B.13: 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 (Date, 1983). Such improvement and change in frequency, speed and capacity indicate the changes in traditional agriculture patterns. From this point of view, it would be necessary to examine the existing means of transport in Nashik district. The Nashik district has two types of transport viz., roadways and railways, both covering 14156 kms length in the study region.

The area under study has dense linkages of roadways and railways (map 2.13). The railway plays a significant role in collecting and distributing agricultural products. Five types of roadways appear in the district, namely National Highway (NH), State Highway (SH), Major District Highway (MDR), Other District Highway (ODR) and Village Road or Kachcha Roads (VR).The total length of roadways in the district is 13899.00Kms (table 2.18). The length of roads in Nashik district has 236 Kms; National Highway, viz. Mumbai-Agra road (186 Km in the district) and Nashik-Pune (48 Km in the district) those are metalled roads and national highway while the state highway

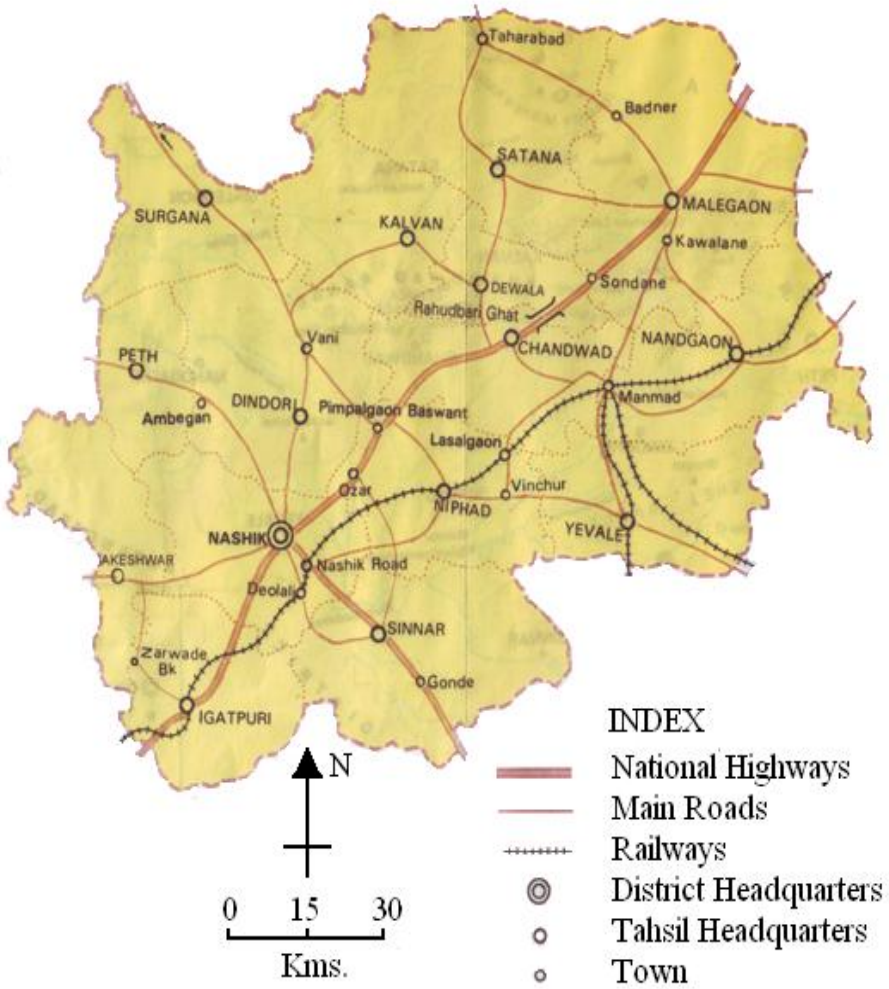
length in Nashik district is 1727 Km length in the district. The major district roads and other district roads show a wide network of transportation with the study area. These roadways are linked to distance villages, either by metalled or unmetalled roads. The total length of major district roads and other district roads are 2285 Kms and 2361 Kms respectively in the district. The village roadways are kachcha in nature and are linked to major district roads and other district roads. Some kachcha roads are unsuited for transportation in the monsoon season because it becomes dirty and muddy and hence it reduces the transportation. The most common and traditional modes of transport is bullock carts and tractors in the villages to collect and distribute the agricultural products. Trucks are occasionally used for transportation.

Table 2.18: Route Length of Nashik District

Sr.No.	Type	Route Length (Km.)
A	**Roads**	
I	National Highway	236.00
II	State Highway	1727.00
III	Major District Road	2285.00
IV	Other District Roads	2361.00
V	Village Roads	7290.00
	Total	13899.00
B	**Railways**	
I	Broad Gauge	203.00
II	Meter Gauge	54.00
III	Narrow Gauge	Nil
	Total	257.00

(Source: Socio-Economic Abstract, Nashik District 2001)

MAP 2.13 : NASHIK DISTRICT - MAIN ROADS AND RAILWAYS



It is observed that maximum villages are linked by S. T. bus services of minimum two frequencies to each village. In rainy season the frequency of ST bus service reduced to distinct and interior villages in the district due to kachha road which are badly affected in the season.

The limited network of railway appears in the district. Manmad is the railway junction while Mumbai-Delhi-Kolkata broad gauge railway passes through the district and covering 203 km length. Manmad-Pune, Aurangabad is the meter gauge

railway line covering 54 km. length. This railway is much significant from agricultural point of view.

2. B.14: LAND HOLDING

The land holding is one of the aspects influencing on agriculture landuse patterns. The easy applications of inputs are possible if the size of land holdings is large and extensive. Nashik district, like other regions has heavy pressure of growing population coupled with the customary laws of inheritance has resulted in subdividing agricultural plot into small holding. 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, pest control in proper time, and limitations for mechanization and experimentation, therefore small sizes of land holdings have adverse effect on efficient land utilization. Moreover, it is observed that the average size of land holding in the district is 2.52 hectares. The unequal and uneconomic small size land holdings are observed in western part of the basin resulted backward agriculture. It is, therefore, needed to consolidate the land for efficient landuse in entire district.

2. B.15: AGRICULTURAL IMPLEMENTS

The timely availability of agricultural implements and its proper use in the process of agricultural operation is imperative for proper and efficient landuse in any region. Nashik like other regions district is apply numerous agricultural implements in ploughing, harrowing, leveling, ridging, hoeing and intercultivation. The common implements used in agriculture operation in the district are iron plough, wooden plough, harrow,

Bakhar, Kolpa, Kurhad, Pawada, Khurpi, Vila (Sickle), and Koyata. The use of implements in agricultural operation indicates the level of farming and resulted level of agriculture in the region. It is observed that the small land holding farmers generally lack of required and essential implements which are borrowed from neighbors' for time being, while large land holding farmers own themselves most of the agricultural implements and has found in improved village due to timely available implement for application in the field.

Chapter 3

IRRIGATION

3.1: INTRODUCTION

The multiplicity is mostly interrelated to physico-socio-economic factors, and having considerable impact on irrigation. But all of them are not equally affecting on the areal variations and temporal development of agricultural phenomenon in an area. To avoid dissipating one's efforts, it is desirable to choose the primary, decisive factors that may be of major importance in causing spatial and temporal variations. Water is one of the important and scarce inputs besides fertilizers, insecticides, high yielding seeds and modern technology for agricultural development. Thus irrigation is the main axis around which the whole agricultural activity revolves. Under this situation of low rainfall and its high variation in nature, the development of artificial means of moisture supply is very essential. The supply of water is depending upon availability of water resources. Ecological environment may limit the range of crops but the human factors determine which of the feasible crops. The farmers will choose and the input intensity with which his farms. Irrigation increases the range and the choice of ecological feasible crops on the farm and raises the practicability and profitability levels of inputs.

Nashik district has very limited water resources. The source of water is surface and under ground water. The surface and under ground water resources are harnessed by constructing major, medium and minor irrigations schemes across rivers and streams of the district, such as Godavari, Girna, Kadva, Punad, Aram, Mosam, Panjan, Maniad, Kashypi, Darna, Valdevi and Banganga.

Besides tanks and dams, minor irrigation also comprises construction of check dams, percolation tanks and ground water wells.

3.2: SURFACE WATER

Surface water is provided by the flowing rivers or from the still water of tanks, ponds and artificial reservoirs. Irrigation from rivers is mainly through canals, drawn from dams constructed across the rivers. When the dam is high enough to form a large reservoir, the water is available throughout the year. The possibilities of developing the normal flows of rivers into irrigation canals. Tanks are mostly rain fed. They depend for their replenishment on the surrounding drainage area and watersheds.

A characteristic feature of the surface flow in Nashik district there is well defined natural drainage system. It consists of two main drainage systems; The Konkan drainage system which flow west into the Arabian Sea and eastward natural drainage system (Godavari and Girna drainage system) which flows into the Bay of Bengal.

Innumerable small streams flow down the Western scarp of the Sahyadris draining towards the Arabian Sea. Nar, Par, Damanganga, Vaitarna, Bhima etc. are the most important Konkan Rivers. Girna basin in Nashik district is one important drainage system. In this catchment area the Punad, Aram, Mosam, Panjan, Manyad etc. tributaries joins to the river Girna. These are the main tributaries of River Girna. Finally Girna joins the river Tapi and meets to the Arabian Sea. Godavari basin is most important drainage system in Nashik district. Kashypi, Darna, Valdevi; Banganga etc. are the well known tributaries of

Godavari. Godavari drainage system flows into the Bay of Bengal.

3.3: UNDER GROUND WATER

Underground water is tapped by digging or drilling wells. In this case the lifting of water is necessary before it is used for irrigation. When the development of irrigation technology, never and more efficient methods are employed for water lifting from the underground water source. Tub well irrigation makes intensive cultivation wherever water is available in required quantities whenever desired depending upon the regularity of energy sources. Particularly, it has proved admirably suited to sub-marginal, marginal and small operational holdings.

3.4: SOURCES OF IRRIGATION

Canal and well are the major sources of irrigation in Nashik district. The percentage of irrigated area was worked out by dividing net sown area by individual source. The percentages were worked out into four categories i.e. low; medium, high and very high (Table 3.1).

Table 3.1: Irrigation by Sources

Sr.No.	Range of percentage according to		Category
	Canal	Well and Tub wells	
1	Above 15	Above 30	Very High
2	5.00 to 14.99	20.00 to 29.99	High
3	Below 5	10.00 to 19.99	Medium
4	Nil	Below 10	Low

3.5: CANAL IRRIGATION

Canal is one of the sources of irrigation which counted for 2.97, 2.11 and 1.38 percent area under net sown area during 1980-81, 1990-91 and 2000-01 respectively.

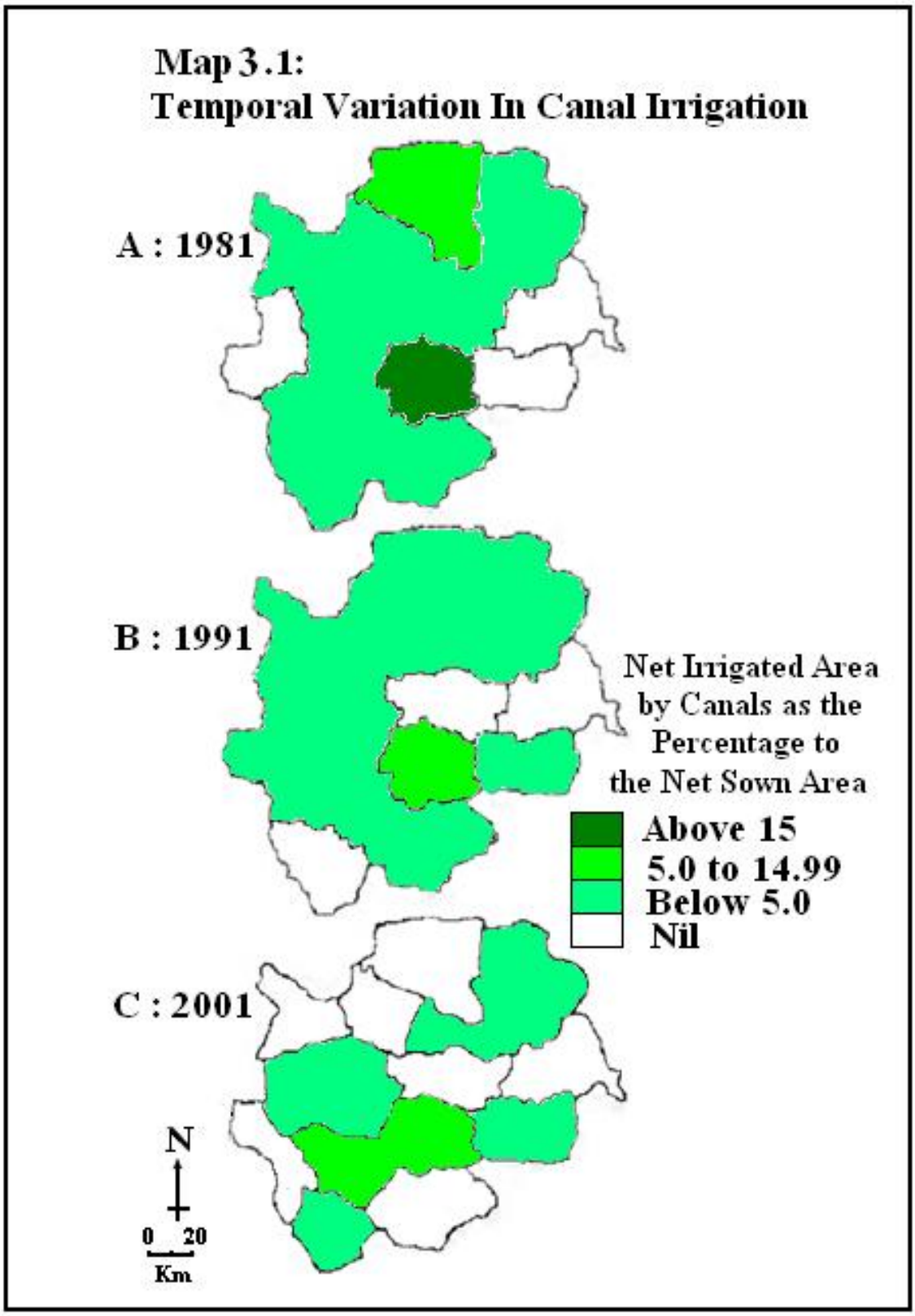
The different categories have been shown in map 3.1. It is revealed that low category of canal irrigation was observed in three tahsils, viz. Peth, Nandgaon and Yeola during 1980-81(map 3.1A).While medium category of canal irrigation (i.e. Percentage of Net Canal Irrigated Area to Net Sown Area) was observed in majority of tahsils, viz. Surgana (0.05%), Igatpuri (0.09%),Chandwad (0.29%), Kalwan (0.80%),Dindori (0.83%), Malegaon (1.91%), Sinner(1.99%) and Nashik (3.7%). High category of canal irrigation was observed in one tahsil i.e. Satana (5.5%) and Niphad (16.16 Percentage of Net Canal Irrigated Area to Net Sown Area) having very high category of canal irrigation during 1980-81 (Map 3.1A &Table 3.2).

Map 3.1B revealed that low category of canal irrigation was observed in three tahsils, viz. Chandwad, Nandgaon and Igatpuri during 1990-91.While medium category of canal irrigation (i.e. Percentage of Net Canal Irrigated Area to Net Sown Area) was observed in majority of tahsils, viz. Satana (0.47%), Kalwan (0.48 %), Yeola (0.55%), Surgana (1.32%), Peth (1.43%), Dindori (1.63%), Sinner(1.87 %),and Nashik (2.07%)and Malegaon (2.35%). High category of canal irrigation was observed in one tahsil i.e. Niphad (13.2%).

Table 3.2: Tahsilwise Temporal Variation in Canal Irrigation

Tahsil	Percentage of Net Canal Irrigated Area to Net Sown Area			Changes (1981 to 2001)
	1980-81	1990-91	2000-01	
Nashik	3.7	2.07	0.00	-3.70
Peth	0.0	1.43	1.28	+1.28
Dindori	0.83	1.63	1.30	+0.47
Surgana	0.05	1.32	0.00	-0.05
Kalwan	0.80	0.48	0.00	-0.80
Satana	5.50	0.47	0.00	-5.50
Malegaon	1.91	2.35	0.10	-1.81
Chandwad	0.29	0.00	0.00	-0.29
Nandgaon	0.00	0.00	0.00	0.00
Yeola	0.00	0.55	3.07	+3.07
Niphad	16.16	13.2	10.36	-5.80
Sinner	1.99	1.87	0.00	+1.99
Igatpuri	0.09	0.00	0.67	+0.58
Trimbak	--	--	0.00	0.00
Deola	--	--	0.18	--
Total	2.97	2.11	1.38	-1.59

(Source: Socio-Economic Abstract- Nashik District)


Map 3.1:
Temporal Variation In Canal Irrigation
A : 1981
B : 1991
C : 2001
Net Irrigated Area by Canals as the Percentage to the Net Sown Area
Above 15
5.0 to 14.99
Below 5.0
Nil
N
0 20
Km

Map 3.1C revealed that low category of canal irrigation was observed in majority of tahsils, viz. Nashik, Surgana, Kalwan, Satana, Chandwad, Nandgaon, Sinner and Trimbak. While medium category of canal irrigation (i.e. Percentage of Net Canal Irrigated Area to Net Sown Area) was observed in six tahsils viz. Malegaon (0.1 %),Deola (0.18%), Igatpuri (0.67 %),Peth (0.1.28 %), Dindori (1.3%), and Yeola (3.07%). High category of canal irrigation was observed in one tahsil i.e. Niphad (10.36%) 2000-01 (Map3.1C &Table 3.2).

3.5.1: Variation of canal irrigation

Tahsilwise variation of canal irrigation in Nashik district comes to -1.59 percent. Out of all 15 tahsils, in six tahsil canal irrigation is decreasing (-5.8to -0.05 percent). Rest 5 tahsils of the study region irrigation is increasing between +0.47 to and 3.07 percent. However the highest increasing of irrigation is obvious in Yeola tahsils (3.07%), while Surgana tahsils records lowest negative variation (-0.05 %) during the study period (table 3.2).

3.6: WELL IRRIGATION

Well irrigation is the most important source of irrigation. Area was irrigated from well, 8.40, 12.12 and 16.33 percent during 1980-81, 1990-91 and 2000-01 respectively. The percentage of well irrigated area to net sown area goes on increase (7.93 %) during 1980-81 and 2000-01. The different categories under well and tub well irrigation is shown in map 3.2. It is revealed that low category of well irrigation was observed in majority of tahsils, viz. Peth (0.04%), Surgana (0.04%), Igatpuri (1.93%), Nandgaon (4.96%), Satana (5.45%), Dindori (5.75%), Nashik (6.75%), Malegaon (7.25%), Sinner (7.48%), Chandwad

(7.78%) and Kalwan (8.53%) during 1980-81(map 2A).While medium category of well irrigation (i.e. Percentage of Net well Irrigated Area to Net Sown Area) was observed in one tahsils, viz. Yeola(11.02%). Niphad (28.15% Percentage of Net Canal Irrigated Area to Net Sown Area) having high category of well irrigation during 1980-81 (Map 3.2A &Table 3.3).

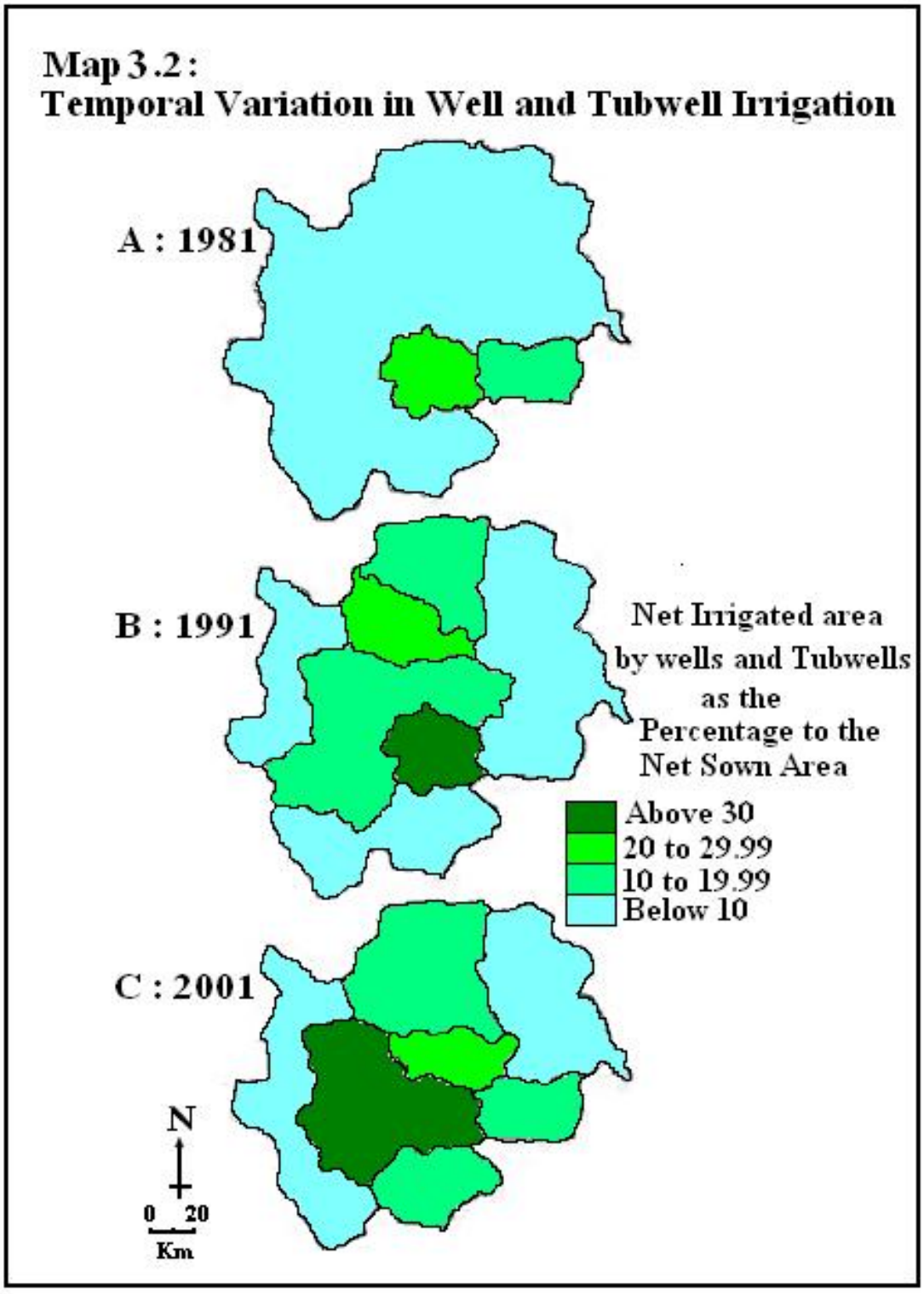
Map 3.2B revealed that low category of well irrigation was observed in seven tahsils, viz. Peth (0.11%), Surgana (2.23%), Igatpuri(2.26%), Malegaon (4.95%), Nandgaon (8.63%), Yeola (8.83%) and Sinner (9.01%) during 1990-91.While medium category of well irrigation (i.e. Percentage of Net well Irrigated Area to Net Sown Area) was observed in four tahsils, viz. Satana (12.45%), Chandwad (12.62%), Nashik (16.09%)and Dindori (16.75). High category of well irrigation was observed in one tahsil i.e. Kalwan (25.34%). While Niphad (32.4%) having very high category of well irrigation during 1990-91(Map 3.2B &Table 3.3).

Map 3.2C revealed that low category of well irrigation was observed in majority of tahsils, viz. Peth (0.19%), Surgana (0.46%), Igatpuri (1.82%), Trimbak (2.9%), Nandgaon (7.4%) and Malegaon (8.41%). While medium category of well irrigation (i.e. Percentage of Net Canal Irrigated Area to Net Sown Area) was observed in six tahsils namely, Kalwan (12.33%), Satana (14.81%), Dindori (16.76%), Yeola (17.53%), Deola (17.83%), and Sinner (18.84%). High category of well irrigation was observed in one tahsil i.e. Chandwad (25.09 % While Niphad

Table 3.3: Temporal Variation in Well and Tub well Irrigation

Tahsil	Percentage of Net Well and Tub well Irrigated Area to Net Sown Area			Changes (1981 to 2001)
	1980-81	1990-91	2000-01	
Nashik	6.75	16.09	72.01	+65.26
Peth	0.04	0.11	0.19	+0.15
Dindori	5.75	16.75	16.76	+11.01
Surgana	0.04	2.23	0.46	+0.42
Kalwan	8.53	25.34	12.33	+3.38
Satana	5.45	12.45	14.81	+9.36
Malegaon	7.25	4.95	8.41	+1.16
Chandwad	7.78	14.62	25.09	+17.31
Nandgaon	4.96	8.63	7.40	+2.44
Yeola	11.02	8.83	17.53	+6.51
Niphad	28.15	32.4	37.23	+9.08
Sinner	7.48	9.01	18.84	+11.36
Igatpuri	1.93	2.26	1.82	-0.11
Trimbak	--	--	2.90	--
Deola	--	--	17.83	--
Total	8.40	12.12	16.33	+7.93

(Source: Socio-Economic Abstract- Nashik District)


Map 3.2 :
Temporal Variation in Well and Tubwell Irrigation
A : 1981
B : 1991
C : 2001
Net Irrigated area by wells and Tubwells as the Percentage to the Net Sown Area
Above 30
20 to 29.99
10 to 19.99
Below 10
N
0 20
Km

(37.23 %) and Nashik (72.01%) tahsil having very high category of well irrigation during 2000-01 ((Map 3.2C &Table 3.3).

3.6.1: Variation of well irrigation

Tahsilwise variation of well and tub well irrigation for the region as a whole is +7.93 percent. All tahsils records positive variation in well and tub well irrigation. Nashik tahsil of the study region records highest (+65.26%) positive variation in well irrigation. However the highest positive variation is obvious in Chandwad (17.31%) Sinner (11.36%) and Dindori (11.01%) tahsils. Igatpuri tahsil records lowest negative variation (-0.11%) during the study period (table 3.3).

3.7: INTENSITY OF IRRIGATION

In order to delineate the use pattern of irrigation facilities in Nashik district, intensity of irrigation is calculated by using the following formula as adopted by Jasbir Singh (1976).

$$Ii = \frac{NI}{NA} \times 100$$

Where, Ii = Intensity of Irrigation
NI = Net irrigated area
NA= Net Sown area

The index of intensive irrigation is calculated for the year 1980-81, 1990-91 and 2000-01. The index of intensity of irrigation is divided into five different ranges i.e. Below 10, between 10.00 to 19.99, 20.00 to 29.99, 30.00 to 39.99 and above 40.00 which can be represented very low, low, medium, high and very high intensity of irrigation. Similarly index of intensive irrigation is divided into five different ranges i.e. Below 110.00. 110.00 to 129.99, 130.00 to 149.99, 150.00 to 169.99 and Above

170.00 which represented very low, low, medium, high and very high category of intensive irrigation (Table 3.4).

Table 3.4 :

Intensity of irrigation and Index of intensive irrigation

Sr. No.	Range		Category of intensity
	Intensity of irrigation	Index of intensive irrigation	
1	Above 40.00	Above 170.00	Very High
2	30.00 to 39.99	150.00 to 169.99	High
3	20.00 to 29.99	130.00 to 149.99	Medium
4	10.00 to 19.99	110.00 to 129.99	Low
5	Below 10.00	Below 110.00	Very low

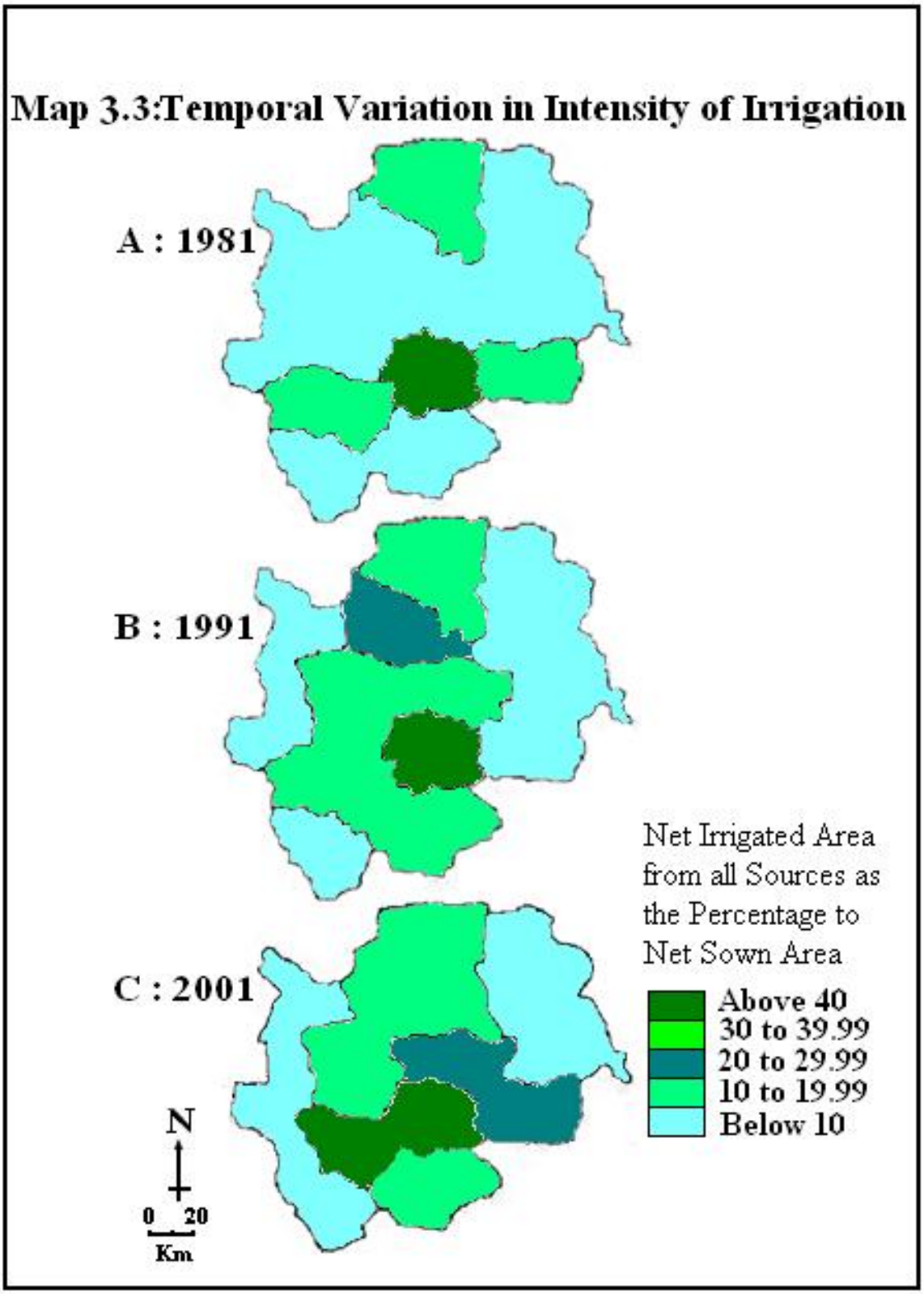
The intensity of irrigation was, 11.37, 14.23 and 17.71 during 1980-81, 1990-91 and 2000-01 respectively. The intensity of irrigation increased (6.34) from 1980-81 to 2000-01. The different categories of intensity of irrigation in different tahsils of Nashik district is shown in map 4.3 (Table 3.4). Peth, Surgana, Igatpuri, Nandgaon, Dindori, Chandwad, Malegaon, Kalwan and Sinner formed very low category during 1980-81. Low category was observed in Nashik, Satana and Yeola tahsils whereas medium and high category was not found in the district during 1980-81, while very high category registered in only Niphad Tahsil (Map 3.3A).

During 1990-91 six tahsils have changed their categories. Out of these six tahsils, viz. Nashik, Dindori, Kalwan, Chandwad, and Sinner indicated increased irrigation intensity while Yeola tahsil registered decreased irrigation intensity (map 3.3B). Peth, Igatpuri, Surgana, Malegaon, Nandgaon and Yeola formed very

Table 3.5: Temporal Variation in Intensity of Irrigation

Tahsil	Percentage of Net Irrigated Area to Net Sown Area **(Intensity of Irrigation)**			Changes (1981 to 2001)
	1980-81	1990-91	2000-01	
Nashik	10.45	18.16	72.01	+61.56
Peth	0.04	1.54	1.47	+1.43
Dindori	6.58	18.38	18.06	+11.48
Surgana	0.09	3.55	0.46	+0.37
Kalwan	9.33	25.82	12.33	+3.00
Satana	10.95	12.92	14.81	+3.86
Malegaon	9.16	7.30	8.51	-0.65
Chandwad	8.07	14.62	25.09	+17.02
Nandgaon	4.96	8.63	7.40	+2.44
Yeola	11.02	9.38	20.6	+9.58
Niphad	44.31	45.60	47.59	+3.28
Sinner	9.47	10.88	18.84	+9.37
Igatpuri	2.02	2.26	2.49	+0.47
Trimbak	--	--	2.90	--
Deola	--	--	18.01	--
Total	11.37	14.23	17.71	+6.34

(Source: Socio-Economic Abstract- Nashik District)


Map 3.3:Temporal Variation in Intensity of Irrigation
A : 1981
B : 1991
C : 2001
Net Irrigated Area from all Sources as the Percentage to Net Sown Area
Above 40
30 to 39.99
20 to 29.99
10 to 19.99
Below 10
N
0 20
Km

low irrigation intensity during 1980-81. Low irrigation intensity was observed in Sinner, Satana, Chandwad, Nashik and Dindori tahsils whereas medium and very high irrigation intensity is registered in Kalwan and Niphad tahsils.

During 2000-01 four tahsils have changed their categories. Out of these four tahsils, viz. Nashik, Chandwad, and Yeola indicated increased irrigation intensity while Kalwan tahsil registered decreased irrigation intensity (map 3.3C). Surgana, Peth, Igatpuri, Trimbak, Nandgaon and Malegaon formed very low category. Low category was observed in Kalwan, Satana, Deola, Dindori, and Sinner tahsils whereas medium category is registered in Yeola and Chandwad tahsils while very high category is registered in Nashik and Niphad tahsils.

3.7.1: Variation in intensity of irrigation

Tahsilwise variation in intensity of irrigation for the region as a whole is +6.34. Except Malegaon all tahsils records positive variation in intensity of irrigation. Nashik tahsil records highest (+61.56) positive variation in intensity of irrigation. However the highest positive variation is obvious in Chandwad (17.02) and (Dindori (11.48) tahsil. Malegaon tahsil records lowest negative variation (-0.65) during the study period (table 3.5).

3.8: INDEX OF INTENSIVE IRRIGATION

Index of intensive irrigation was worked out to find out whether available water is efficiently used or not. This is calculated by following formula;

$$Iii = \frac{Ti}{Ni} X\ 100$$

Where,

Iii = Index of intensive irrigation
Ti = Total irrigated area
Ni = Net irrigated area

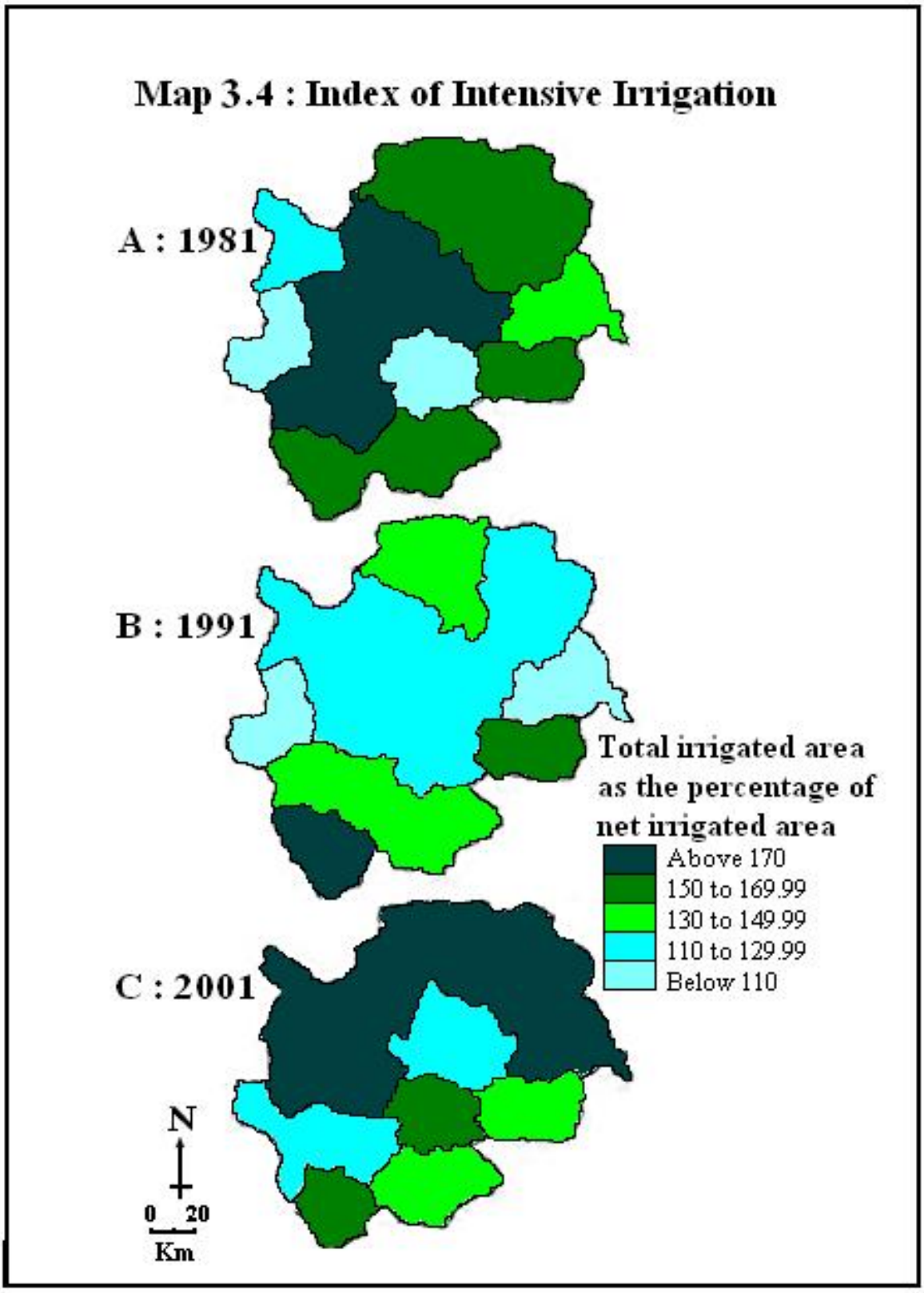
The index of intensive irrigation is calculated for the years 1980-81, 1990-91 and 2000-01. The index of intensive irrigation is divided into five different ranges i.e. Below 110.00. 110.00 to 129.99, 130.00 to 149.99, 150.00 to 169.99 and Above 170.00 which represented very low, low, medium, high and very high intensive irrigation (Table 3.4).

The index of intensive irrigation was, 435.66, 124.8 and 166.94 during 1980-81, 1990-91 and 2000-01. The index of intensive irrigation goes on decrease (268.72) from 1980-81 to 2000-01 respectively. The index of intensive irrigation is different in tahsils of Nashik district is shown in map 4.4 (Table 3.6). Peth and Niphad formed very low category during 1980-81. Low category was observed in Surgana tahsil whereas medium category was found in the Nandgaon tahsil, as well as high index of intensive irrigation was observed in Satana, Malegaon, Yeola, Sinner and Igatpuri tahsils during 1980-81, while very high irrigation intensity registered in Nashik, Dindori, Kalwan and Chandwad Tahsils (Map 3.4A).Peth and Nandgaon formed very low irrigation intensity during 1990-91. Low category was observed in Dindori, Surgana, Sinner tahsil, as well as high index of intensive irrigation was observed in Yeola tahsil during 1990-91, while very high category registered in Igatpuri Tahsil (Map 3.4B).

Table 3.6: Temporal Variation in Index of Intensive Irrigation

Tahsil	Percentage of Total Irrigated Area to Net Irrigated Area **(Index of Intensive Irrigation)**			Changes (1981 to 2001)
	1980-81	1990-91	2000-01	
Nashik	180.60	133.89	128.16	-52.44
Peth	100.00	107.48	299.07	+199.07
Dindori	174.10	113.52	172.61	-1.49
Surgana	111.54	125.97	350.34	+238.80
Kalwan	236.00	121.32	382.73	+146.73
Satana	151.96	132.95	294.90	+142.94
Malegaon	167.24	120.44	265.58	+98.34
Chandwad	175.56	114.93	119.80	-55.76
Nandgaon	139.57	105.55	265.17	+125.60
Yeola	161.36	165.23	138.80	-22.56
Niphad	104.70	117.61	155.86	+51.16
Sinner	157.75	138.37	133.32	-24.43
Igatpuri	162.68	192.96	163.69	+1.01
Trimbak	--	--	118.71	--
Deola	--	--	115.19	--
Total	435.66	124.80	166.94	+268.72

(Source: Socio-Economic Abstract- Nashik District)


Map 3.4 : Index of Intensive Irrigation
A : 1981
B : 1991
C : 2001
Total irrigated area as the percentage of net irrigated area
Above 170
150 to 169.99
130 to 149.99
110 to 129.99
Below 110
N
0 20
Km

Medium irrigation intensity was found in the Nashik, Satana and during 2000-01 eight tahsils have changed their intensive irrigation. Out of these eight tahsils, viz. Peth, Dindori, Surgana, Kalwan, Satana, Malegaon, Nandgaon and Niphad indicated increased intensive irrigation and Chandwad, Sinner constant while Nashik, Yeola and Igatpuri tahsil registered decreased intensive irrigation. Low intensive irrigation was observed in Nashik, Chandwad, Trimbak and Deola tahsils whereas medium intensive irrigation is registered in Yeola and Sinner tahsils as well as high intensive irrigation was observed in Niphad and Igatpuri tahsils while very high intensive irrigation is registered in Peth, Dindori, Surgana, Kalwan, Satana, Malegaon and Yeola tahsils (map 3.4C).

3.8.1: Variation in index of intensive irrigation

Tahsilwise variation in index of intensive irrigation for the region as a whole comes to +268.72. Eight tahsils viz. Peth, Surgana, Kalwan, Satana, Malegaon, Nandgaon, Niphad and Igatpuri records positive variation in index of intensive irrigation while five tahsils viz. Nashik, Dindori, Chandwad, Yeola and Sinner records negative variation in index of intensive irrigation. Surgana tahsil of the study region records highest (+238.8) positive variation in index of intensive irrigation. However Dindori tahsil records lowest negative variation (-1.49) during the study period (table 3.6).

Chapter 4

LANDUSE

4-A: GENERAL LANDUSE

4-A.1: INTRODUCTION

The fundamental utility of land is satisfying the human need of food habitation and housing materials. It is essential to choose proper mode of landuse planning and allocation to various ingredients of optimum landuse to meet /solve the human needs Kellong (1980) has rightly pointed out that this calls for the clear understanding of land classification for successful planning and development. The application of various inputs in land may change the allocation of land to different uses. The factors, conservation and quality of our socio economic environments are most fundamental for the proper use of our land. This statement is true not only of large urban centers as well as most of the remote 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. It is therefore, the study of classification of landuse pattern in Nashik district would be helpful for preparation of the relative development plan for the district.

The objective of this chapter is to assess spatial as well as temporal landuse and suggest possible Solutions to improve existing landuse in the district in the light of physico-socio-economic conditions.

The area of forest cover (FC), net sown area (NSA) area not available for cultivation (ANC), Fallow Land (FL) and cultivable waste (CW) 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. A line graph Exhibits the temporal variation of land classification for a period of forty years (1960-61to 2000-01) in the district. The description of each land classification has been supplemented by numerous spot-inquires, besides information embodied by using the relative District Census Handbook, District Gazetteer and District socio economic Review of Nashik District.

4-A.2: CLASSIFICATION OF LAND

The aim of the classification of land is to divide land into different categories according to single factor or set of factors. Therefore, classification of land may be different types and depending on the factors taken into consideration. The classification of land 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, classification portrays, physical capability of land to produce over a long period of time for selected uses, which can be provide land operation with a basis for actual practice of land (Stamp, 1968).

In the recent years several attempts have been made in different countries of world to classify landuses from different points of views and for different purposes, employing varieties of methods. A stamp (1960) has cogently remarked that it is not surprising that the divergence points of view on classification of land prevail. He is well regarded as pioneer in the field of land classification. His example initiated further studies in this direction. In his work entitled “The land of Britain : Its Use and

Misuse" he classified land into six categories, namely, (1)Forest and woodland (2) Arable land, (3)Meadow land and permanent grass,(4)Health and moorland,(5)Gardens orchards, nurseries and (6)Unproductive land : such as buildings, mines, wasteland, etc.

In the international classification of landuse, there are nine major landuse classes have been recognized : (1)settlement and non-agricultural land, (2)Horticulture, (3)Tress and permanent crops (4)Crop land, (5) Improved permanent pastures, (6)Improved gazing land, (7)Woodland, (8)Stamps and marshes and (9)Unproductive land.

In India various schemes have been proposed to classify the land into different uses. The National Atlas Organization in 1957 classified the land into nine categories Forest, Scrub, and Arable land with trees, Plantation, Pasture, and Wasteland, Alpine grass and scrub and, Glaciated region. The Damodar Valley region has classified land into ten major categories : (1)Field crop, (2)Orchards, (3)Dense forests, (4)Light forests, (5)Non-agricultural land, (6)Unproductive land, (7)Water bodies, (8) Cultivable waste, (9)Villages and (10)City and towns.

Landuse records department has officially classified land under following categories (1) Reporting area for land utilization purposes, (2)Forest, (3)Barren and uncultivable land, (4)Land put to non-agricultural uses (i)cultivable waste, (ii)Permanent pastures and other gazing land, (5)land under miscellaneous tree crops and groves not included in net area sown; (i)Current fallows(ii)Other fallow land, (6)Net sown area, (7)Area sown more than once and (8)total cropped area.

It would be convenient for a clear understanding to condense to above mentioned twelve categories into five

categories as (1) Forest land, (2) Net sown area, (3) Land not available for cultivation, (4) cultivable waste and (5) Fallow land.

4-A.3: TEMPORAL VARIATIONS IN LANDUSE

The temporal variations in landuse pattern in the Nashik district have been studied for a period of forty years (1960-61 to 2000-01) and possible causes of changing landuse have been 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, alternative year has been taken into consideration for showing temporal variations in landuse pattern in the area under study.

The temporal variations in landuse for Nashik district are studied in five categories as follows:

a. Net area Sown (**NSA**)

b. Land not available for cultivation, **(LNAC**),

c. Cultivable Waste (**CW**)

d. Fallow land **(FL)** and

e. Forest/Forest Cover **(F**)

The changes occurred during the period of study are interpreted as follows:

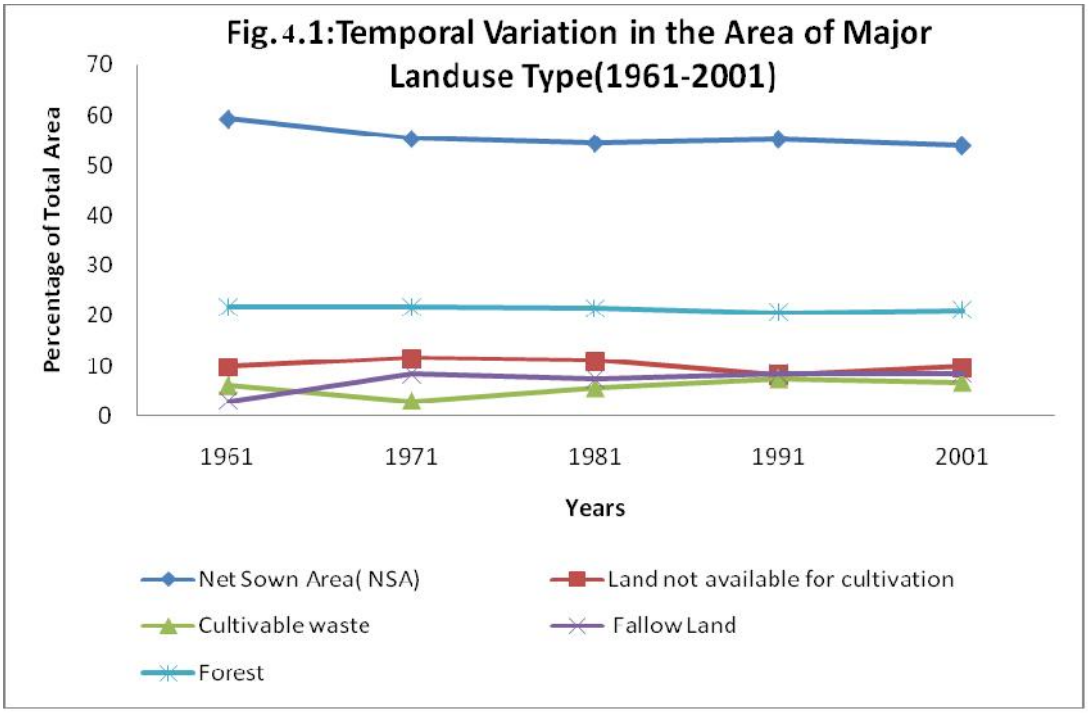
4-A.3.a: Net Sown Area (NSA)

The net sown area is steadily decreased since 1960-61 to 2000-2001 (Fig. 4.1). It is seen from table 4.1 that 59.25 percent area was under cultivation in 1960-61 and it has been stepped to 53.95 percent area under cultivation in 2000-01, registering decreased by 5.3 percent. This decrease may be attributed to

Table 4.1: Nashik District- Temporal Variation in General Landuse Pattern from 1961to 2001 (Area in Percentages)

Sr. No.	Landuse Types	Years				
		1961	**1971**	**1981**	**1991**	**2001**
1.	**Net Sown Area(NSA)**	**59.25**	**55.34**	**54.46**	**55.27**	**53.95**
2.	**Land not available for cultivation(LNAC)**	**9.83**	**11.53**	**10.96**	**8.16**	**9.75**
a)	Land put to non-agricultural use	0.05	0.07	0.44	0.89	0.68
b)	Barren and uncultivated land	9.78	11.46	10.52	7.27	9.09
3.	**Cultivable waste(CW)**	**6.11**	**3.03**	**5.68**	**7.45**	**6.74**
a)	Permanent pastures and other grazing land	4.32	1.55	3.62	3.58	2.48
b)	Miscellaneous tree crops and groves not include to Net Sown Area	0.23	0.25	0.22	0.82	1.59
c)	Cultivable waste	1.56	1.23	1.84	3.05	2.67
4.	**Fallow Land(FL)**	**3.06**	**8.42**	**7.34**	**8.43**	**8.44**
a)	Current Fallow	1.08	5.57	3.85	6.37	6.34
b)	Fallow land other than current fallow	1.98	2.85	3.49	2.06	2.10
5.	**Forest (F)**	**21.75**	**21.68**	**21.56**	**20.69**	**21.12**

(Source: Socio-Economic Abstract- Nashik District)



increasing population, development of transportation routes and residential purpose. From1960-61 to 1970-71net sown area decreased by 3.91 percent in 1970-71 and 1980-81 it has decreased by 0.88 percent; from 1980-1981 to 1990-91 there is a slight increase (0.81%). It decreased 1.32 percent from 1990-91 to 2000-01. The total decrease between the study periods is 5.3 percent. This significant decrease in net sown area may be due to more land under roads, residuals subsequently under landput to non-agricultural use, cultivable waste and fallow land. There fore, other types of land have continuously increased from 1960-61 to 2000-01 (Fig. 4.1 and table 4.1).

4-A.3.b: Land Not Available For Cultivation (LNAC)

This category includes the landput to non-agricultural uses, barren and uncultivated land. The area under this category has shows the cyclic change from 1960-61 to 2000-01 in the study area. The total decline during the study period is only 0.08 percent (table 4.1).There is slight decline during the last two decades. The

land not available for cultivation has been decreasing due to the increase in the cultivable waste and fallow land. Figure 4.1 reveals the temporal variations in landput to non-agricultural uses. Non-agricultural land has been substantially increased for the study period from 1960-61 to 2000-01 (0.63%).While barren and uncultivated land slightly decrease between the study period (0.71%). More land in the past has been put to cultivation use, brought under non-agricultural use due to residential purpose and transport.

4-A.3.c: Cultivable Waste (CW)

In Nashik district, cultivable waste indicates less increase during the study period. In 1960-61, land under cultivable waste was 6.11 percent to the total geographical area while it is increased up to 0.63 percent in 2000-01 (table 4.1). The cultivable waste includes such sub types as permanent pasture and other grazing land, miscellaneous tree crops and groves not include in net sown area and cultivable waste.

The trend of cultivable waste is shown in fig. 4.1. The total increase in cultivable waste is only 0.63 percent from 1960-61 to 2000-01, that shows lightly upward trend. The permanent pasture and other grazing land decline by 1.84 percent, but miscellaneous tree and groves increased by 1.36 percent and cultivable waste increased by 1.11 percent. There was a small decline in permanent pasture and other grazing land while there was less increase in miscellaneous tree and groves and cultivable waste due to population pressure.

4-A.3.d: Fallow Land (FL)

The fallow land includes current fallow and other than current fallow. The current fallow means land kept uncultivated

for regaining fertility of soil and other purposes during the agricultural year. Other fallow land means land kept uncultivated more than five years due to various reasons i.e. non-availability of capital, lack of agricultural know-how. In study region both current fallow and other than current fallow show increased trend during the study period of 5.26 percent and 0.12 percent respectively while the total increase of fallow land is 5.38 percent (table 4.1). This fact suggests that less land under other fallow has been brought under cultivation. Moreover, there is a fluctuation in the area under fallow land from 1970-71 to 2000-01.

4-A.3.e: Forest (F)

In assessing the character of the vegetation type, a factor that can not be neglected in the long occupation of man and the consequent change on the vegetal carpet through agriculture. The type of vegetation met with any given locality depends on the climate, soil and past treatment has been emphasized by the leading plant ecologists. The influence of temperature and rainfall on plant life has received a special attention in the classifications of climate proposed by Koppen and Thornthwait.

Nasik district has 21.75 percent and 21.68 percent of land under forest cover during 1960-61 and 1970-71 respectively. There is almost no change in forest lands during a span of ten years. Whereas during 2000-2001, land under forest increases 0.43 percent between 1990-1991 and 2000-2001. The statistics shows that 6698 hectares. Geographical area has been increased under forest between 1990-91 and 2000-2001. Forest plays a dominant role in maintaining ecological and environmental balance in the district.

4-A.4: Comparative Study of Landuse in Nashik District and Maharashtra

Table 4.2 shows the area under different landuse categories in Nashik district and Maharashtra. Net sown area in the district is relatively less under cultivation (53.95%) and Maharashtra (57.34%). The less hectare of net sown area in Nashik district is attributed to highly diversified relief. Moreover presence of Sahyadrian mountain range and its offshoots spread within the district restricted land for cultivation. The percentage of land not available for cultivation is same as compare to Maharashtra, but the percentage of landput to non-agricultural use is very less (0.68%) as compare to the state (4.23%) while the percentage of barren and uncultivated land is maximum (9.07%) and in Maharashtra (5.51%).

Table 4.2 shows that land under permanent pasture and other grazing is less (2.48%) as compared to Maharashtra (4.36%) while land under miscellaneous tree crops and groves (1.59%) in Nashik district and it is less in Maharashtra (0.73%). This table also shows that negligible land under cultivable waste (2.67%) in Nashik district. It is less than Maharashtra (2.94%). The area under current fallow is maximum (6.34%) in Nashik and it is minimum in Maharashtra (3.87%), while the area under fallow land other than current fallow is less (2.1%) as compared to Maharashtra (3.77%). the area under forest is maximum in Nashik (21.12%) as compared to Maharashtra (17.25%).

Table 4.2: Landuse in Nashik District and Maharashtra (2000-01)

Sr. No.	Landuse Types	Nashik		Maharashtra	
		Area in hectare	Area in %	Area in hectare	Area in %
1.	**Net Sown Area (NSA)**	**837793**	**53.95**	**17636000**	**57.34**
2.	**Land not available for cultivation (LNAC)**	**151514**	**9.75**	**2997000**	**9.74**
a)	Land put to non-agricultural use	10606	0.68	1301000	4.23
b)	Barren and uncultivated land	140908	9.07	1696000	5.51
3.	**Cultivable waste (CW)**	**104613**	**6.74**	**2470000**	**8.03**
a)	Permanent pastures and other grazing land	38498	2.48	1341000	4.36
b)	Miscellaneous tree crops and groves not include to Net Sown Area	24688	1.59	226000	0.73
c)	Cultivable waste	41427	2.67	903000	2.94
4.	**Fallow Land (FL)**	**131117**	**8.44**	**2350000**	**7.64**
a)	Current Fallow	98469	6.34	1189000	3.87
b)	Fallow land other than current fallow	32648	2.10	1161000	3.77
5.	**Forest (F)**	**327979**	**21.12**	**5306000**	**17.25**
6.	**Total Geographical Area**	**1553016**	**100**	**30758000**	**100**

(Source: Socio-Economic Abstract- Nashik District)

4-A.5: SPATIAL VARIATION IN LANDUSE

The spatial pattern in landuse in Nashik district is the result of interaction between physical environment and socio-economic environment. But the impact of regional and local factors is clearly evident from the landuse patterns. Besides these factors, amount of rainfall exerts profound influence on the types of landuse in the Nashik district. The overall landuse has been categorized into different subtypes on the basis of recommendations made by Food and Agricultural Department, Government of India. These subtypes are as follows;

a. Net area Sown (**NSA**)

b. Land not available for cultivation, **(LNAC**)

a) Landput to non-agricultural uses,

b) Barren and uncultivable land

c. Cultivable Waste (**CW**)

a) Permanent pastures and other grazing land,

b) Land under miscellaneous tree crops and groves not included in net sown area

c) Cultivable waste

d. Fallow land **(FL)**

a) Current fallow land and,

b) Fallow land other than current fallow, and,

e. Forest/Forest Cover **(F**)

The above mentioned categories have been used to examine the spatial pattern of landuse in Nashik district. The percentage of each landuse type has been calculated to total geographical area of the district. The percentage area of landuse type has given in Table 4.3(1960-61) and 4.4(2000-01).

4-A.5.a: Net Sown Area

The net sown area includes land actually under food crops, cash and fodder crops. The Nashik district has 53.95 percent land under cultivation to total geographical area showing relatively less area than that of Maharashtra (57.34 %) as per 2000-01.This peculiarity of the land pattern of the district can be accounted by the presence of Sahyadrian Mountain range and its offshoots spread within the district.

Table 4.3 and Map 4.1 reveals the spatial variations in the percentage of net sown area to total geographical area in the Nashik district (1960-61). It is observed from this map that net sown area was maximum (more than 70 percent) in Niphad (81.4%) followed by Yeola (76.4%), Chandwad 73.00%) and Sinner (71.6%) while it was minimum (less than 50 percent) in Peth (32.3%) and Surgana (36.2%). This is the outstanding trend of net sown area. This can be explained by the fact that the north-western part (Peth, Surgana) of the district occupied by Sahyadrian mountain range that is almost forest land, unsuitable and low fertility soil. As a result, comparatively less percentage of area has been brought under cultivation. Remaining part of the district (Godavari, Girna and Mosam River Basin) is low-lying plain with medium to deep black soil, suitable for extensive land under plough.

Table 4.4 and map 4.2 clearly shows that in 2000-01, there was great change or decrease in the percentage of net sown area to total geographical area. Overall the district the percentage of net sown area decreased (5.3%) in the study period. Net sown area increased in Peth (7.1%), Surgana (1.7%)and Igatpuri 8.5%) while the remaining part of the district the percentage of net sown

Table 4.3: Nashik- General Landuse (1961) Area in Percentage

Sr. No.	Tahsil/ Taluka	LANDUSE TYPES				
		NSA	LNAC	CW	FL	F
1	Nashik	54.3	15.5	12.1	3.7	14.4
2	Peth	32.3	4.8	7.5	5.4	50.0
3	Dindori	63.1	8.6	6.6	5.4	16.3
4	Surgana	36.2	3.0	6.3	1.5	53.0
5	Kalwan	52.1	6.7	6.1	1.6	33.5
6	Satana	54.5	8.0	5.3	2.7	29.5
7	Malegaon	59.7	12.2	5.4	2.3	20.4
8	Chandwad	73.00	13.1	2.2	1.6	10.1
9	Nandgaon	55.7	14.6	3.5	2.1	24.1
10	Yeola	76.4	4.8	7.0	1.6	10.2
11	Niphad	81.4	6.1	8.9	2.5	1.1
12	Sinner	71.6	13.5	1.9	2.4	10.6
13	Igatpuri	51.7	12.3	7.4	7.3	21.3
14	Trimbak	--	--	--	--	--
15	Deola	--	--	--	--	--
	Total	59.25	9.83	6.1	3.06	21.75

(Source: Socio-Economic Abstract- Nashik District)

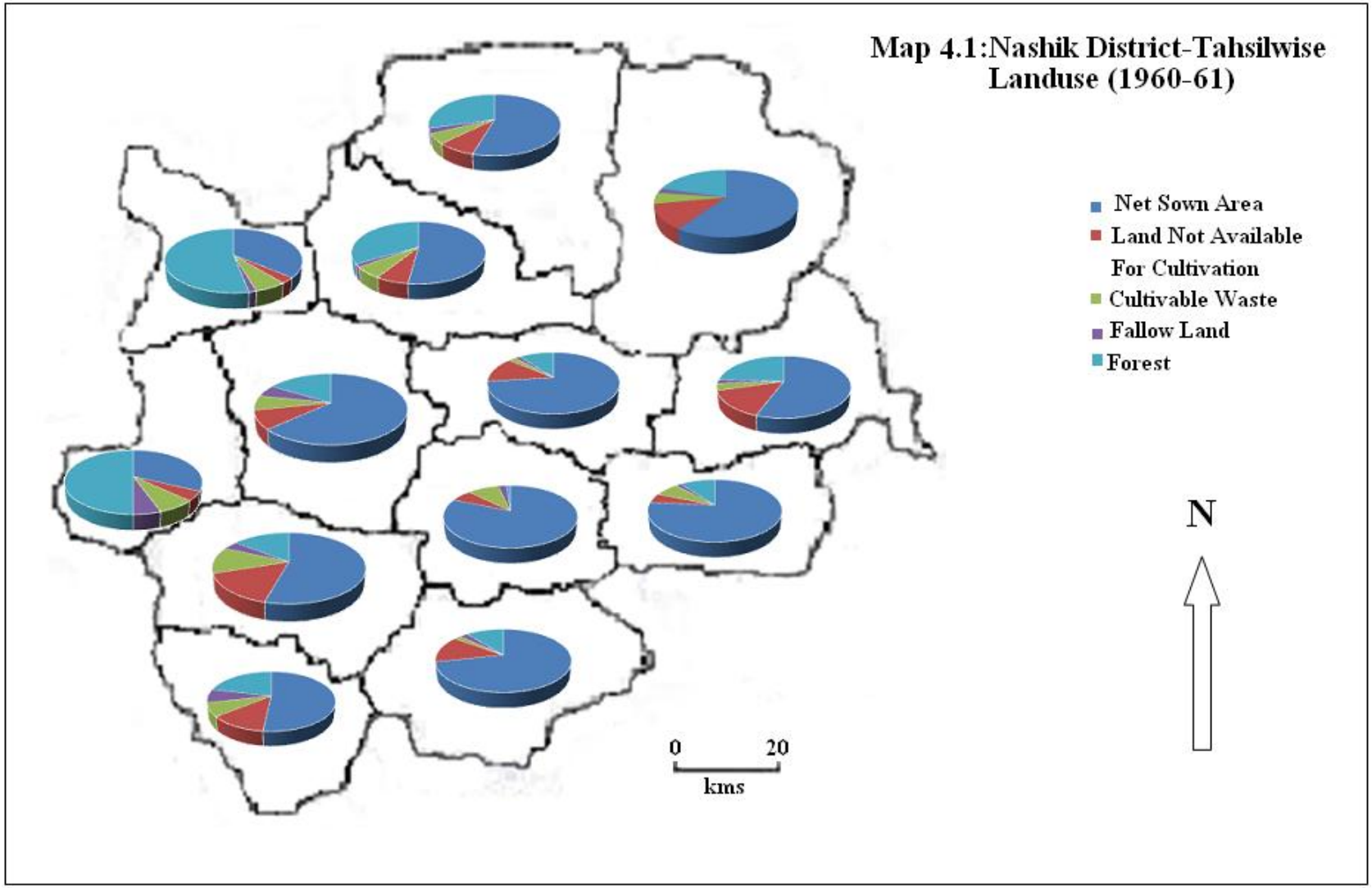

Map 4.1:Nashik District-Tahsilwise Landuse (1960-61)
Net Sown Area
Land Not Available For Cultivation
Cultivable Waste
Fallow Land
Forest
N
0
20
kms

Table 4.4: Nashik- General Landuse (2001) Area in Percentage

Sr. No.	Tahsil/ Taluka	LANDUSE TYPES				
		NSA	LNAC	CW	FL	F
1	Nashik	26.7	12.8	23.9	25.3	11.3
2	Peth	39.4	7.0	0.2	0.1	53.3
3	Dindori	54.4	4.4	7.4	15.0	18.8
4	Surgana	37.9	4.7	1.7	3.7	52.0
5	Kalwan	42.3	5.2	12.8	5.1	34.6
6	Satana	49.3	15.0	3.3	4.1	28.3
7	Malegaon	58.0	14.3	3.8	2.4	21.5
8	Chandwad	68.5	9.4	7.2	5.1	9.8
9	Nandgaon	48.2	13.8	6.5	5.7	25.8
10	Yeola	68.6	10.5	4.9	10.2	5.8
11	Niphad	68.8	8.8	7.1	14.2	1.1
12	Sinner	58.4	10.5	7.9	9.2	14.0
13	Igatpuri	60.2	12.5	9.8	15.0	2.5
14	Trimbak	43.2	5.7	3.0	8.1	40.0
15	Deola	73.6	0.2	4.5	6.2	15.5
	Total	53.95	9.76	6.74	8.43	21.12

(Source: Socio-Economic Abstract- Nashik District)

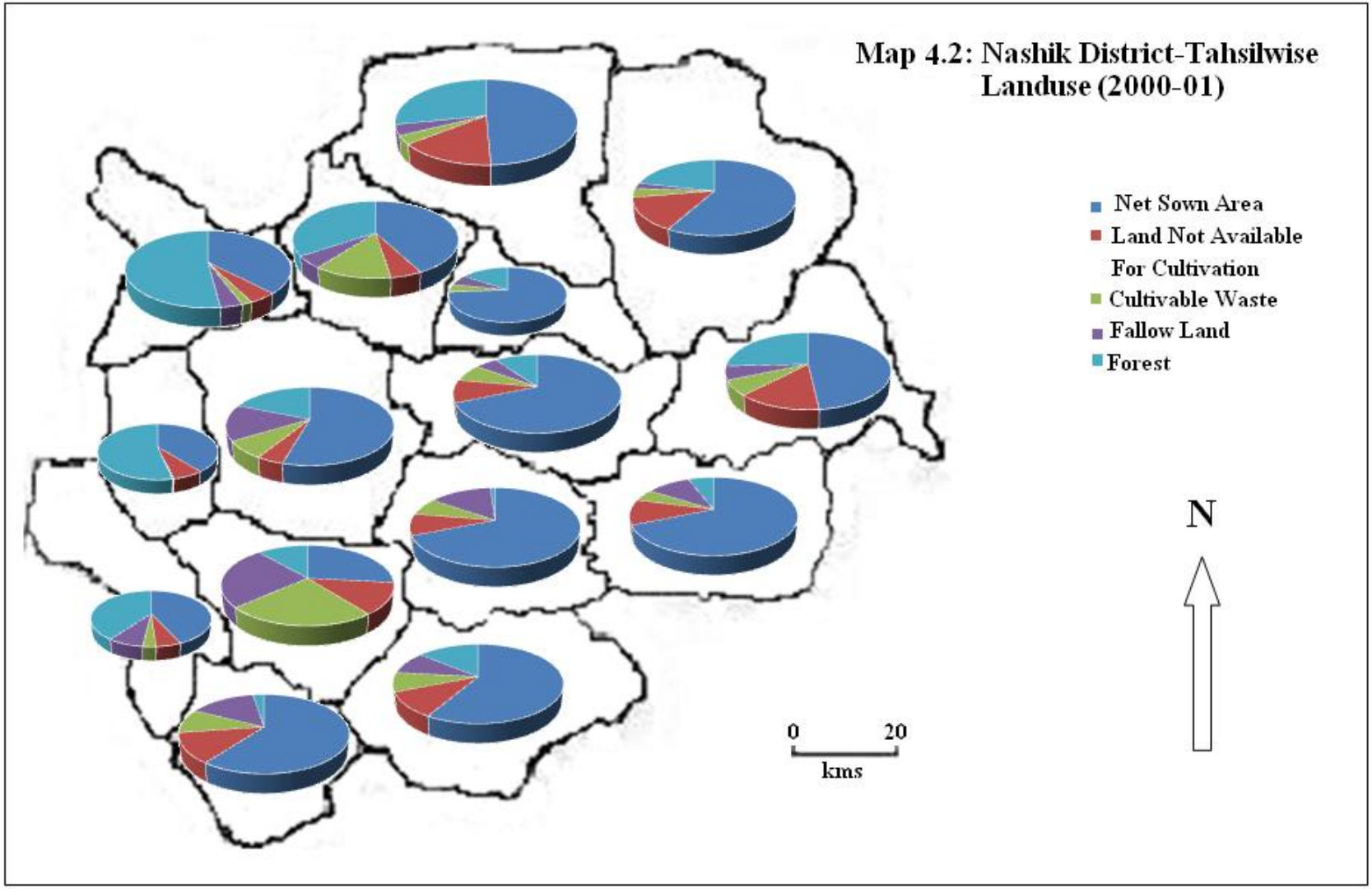

Map 4.2: Nashik District-Tahsilwise Landuse (2000-01)
Net Sown Area
Land Not Available For Cultivation
Cultivable Waste
Fallow Land
Forest
N
0
20
kms

Table 4.5: Percentage Variation in General Landuse

(Between 1960-61 to 2000-01)

Sr. No.	Tahsil/ Taluka	LANDUSE TYPES				
		NSA	LNAC	CW	FL	F
1	Nashik	-27.6	-2.7	+11.8	+21.6	-3.1
2	Peth	+7.1	+2.2	-7.3	-5.3	+3.3
3	Dindori	-8.7	-4.2	+0.8	+9.6	+2.5
4	Surgana	-1.7	+1.7	-4.6	+2.2	-1.0
5	Kalwan	-9.5	-1.5	+6.7	+3.5	+1.1
6	Satana	-5.2	+7.0	-2.0	+1.4	-1.2
7	Malegaon	-1.7	+2.1	-1.6	+0.1	+1.1
8	Chandwad	-4.5	-3.7	+5.0	+3.5	-0.3
9	Nandgaon	-7.5	-0.8	+3.0	+3.6	+1.7
10	Yeola	-7.5	+5.7	-2.1	+8.6	-4.4
11	Niphad	-12.6	+2.7	-1.8	+11.7	nil
12	Sinner	-13.2	-3.0	+6.0	+6.8	+3.4
13	Igatpuri	+8.5	+0.2	+2.4	+7.7	-18.8
14	Trimbak	--	--	--	--	--
15	Deola	--	--	--	--	--
	Total	-5.3	-0.08	+0.63	+5.38	-0.63

(Source: Research Student)

area goes on decrease. In 2000-2001, maximum percentage (more than 60 percent) of land under net sown area is found at Deola (73.6%) followed by Niphad (68.8%), Yeola (68.6%), Chandwad (68.5%) and Igatpuri (60.2%).

The category consisting 50 to 60 percent net sown area to the total geographical area is shown in map 4.2 and table 4.4. Only three tahsils comes under this category i.e. Sinner (58.4%), Malegaon (58.0%) and Dindori (54.4%). While 40 to 50 percent net sown area observed in Satana (49.3%) followed by Nandgaon (48.2%), Trimbak (43.2%) and Kalwan (42.3). Below 40 percent net sown area observed in Nashik tahsil (26.7%), followed by Surgana (37.9%) and Peth (39.4%).

Table 4.5 shows the percentage variation in general landuse between the study periods. The percentage of net sown area increased in Peth, Surgana and Igatpuri tahsils while in reaming tahsils the percentage of net sown area goes on decrease. This significant decrease in net sown area may be due to more land under roads, residuals subsequently under landput to non-agricultural use, cultivable waste and fallow land. After the overall observation of Nashik district there was decrease in the percentage of net sown area (-5.3%), land not available for cultivation (-0.08%) and forest (-0.62%) while the percentage increase in cultivable waste (+0.63%) and fallow land (5.38%).

4-A.5.b: Land Not Available for Cultivation (LNAC)

This is divided into following types;

a) Land-put to non-agricultural uses: Land occupied by settlements, roads, railways, streams, canals and rivers are included in this type.

b) Barren and uncultivable land: Outcrops of hills and mountains are included in this type. The small part of this land can be brought under cultivation of very high costs. Generally, barren and uncultivated land is associated with poor soils, heavy rainfall and intense erosion.

In 1960-61 more than 10 percent land not available for cultivation is observed in Nashik , Nandgaon, Sinner, Chandwad, Igatpuri and Malegaon tahsils; while remaining tahsils observed less than 10 percent land not available for cultivation (table 4.3 and map 4.1). As well as in 2000-01, there is significance change in land not available for cultivation. Table 4.4 and map 4.2 shows that seven tahsils falls in the range of 10 to 15 percent of land not available for cultivation in the study area. While in remaining tahsils having less than 10 percent land not available for cultivation.

In the Nashik district, the land not available for cultivation is 9.83 percent (1960-61) to the total geographical area; it decreases 0.08 percentages (9.75%) in 2000-01. This type shows considerable variations within the district (table 4.5).The land not available for cultivation (9.75%) is almost same to that of the Maharashtra (9.74%). The percentage of land not available for cultivation is highly increased in Satana (+7.0%) followed by Yeola (+5.7%), while it is highly decreased in Dindori (-4.2%) followed by Chandwad (-3.7%) and Sinner (-3.0%) between the study period.

4-A.5.c: Cultivable waste (CW)

The cultivable waste land includes other uncultivated lands excluding fallow land. This category is divided into three types. a) Permanent pastures and other grazing lands, b) Miscellaneous

tree crops and groves and c) cultivable waste. The permanent pastures and grazing lands include all land, are 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 land. The miscellaneous tree crops and groves include land under grasses, bamboo, bushes and other groves for fuels etc. which not included under orchards or forests are included in this category and, the land not cultivated during the preceding five years is called cultivable waste.

The Nashik district has 6.11 percent (1960-61) and 6.74 percent (2000-01) to total land under cultivable waste (table 4.3 and 4.4). It is slightly increase (+0.63%) between the study period and 1.29 percent less as compared to Maharashtra. The cultivable waste is observed in varied ranges within the district. One comes across the maximum cultivable waste at Nashik (12.1% in 1960-61 and 23.9% in 2000-01) and the minimum at Sinner (1.9% in 1960-61) and Peth (0.2% in 2000-01) in the study period. In 1960-61, Chandwad and Nandgaon come under less than 5 percent cultivable waste to the total geographical land and remaining tahsils having 5 to 10 percent cultivable waste land. While in 2000-01, Surgana, Trimbak, Satana, Malegaon, Deola and Yeola observed less than 5 percent of cultivable waste land as well as remaining tahsils observed 5 to 10 percent cultivable waste land.

Table 4.5 clearly shows that there is significant variation in cultivable waste between the study periods. There is high percentage of cultivable waste land increased at Nashik tahsil (+11.8%) followed by Kalwan (+6.7%), Sinner (+6.0%) and Chandwad (+5.0%) while the percentage of cultivable waste land

highly goes on decreased at Peth (-7.3%) followed by Surgana (-4.6%) and Yeola (-2.1%).

4-A.5.d: Fallow Land (FL)

The Nashik district has 3.06 percent area in 1960-61 and 8.44 percent area in 2000-01to its total area under fallow land. The fallow land is generally, divided into two categories; (a) current fallow land and (b) other than current fallow land. The current fallow land includes the land which is not cultivated during the current year due to variety of regions i.e. as phase to rotation, for regaining fertility or due to some other constrains. The land than current land 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 Nashik district has 3.06 percent (1960-61) and 8.44 percent (2000-01) to total area under fallow land (table 4.3 and 4.4). It is increased (+5.38%) between the study period and 0.8 percent more as compared to Maharashtra (2000-01). The fallow land is observed in varied ranges within the district. One comes across the maximum fallow land at Igatpuri (7.3% in 1960-61) and Nashik (25.3% in 2000-01) while the minimum at Surgana (1.5% in 1960-61) and Peth (0.1% in 2000-01) in the study period. In 1960-61, Igatpuri, Peth and Dindori observed more than 5 percent fallow land in 1960-61, while remaining tahsils observed less than 5 percent of fallow land to the total geographical area. As well as in 2000-01, high percentage of fallow land will be observed at Dindori and Igatpuri (15%) followed by Niphad (14.2%), Yeola (10.2%) and Sinner (9.2%). While Malegaon (2.4%), Surgana (3.7%) and Satana (4.1%)

observed low percentage (less than 5 %) of fallow land in the district.

Table 4.5 clearly shows that there is great variation in fallow land between the study periods. There is high percentage of fallow land increased at Nashik tahsil (+21.6%) followed by Niphad (+11.7%), Dindori (+9.6%) and Yeola (+8.6%) while the percentage of fallow land highly goes on decreased at Peth (-5.3%) only.

4-A.5.e: Forest Land (F)

In assessing the character of the vegetation type, a factor that can not be neglected in the long occupation of man and the consequent change on the vegetal carpet through agriculture. The type of vegetation met with any given locality depends on the climate, soil and past treatment has been emphasized by the leading plant ecologists.

The Nashik district has 21.75 percent (1960-61) and 21.12 percent (2000-01) of total area under forest land (table 4.3 and 4.4). It is decreased (-0.63%) between the study period and 3.87 percent more as compared to Maharashtra (2000-01). The forest land is observed almost in stable range within the district. One comes across the maximum forest land at Surgana(53.0%) followed by Peth (50.0%) in 1960-61 and Peth (53.3%) followed by Surgana (52.0%) in 2000-01,while the minimum at Niphad (1.1%) in 1960-61 and 2000-01 in the study period.

Table 4.5 clearly shows that there is significant variation in forest land. There is high percentage of forest land increased at Sinner (+3.4%) followed by Peth(+3.3%), Dindori (+2.5%) and Nandgaon (+1.7%) while the percentage of forest land highly goes on decreased at Igatpuri (-18.8%) followed by Yeola

(-4.4%) and Nashik (-3.1%). There is not more decrease in forest land in the district. But the density of trees goes on decreased day by day.

4-B: AGRICULTURAL LANDUSE

4-B.1: INTRODUCTION

After unfolding the various categories of general landuse in Nashik district in the earlier chapter, it would be worthwhile to explain agricultural landuse pattern in the area for individual crops to explicate the crop growth and crop pattern. The term, "Agricultural Landuse" denotes the extent of the gross cropped area during the 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 the physical constraints and limitations but also depends 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 reflects of crops growth, production and changes.

The present chapter attempts to expound the agricultural landuse, its growth and crop pattern in relation to the physio-socio-economic conditions prevalent in the basin and highlights the use of cropland in the context of existing crop ecology, their spatial distribution, and methods of farm operation and to discuss the possible causes for the existing cropland pattern in the basin.

The area under various crops have been obtained from concerned talukas and it was converted into percentage to net sown area, which are later on used for depicting the distribution of individual crops. The distribution of landuse patterns show

variations in agricultural landuse in the Nashik district. The information collected during field work sustains explanations. The District Census Handbook, Gazetteer and Socio-economic Abstract of Nashik District have been used for explaining the agricultural landuse patterns and Analytical expositions on crop pattern have been attempted.

4-B.2: AGRICULTURAL LANDUSE PATTERNS

The spatial and temporal variations in agricultural landuse patterns have been studied in the area under review. The spatial distribution patterns were studied for the year i.e. 2000-2001, while temporal study were made for the period of 1960-61to 2000-2001. The investigator could not succeed in displaying temporal variations for consecutive years due to lack of data for the concerned taluka. Hence, decadal data has been taken into account for temporal study of agricultural landuse in Nashik district.

4-B.3: CROPS AND SEASONS

There are two agricultural seasons in Nashik district, viz. kharif and Rabi. The kharif crops are sown in June and July and harvested at the end of October or early November, while Rabi crops are sown in October or mid-November and harvested in month of February or March. The kharif crops are rice, bajra, jawar, nachani, cotton, pulses, maiz, groundnut, and vegetable, while Rabi crops are wheat, rabi jawar and gram.

4-B.4: TEMPORAL VARIATION IN AGRICULTURAL LANDUSE PATTERS

The crop pattern in any region cannot remain static due to the variations in the rainfall amount and nature of inputs and environmental instability. Moreover, introduction of new high

Table 4.6: Temporal Variation in Agricultural Landuse

(1960-61 to 2000-2001)

Crops	Decades									Total
	1960-61	1970-71		1980-81		1990-91		2000-2001		
	Area (in %)	Area (in %)	Decr. /Incr.	Area (in %)	Decr/ Incr.	Area (in %)	Decr/ Incr.	Area (in %)	Decr. /Incr.	
Bajara	**40.2**	**36.6**	**-3.6**	**33.4**	**-3.16**	**45.6**	**12.2**	**39.8**	**-5.81**	**-0.4**
Pulses	**11.43**	**8.22**	**-3.2**	**11.7**	**3.4**	**8.31**	**-3.38**	**7.8**	**-0.51**	**-3.63**
Jawar	**9.13**	**14.5**	**5.4**	**11.1**	**-3.43**	**5.13**	**-5.96**	**3.73**	**-1.4**	**-5.4**
O. S.	**13.35**	**7.47**	**-5.9**	**8.97**	**1.5**	**6.71**	**-2.26**	**6.11**	**-0.6**	**-7.24**
Wheat	**10.95**	**13.8**	**2.85**	**6.89**	**-6.91**	**4.07**	**-2.82**	**4.71**	**0.64**	**-6.24**
Nach.	**6.89**	**8.12**	**1.23**	**6.75**	**-1.37**	**4.46**	**-2.29**	**5.45**	**0.99**	**-1.44**
Rice	**4.25**	**4.88**	**0.63**	**4.34**	**-0.54**	**5.64**	**1.3**	**5.64**	**nil**	**1.39**
Veg.l	**1.61**	**2.54**	**0.93**	**2.97**	**0.43**	**4.45**	**1.48**	**7.9**	**3.45**	**6.29**
Fodd.	**0.17**	**0.72**	**0.55**	**7.77**	**7.05**	**6.06**	**-1.71**	**5.37**	**-0.69**	**5.2**
S. C.	**1.07**	**1.86**	**0.79**	**2.46**	**0.6**	**3.63**	**1.17**	**3.5**	**-0.13**	**2.43**
Fruits	**0.2**	**0.5**	**0.3**	**1.5**	**1.0**	**1.77**	**0.27**	**3.25**	**1.48**	**3.05**
Other Crops	**0.93**	**1.88**	**0.95**	**1.07**	**-0.81**	**1.58**	**0.51**	**2.15**	**0.57**	**1.22**

(Source: Revenue Records)

Note: The year 1960-61 is considered as base year.

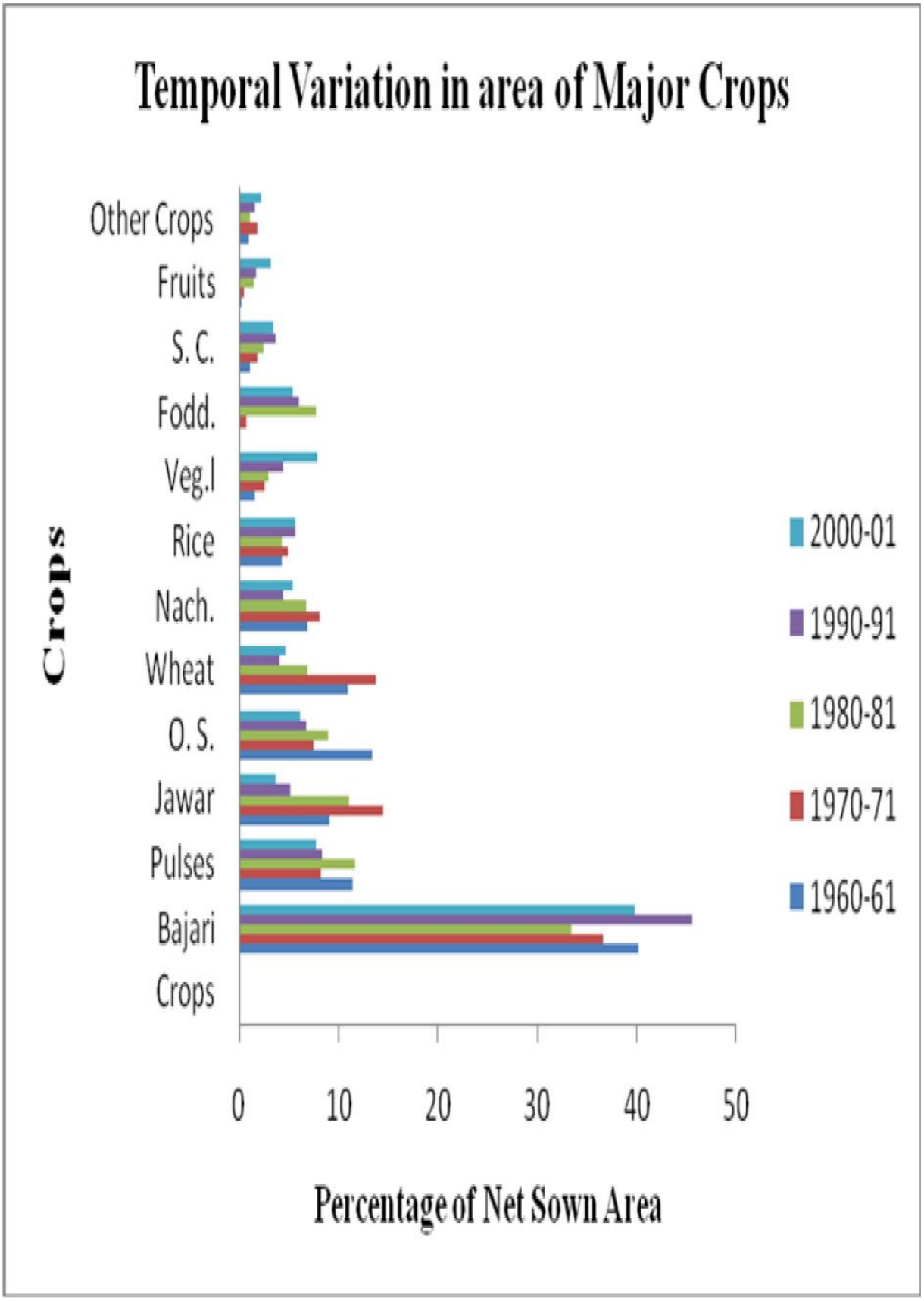


Fig.4.2: Temporal variation in the area of major crops.

yielding varieties of Seeds, irrigation facilities and technical know-how are responsible for temporal changes. Such changes in cropping patterns are differing from taluka to taluka and region to region. Therefore it is worthwhile to study isolated causes of change occurring through space and time.

Fig.4.2 displays the temporal variations in cropping pattern in the Nashik district from 1960-1961 to 2000-2001. The identified possible main features of temporal variations in cropping pattern summarized as below;

Bajra is predominant in the area under review since 1961. The areal extent of bajra has recorded steady decrease during the study period. The total decrease of bajra is 0.39 percent from 1960-61 to 2000-2001 (table 4.6). Bajra was cultivated 40.2 percent in the year 1960-61 and it is cultivated more than 33.4 percent (except 1980-81). During 1990-91 the net sown area under bajra reveals highest increase (12.2 percent). The introduction of new high yielding varieties of seeds may be important for increasing area and yield of bajra in the district.

The areal extent under pulses in the district had successfully cultivated before 1960-61 on the area of 11.43 percent to total net sown area. The decreasing in area under pulses was registered for the following years. It has been reduced 7.8 percent in 2000-2001. The total decline of pulses from 1960-61 to 2000-01 was 3.63 percent except in 1980-81 where it has 3.4 percent increase in the district.

The areas under Jawar declined in the study period. The decreasing in area under jawar was registered for the following years. It has been declined 3.73 percent in 2000-01. The total decline of jawar from 1960-61 to 2000-01 is 5.4 percent except in

1970-71 where it has 5.4 percent increase respectively in the district.

Table 4.6 shows 7.24 percent to net sown area under oilseeds has decreased during study period (1960-61 to 2000-01). It is noticed from table 4.6 that the oilseeds was found 13.35 percent area in 1960-61 while it reduced 6.11 percent to net sown area in 2000-01. The area under oilseeds goes on decrease throughout the study period.

It is clear from table 4.6 that area under wheat was 10.95 percent to net sown area in 1960-61 which was further increase 2.85 percent in 1970-71. From 1980-81 to 2000-01 the area under wheat goes on decrease. The total decrease is 6.24 percent between the study periods.

The areas under Nachani have declined between the study periods. The areal extent of nachani in the district has successfully cultivated up to 1970-71. The area under Nachani was 6.89 percent in 1960-61 it was increased up to 1.23 percent in 1970-71. From 1970-71 the area under nachani goes on decline. The total decline of area under Nachani is 1.44 percent between the study periods.

Table 4.6 shows 1.39 percent to the net sown area under rice has increased during the study period (1960-61 to 2000-01). It is noticed from fig.4.2 that the rice was found 4.25 percent area in 1960-61, while it increased 5.64 percent to net sown area in 2000-01. The maximum area under rice was registered in the years 1990-91 and 2000-01 (5.64 percent) in the district.

The area under vegetable in the district had successfully cultivated after 1960-61. In 1960-61 area under vegetable was 1.61 percent which is increased to 6.29 percent (table 4.6) between

the study period. In 2000-01 area under vegetable rapidly increase and reach up to 7.9 percent to total net sown area of the district.

Table 4.6 shows 5.2 percent to net sown area under fodders has increased during study period (1960-61 to 2000-01). It is clearly shown in fig.4.2 that the fodder crops was found 0.17 percent area in 1960-61, while it increased to 5.37 percent to net sown area in 2000-01. The maximum area under fodder crops was registered in the year 1980-81 (7.77 percent) in the district.

Sugarcane is one of the important cash crops in the district. The areal extent under sugarcane in the district has increased up to 1990-91. In 1960-61 area under sugarcane was 1.07 percent which is increased to 2.43 percent (table 4.6) between the study periods. The maximum area under sugarcane was registered in the year 1990-91 (3.63 percent) in the district.

The areal extent under fruits in the district has successfully cultivated after 1960-61. In 1960-61 area under fruits was only 0.2 percent which is increased to 3.05 percent during the study period. Table 4.6 shows that there is significant increase in the area under fruits in the district.

Other crops have remained unaffected during the study period except the year 1970-71 and 2000-01 which is increased to 1.88 percent and 2.15 percent (table 4.6). The total increase was 1.22 percent.

The temporal variation reflects on major changes with upward trend in the area under rice, vegetable, fodder crops, sugarcane, fruits and other crops and hence the area under bajra, pulses, jawar, oilseeds, wheat and nachani decreased due to

increasing demand of other crops like vegetable, fruits and fodder milk supply zone is increasing in the district.

4-B.5: SPATIAL ANALYSIS OF AGRICULTURAL LANDUSE

Nashik district is an important region involving 20.5 percent working force in agricultural practice. The crops viz. Bajra, Rice, Nachani, Wheat, Jawar, Maiz, Vegetable, Pulses, Fodder crops, Oil-seeds, Sugarcane and Fruits are cultivating in the district. The variations in areal extent under these crops are mostly depending on adoption of improved varieties of seeds for sowing, local environment and traditional approach of farmers in the area under review. Besides these soil types and rainfall influencing on the crop cultivation and cropping pattern. The relative importance of kharif and Rabi crops is shown in fig.4.3A. It is seen that more than three-fourth area under plough in kharif (91.74 percent to net sown area) and less than one-fourth is under Rabi (8.26 percent to net sown area) season in the district. The relative importance of individual crop in kharif and rabi are shown in fig.4.3B.

The relative significance of crops and their spatial variation in the area under review has studied in detail with studying crop ecology, land operations and spatial distribution of crops in Nashik district.

4-B.5.1: Bajra

Bajra is the principal crop in Nashik district. It is rainfed crop cultivated in kharif season. This crop is raised in 13 tahsils of the district and occupying 329109 hectares (39.8 percent to net sown area) area of the district. The average annual rainfall amount and soil types in the district favor the cultivation of bajra in every village in the 13 tahsils except Peth and Surgana tahsil. Peth and

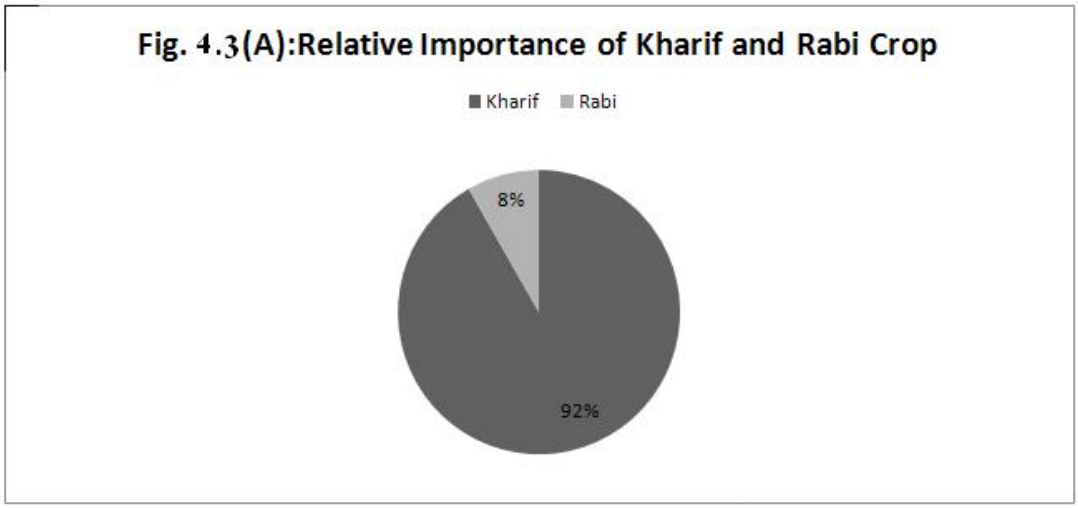


Fig. 4.3(A):Relative Importance of Kharif and Rabi Crop
Kharif
Rabi
8%
92%

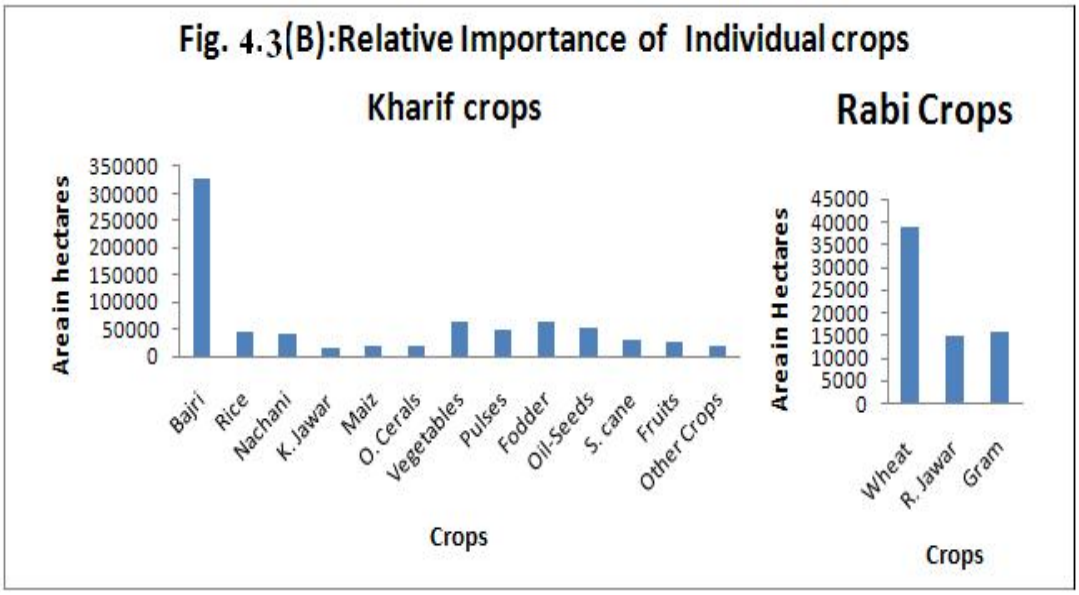


Fig. 4.3(B):Relative Importance of Individual crops
Kharif crops
Area in hectares
350000
300000
250000
200000
150000
100000
50000
0
Bajri
Rice
Nachani
K.Jawar
Maiz
O. Cerals
Vegetables
Pulses
Fodder
Oil-Seeds
S.cane
Fruits
Other Crops
Crops
Rabi Crops
Area in Hectares
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
Wheat
R. Jawar
Gram
Crops

Surgana tahsils are not cultivating bajra due to hilly area and heavy rainfall.

Table 4.7: Agricultural Landuse of Nashik District (2000-01)

Sr. No.	Crops	Area (in Hectares)	Percent of Net Sown Area
1	Bajra	329109	39.8
2	Vegetables	64347	7.67
3	Pulses	64134	7.64
4	Fodder Crops	62186	7.41
5	Oil-Seeds	50523	6.02
6	Rice	46536	5.54
7	Nachani	40220	4.79
8	Wheat	38945	4.64
9	Jawar	30860	3.68
10	Sugarcane	28967	3.45
11	Fruits	26897	3.2
12	Maize	20159	2.4
13	Other Cereals	18623	2.22
14	Other Crops	17829	2.12

(Source: Socio-Economic Abstract- Nashik District)

Ecological condition:

Bajra can grow successfully in tropical and sub-tropical climate. It requires temperature between 18^0 to 29^0 C and average annual rainfall between 600 and 1000 mms. Generally bajra is sown later and reaped earlier than jawar. It is usually grown on light to medium black soils.

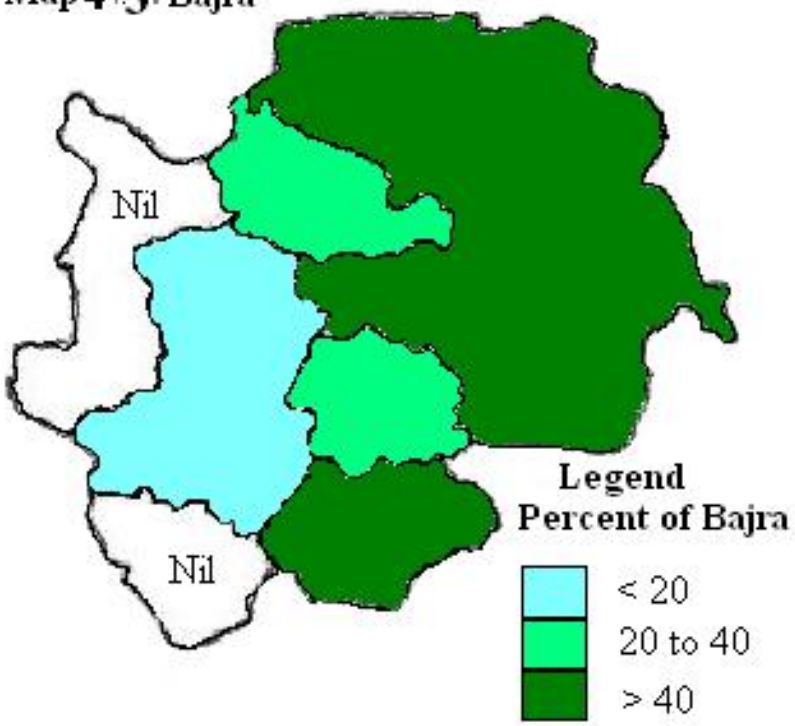
Spatial Distribution:

Bajra is successfully grown in Nashik district. The spatial distribution of bajra is shown in map4.3. Map 4.3 shows that this crop is found in three categories as under;

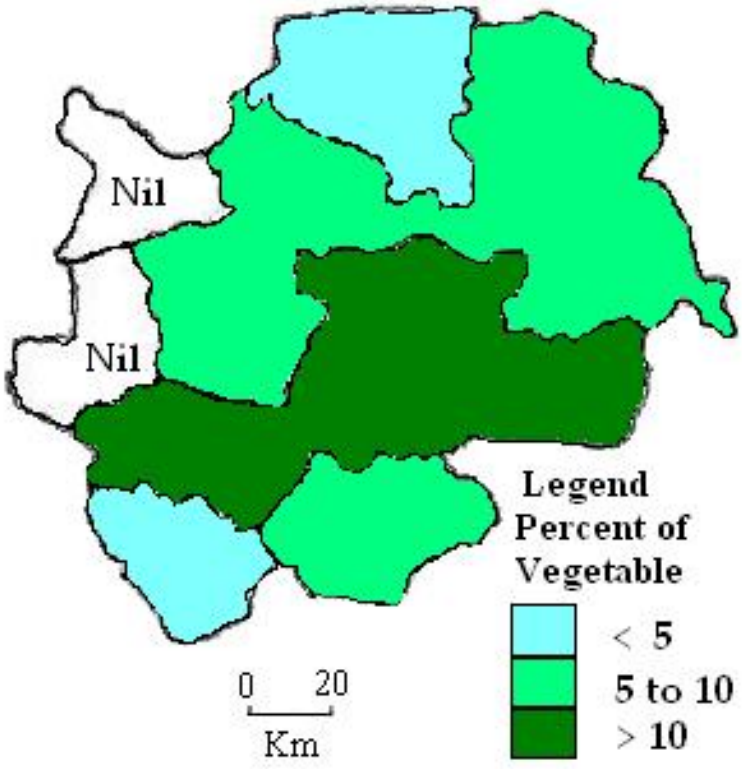
1. <u>The area more than 40 percent to the net sown area in the district:</u> The area of land occupying more than per cent of net sown area under bajra is found in the eastern and south part of

Nashik District - Distribution of Crops

Map 4.3: Bajra



Map 4.4: Vegetable



the district (map4.3). The concentration of the cultivation of this crop is in the tahsils viz Sinner (67.67 Per cent), Nandgaon (62.00 per cent), and Malegaon. (61.5 percent), Yeola (59.63 per cent), Satana (57.34 per cent) and Chandwad (52.91 per cent).

2) Land occupying between 20 to 40 percent to net sown area: The second category of 20 to 40 per cent area under bajra to net sown area occurs in two tahsils viz Niphad (30.62 per cent) and Kalwan (23.53 per cent) in the district.

3) Area less than 20 percent to net sown area under bajra: Nashik and Dindori tahsils in the district occupying less than 20 per cent area of net sown area under bajra (map4.3).

4-B.5.2: Vegetables

Vegetable ranks second in the district. It accounts for 7.67 per cent to the net sown area (64347 hectares). Vegetables are extensively grown in Nashik district due to the nearness of the district head quarter and Mumbai market where much of the produce is sold profitably. Besides the land and climatic condition in Nashik is very favorable for vegetable cultivation. It occupied an area of 64347 hectares in 2000-2001. Except the western hilly part consisting of Peth and Surgana tahsils vegetables are extensively grown in the rest of the district. The main vegetables grown in the district are onion, brinjal, fenugreek, lady's finger, carrot, sweet potato, potato, cabbage, tomato, radish etc.

Ecological condition:

Onion is the most important and area under onion is more as compare to other vegetables. It is produced in the kharif as well as Rabi seasons. The kharif crop is produced between August and November, while the Rabi crops is sown in November and

harvested in February. It requires a variety of soils, such as rich, sandy or medium black or black clayey loams.

Tomato is a considerable needful next to onion; tomato is widely grown in the district. Well drained light brown or black medium soils are suitable for the crop. The crop gets ready in 2.5 to 3.0 months. When the Fruits tomato change colors from green to red are harvested. Picking of red tomatoes is done at the frequency of three times in a fortnight.

Cabbage cultivation is mainly concentrated in Nashik, Dindori and Kalwan tahsils. Sandy loam and clay loam soils are suitable for this crop. Many time cabbages are grown along with cauliflower. Carrot is another most important vegetable widely grown in the district. The crop can be grown on sandy to medium clay soils.

Potato is grown where the rainfall ranges between 65 cm to 110 cm. and where the temperature is 60^0 to 70^0 F. It requires well-drained soil with a sandy loam or black cotton clayey texture. In the district, it is produced as a Rabi crop. The crop is ready for harvest within 90 days. Fenugreek is another important crop grown in the district. It is grown in garden land at any time of the year. Besides the other vegetables grown in the district are lady's finger, radish, sweet potato etc.

Spatial Distribution:

Vegetables are extensively grown in all the tahsils in the district except Peth and Surgana. The distribution of vegetable in the district shown as under;

1) Area more than 10 per cent to net sown area: The most concentration of vegetable is found in four tahsils. These tahsils has more than 10 per cent land to net sown area under

this crop (Map 4.4). This area receives average annual rainfall between 500 to 750 mm. Four tahsils have observed more than 10 per cent to the net sown area in this category. These tahsils are Chandwad (18.14 per cent), Nashik (12.03 Per cent), Niphad (10.87 per cent) and Yeola (10.79 per cent).

2) Land between 5 to 10 per cent: About 5 to 10 per cent land under vegetables is found in five tahsils, viz. Sinner (7.99 Per cent), Dindori (6.9 Percent), Malegaon (6.01 Per cent), Kalwan (5.89 per cent) and Nandgaon (5.78 per cent).
3) Less than 5 percent area under vegetable: Satana and Sinner observed that there is less than 5 per cent land under vegetable to the net sown area (map4.4).

4-B.5.3: Pulses

Pulses rank third in the district. It accounts for 7.64 per cent to the net sown area (64134 hectares) in the district. The chief pulses grown in the district are gram, horse grame, black-grame, mug and tur while math, chavali, vatana and Val are also grown on a small scale.

Ecological condition:

Gram occupies a prominent place and is grown extensively in the district. The area under gram was 15555 hectare in 2000-2010. It is produced as a Rabi crop. Severe cold, frost and cloudy weather do great damage to the crop. It is sown as a single crop in heavy soil, where it gives high yields, while in light soils; it is taken as a mixed crop. The land is made ready by September for sowing. The gram crop matures in about four months.

Next to gram Kulith (horse-gram) assumes an important place among the pulses in the district. It is grown either in rows or

with other crops in the kharif season. It is produced on deep red loams to black cotton soil, clay stony and poor sandy loam soils. The mix crop is sown in July. If sown mixed, it is found in all rows. Otherwise it is sown in the fourth row. The crop is sown as a subordinate to bajra or sometimes with Niger seed.

Mug is grown in the kharif season between June and August. It is grown on ordinary black and red soils. The crop becomes ready for harvesting after three and half months.

Tur is generally sown in June or July and is ripe for harvest either in February or in March. It is generally taken as a mixed crop with cotton, groundnut, jawar or bajra. Well-drained and medium to heavy soils are suitable for this crop. The crop is harvested from January onwards.

Udid is produced generally as a mixed crop either with jawar or with bajra in the kharif season. It is sown on black cotton, clayey soil, or light red or brown alluvial soil. The land is prepared by two ploughings followed by two harrowing.

Spatial Distribution:

Pulses ranks third accounting for 7.64 per cent (64134 hectares) to net sown area for 2000-01 in Nashik district. The maximum area of pulses is found at Surgana (20.29 percent to net sown area) in north-western part whereas minimum area under pulses is at Dindori (1.92 percent to net sown area). The spatial distribution of pulses in Nashik district can be studied under three classes as below;

1) Area having more than 10 percent land under pulses: Map4.5 clearly shows that the major concentration of pulses (More than 10 percent) is found in three tahsils in the district. These

tahsils are viz, Surgana (20.29 Percent), Nandgaon (12.23 Percent) and Kalwan (10.39 percent).

2) Land between 5 to 10 percent: About 5 to 10 percent land under pulses is found in nine tahsils in the district. These tahsils are viz Nashik (9.48 %), Satana (8.54%), Chandwad (8.14 %), Peth (7.43 %), Niphad (7.2 %), Yeola (7.04 %), Igatpuri (6.8 %), Malegaon (5.82 %) and Sinner (5.44 %).
3) Less than 5 percent area under pulses: Less than 5 percent land under pulses was observed only in Dindori tahsil in the district (map4.5).

4-B.5.4: Fodder

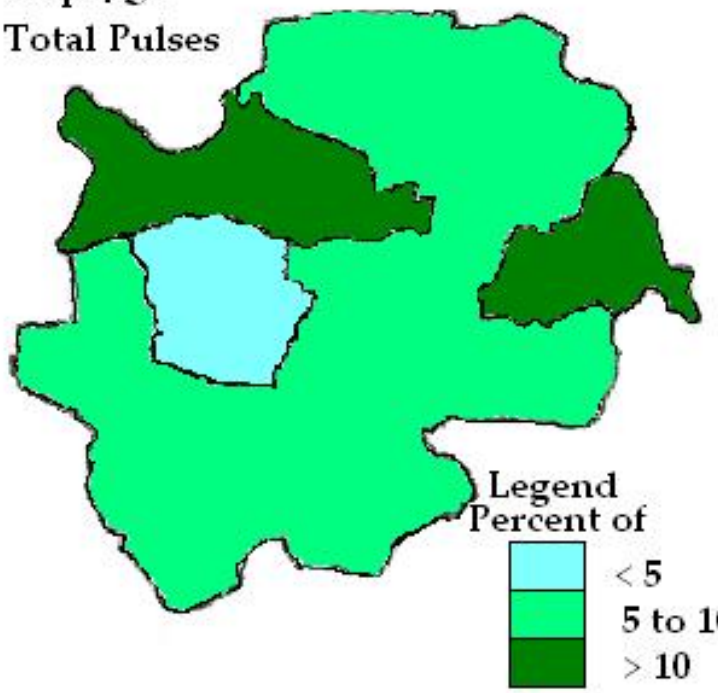
Fodder is kharif as well as rabbi crop occupying 62186 hectares (7.41 percent to net sown area) and ranks fourth in the district. It can be used as food of the animals.

Ecological condition:

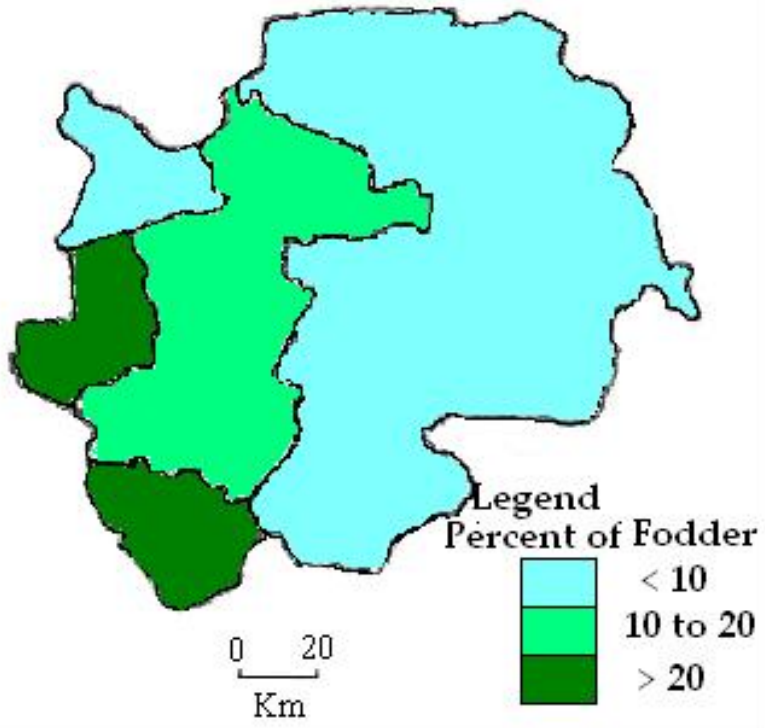
Fodder crops grown in different types of climatic conditions. It can be grown on all soil types. It's per hectare yield is depends on soil types. The average annual rainfall between 100 to 700 mm is suitable for proper growth. The fodder crops are grown on a large scale in the district. They comprise grass, lasoon ghas, summer jawar etc. It is grown in maximum tahsil. The field preparation is similar to crops grown in kharif as well as rabbi seasons in the district.

Nashik District : Distribution of Crops

Map 4.5:
Total Pulses



Map 4.6: Fodder



Spatial Distribution:

The spatial distribution of fodder crops is shown in map 4.4. It is obvious that soil types do not correlate with distribution of fodder. Maximum percent (More than 20%) under fodder is found in Igatpuri and Peth tahsils; whereas minimum (less than 10 %) is in Nandgaon and Satana tahsils. The distribution of fodder can be studied as under;

1) Areas having more than 20 percent to net sown area: More than 20 percent land under fodder is observed in Igatpuri (27.74 %) and Peth (20.30%) in the district where the soil are neutral in reaction, contain higher amounts of organic matter and are low in their basic status.
2) Areas having 10 to 20 percent to net sown area : Nashik, Dindori and Kalwan have areas between 10 to 20 percent land under fodder to net sown area are confined to fertile soils producing high yield per hectare in these three tahsils. The tahsils namely Dindori (19.95 %), Nashik (17.79 %) and Kalwan (16.81 %) in the study area under review (Map4.6).
3) Less than 10 percent land under fodder : The area under fodder crops having less than 10 percent to net sown area is found in eight tahsils namely Chandwad (5.62%), Surgana (5.1%), Sinner (4.3%), Niphad (2.2%0, Malegaon (1.65%), Yeola (0.98%), Satana (0.9%) and Nandgaon(0.27) area under fodder to net sown area (map4.6).

4-B.5.5: Oil-Seeds

Groundnut, Sunflower, Sesumum, Caster and Khurasani etc oil-seeds are produced in the district. Of these, groundnut is an important cash crop produced extensively in the district. Next to

groundnut and khurasani, Sunflower and Sesamum assume third and fourth position in the field of oil-seeds production. The area under all oil-seeds was 50523 hectares in 2000-2010. Generally 6.02 percent of the total area under cultivation is under oil-seeds in the district.

Ecological condition:

Groundnut is mainly a kharif crop. However it is also grown as a Rabi crop if irrigation facilities are available. It is sown on light sandy soils, or on medium black.

Sesamum is grown on light sandy loams or light soils, usually as a kharif crop. It is either grown as a mixed or border crop or as a single crop. It is sown in June or July.

Sunflower is a Rabi crop and is grown on black cotton soils, loams and light alluvial soils. However, it is seldom grown as a pure crop. The crop is sown in October or November and is harvested in March-April.

Mustard is grown throughout the year in gardens or during the cold season around wheat or gram fields or mixed with wheat or linseed. The leaves and green pods are eaten as vegetable.

Niger is a kharif crop and is grown mostly under conditions of moderate rainfall not exceeding 40 inches. The peculiarity of the crop is that it requires no ploughing and no manuring. It is grown on light red and brown loam soils. The crop is generally sown in June or July and taken as a mixed crop mostly along with ragi and sometimes along with groundnut, castor or bajra.

Spatial Distribution

It is observed from map 4.7 that Nashik district has cultivated oil seeds everywhere in the district. The spatial distribution of oilseeds can be studied as under;

1) Area having more than 10 percent to net sown area: It is observed that more than 10 percent land under oilseeds occurs in the western part of the district (map4.7). The tahsils include namely Igatpuri (11.73 %), Surgana (11.48 %) and Peth (11.33 %).

2) About 5 to 10 percent land under oilseeds: About 5 to 10 percent land under oilseeds has observed in eastern and central part of the district. Maximum percentages of this category are observed at eastern part of Malegaon (8.71 percent to net sown area) and minimum at Niphad (6.24 percent to net sown area) in the central part of the district.

3) Less than 5 percent : Less than 5 percent land under oil seeds is found in Kalwan (4.13 %), Satana (3.48 %), Chandwad (3.4 %), Sinner (3.00 %) and Yeola (1.88 %) in the area under review (map4.7).

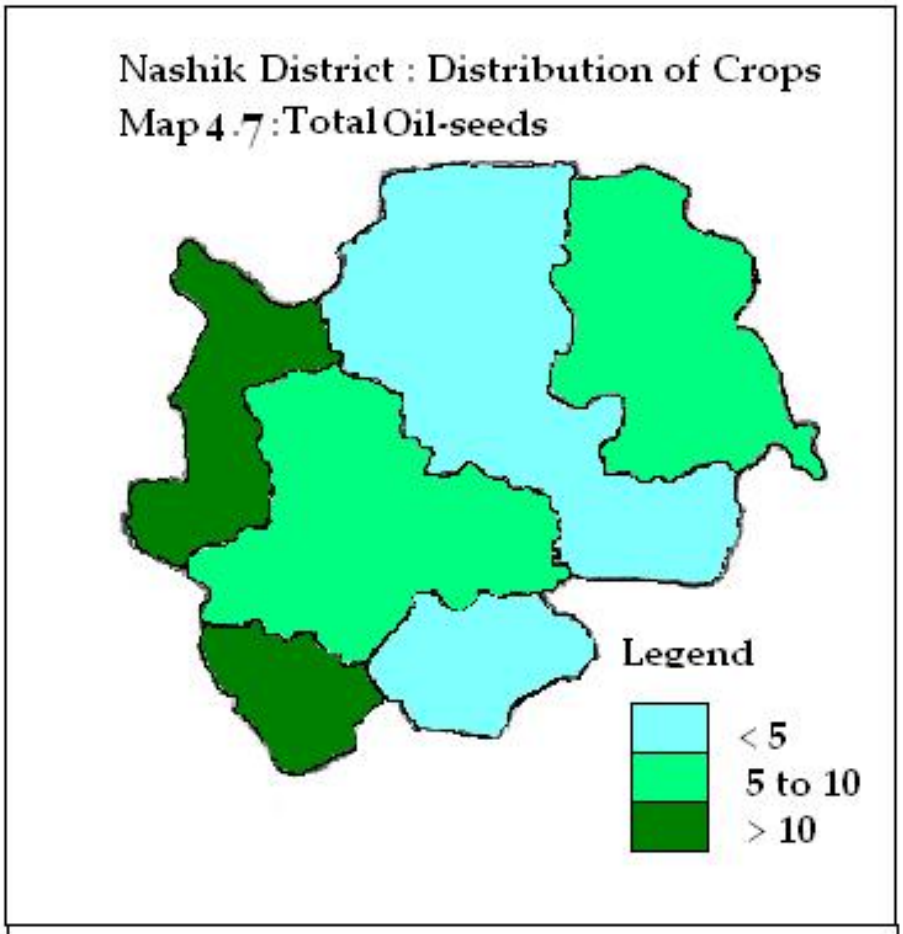
4-B.5.6: Rice

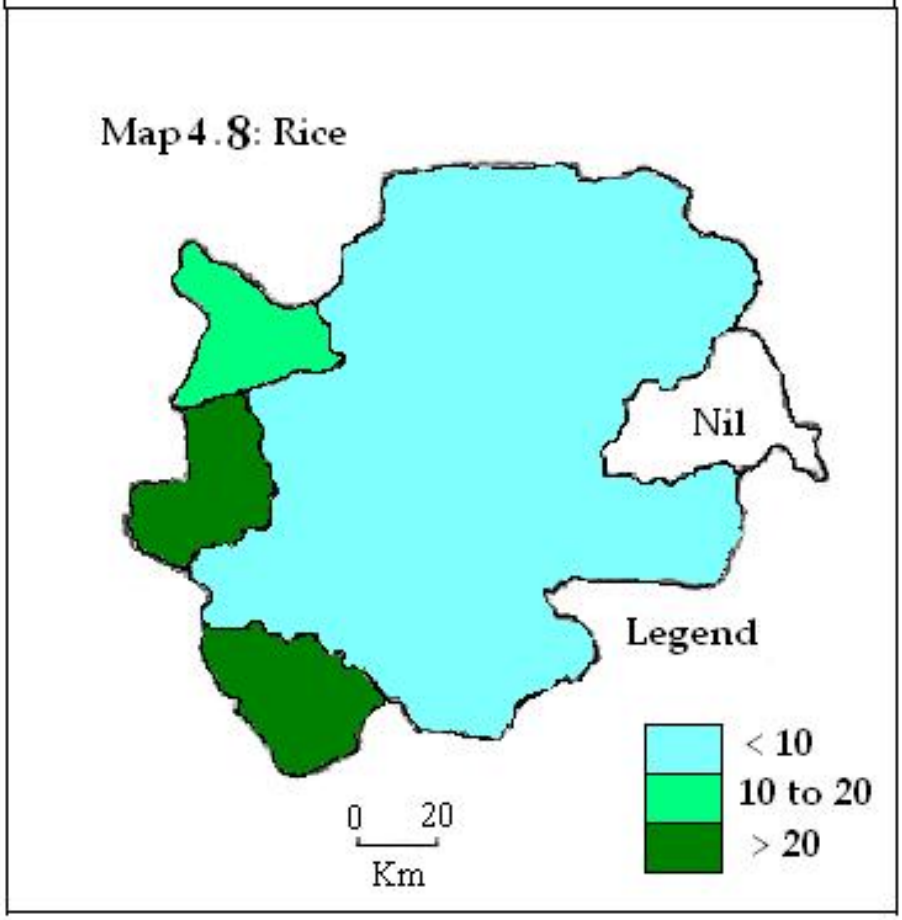
Rice is a kharif crop sown on 46536 hectares (5.54 percent) to net sown area of the district. It ranks sixth and grown to some extent almost all over the district, but mostly in Igatpuri, Peth and Surgana tahsils.

Ecological Condition:

Nashik district is famous for its superior varieties of rice such as *ambemohor* and *chimansal*. Rice is a kharif crop and generally grown on light and black soil. The temperature ranging between 20^0 to 37^0C is optimum for growth. It grows well in the areas where rainfall is between 1000 mm to 1100 mms.

The agricultural department has suggested *Halvi Kolpi 70*, *Garvikolpi 248* and *Bhadas 1303* as the improved strains for the district.


Nashik District : Distribution of Crops
Map 4.7 : Total Oil-seeds
Legend
< 5
5 to 10
> 10


Map 4.8: Rice
Nil
Legend
< 10
10 to 20
> 20
0 20
Km

Spat

Spatial Distribution:

The spatial distribution of rice in the district is shown in map5.6. This map reveals three distinct areas of rice distribution are as under;

1) Area having more than 20 percent to net sown area: The land more than 20 percent to net sown area under rice is found in the western part (i.e. Downghat Konkan) of the district, viz in the Igatpuri (33.56 %) and Peth (24.31 %) tahsils.
2) About 10 to 20 percent land to net sown area: It is found only in Surgana (17.6 %) tahsil.
3) Less than 10 percent land under rice to net sown area: The third category is less than 5 percent land to net sown area under rice found in nine tahsils to the eastern part except downghat konkan. The notable tahsils where rice is cultivated between 5 to 10 percent out to net sown area are viz. Dindori (8.47 %), Nashik (8.33 %), and Kalwan (6.47 %). While less than 5 percent area to net sown area are viz , Sinner (2.5 %), Satana (0.65 5), Chandwad (0.44 %), Niphad (0.31 %), Malegaon (0.06 %) and Yeola (0.03) (map4.8).

4-B.5.7: Nachani

Nachani ranks seventh in Nashik district with 4.79 percent to net sown area (40220 hectares). The crop is grown in the high rainfall areas of Peth, Surgana and Igatpuri tahsils.

Ecological Condition:

Nachani is entirely a rain-fed crop, and is generally grown on too light soil and sloping lands. The crop is weeded once, and superfluous seedlings are thinned out. No further attention is required until the harvest time. The crop becomes ready for harvest by October or the beginning of November. The crop is

grown in the high rainfall areas of Peth, Surgana and Igatpuri tahsils.

Spatial Distribution:

The spatial distribution of nachini is shown in map 4.9. It is obvious that soil types do not correlate with distribution of nachani. Maximum percentages under nachani are found in Surgana to the north-western part of the district, whereas minimum percentages are found in Igatpuri to the south-western part of the district. The distribution of nachani can be studied as under;

1) Area having more than 30 percent to net sown area : It is observed that more than 30 percent land under nachani occurs in north-western part of the district, viz. in Surgana (40.08 %) and Peth (33.4 %) tahsils.

2) About 15 to 30 percent land under nachani: 15 to 30 percent land under nachani has observed only in Dindori (18.69 %) tahsil.

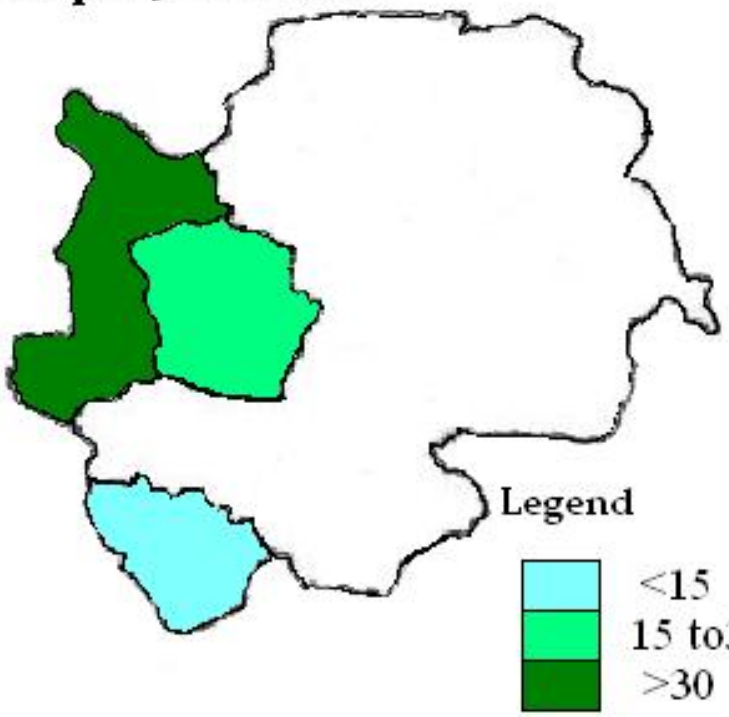
3) Less than 15 percent hectare: Less than 15 percent land under nachani is found in Igatpuri tahsil (13.02 %) in the district (map4.9).

4-B.5.8: Wheat

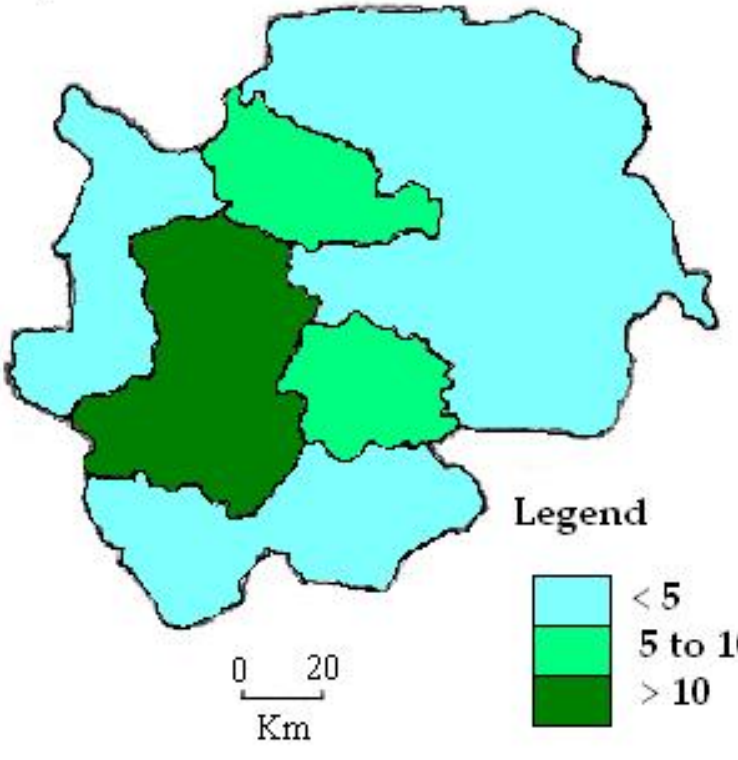
Wheat is Rabi crop in Nashik district. It accounts 4.64 percent to net sown area (38945 hectares) in all tahsils of the district. Wheat ranks eighths in the district. It can be used for many purposes such as bread-making, chapatti and in different forms of food.

Nashik District : Distribution of Crops

Map 4.9 : Nachani



Map 4.10 : Wheat



Ecological condition:

Wheat grows in varying climatic conditions but it does thrive well under cool, dry and clear weather. It requires cool weather in early stage for proper tillering. Dry, sunny days and cool nights are helpful. Moreover, long duration of day and short nights are essential for optimum growth of plants. Temperature ranging from 7^0 C to 21^0 C finds better for wheat.

Wheat is a Rabi crop, sown in October and harvested in March. The irrigated crop is grown on medium or black soil which is moisture-retentive. The crop takes about five months to mature and is ready for harvesting from the middle of February to the end of March.

Spatial Distribution:

Wheat is grown in all tahsils in the district (map4.10). Most of the area under wheat is found in Nashik tahsil (14.25 percent to net sown area) and less is in Nandgaon (0.15 percent to net sown area). It is noticed that area under wheat is not extensive in each tahsils due to the different physical condition. The distribution of wheat can be studied under following categories;

1) The area of wheat more than 10 percent land to net sown area: The major concentration of wheat is found in Nashik and Dindori tahsils. This tahsils has more than 10 percent land to net sown area under this crop (map4.10). Two tahsils have observed more than 10 percent to net sown area in this category. These tahsils are viz. Nashik (14.25 %) and Dindori (13.67%).
2) About 5 to 10 percent land under wheat: About 5 to 10 percent land under wheat is found in two tahsils namely, Kalwan (7.89%) and Niphad (6.65%).

3) Less than 5 percent area to net sown area: Less than 5 percent land to net sown area under wheat is found in nine tahsils of the district. The notable tahsils where wheat is cultivated less than 5 percent to the net sown area are viz. Sinner (3.89 %), Satana (3.96%), Yeola (3.94 %), Chandwad (3.19%), Igatpuri (3.05%), Peth (2.3 %), Malegaon (2.23 %), Surgana (1.04%) and Nandgaon (0.15 %) in the area under review.

4-B.5.9: Jawar

Jawar is staple crop provides food to human and fodder to livestock's. It is growned on 30860 hectares (Kharif and Rabi) throughout the district. Jawar is mainly cultivated for local consumption.

Ecological Condition:

Jawar is essentially a tropical crop grown in both kharif and Rabi seasons. It thrives better under the condition of high temperature of 27^0 C. It requires average annual rainfall between 600 to 1000mm. Jawar is drought resistant , remains dormant during the period of drought and starts active growth when the moisture in soil improve. Jawar thrives well in medium black to heavy soils. Kharif jawar is produced between June and December while Rabi jawar is produced between September and February.

Spatial Distribution:

The spatial distribution of jawar is largely controlled by average annual rainfall, soil types and altitude of the farmers of the district. Increasing awareness among farmers to adopt new varieties of crops for sowing has changed the cropping pattern of jawar and hence the major concentration of this crop is mostly

confined to Dindori and Yeola tahsils in the district. The main features of spatial distribution of jawar are as below;

1) The area of Jawar more than 10 percent land to net sown area: The major concentration of jawar is found in Dindori tahsil. This tahsil has more than 10 percent (11.39 %) land to net sown area under this crop (map4.11).
2) 5 to 10 percent land to net sown area: About 5 to 10 percent land under jawar is found only in Yeola (6.69 %) tahsil in the district.
3) Less than 5 percent area to net sown area: The third category of less than 5 percent land to net sown area under jawar is found in eleven tahsils of the district. The notable tahsils where jawar is cultivated less than 5 percent to net sown area is viz. in Niphad (4.36 %), Chandwad (4.13 %), Surgana (3.86 %), Kalwan (3.55 %), Nandgaon (2.85 %), Malegaon (2.45 %), Peth (2.24 %), Satana (1.89 %), Sinner (1.83 %), Igatpuri (1.4 %) and Nashik (1.06 %) tahsil in the area under study.

4-B.5.10: Sugarcane

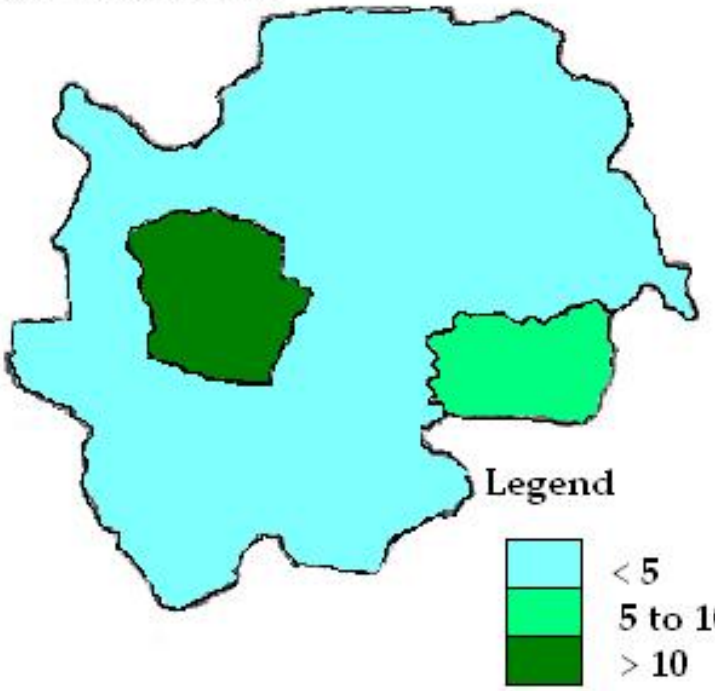
Sugarcane is one of the important cash crops of the district. Sugarcane ranks tenth in the district. It accounts for 3.45 percent to net sown area (28967 hectares). This crop is cultivated in ten tahsils of the district.

Ecological Condition:

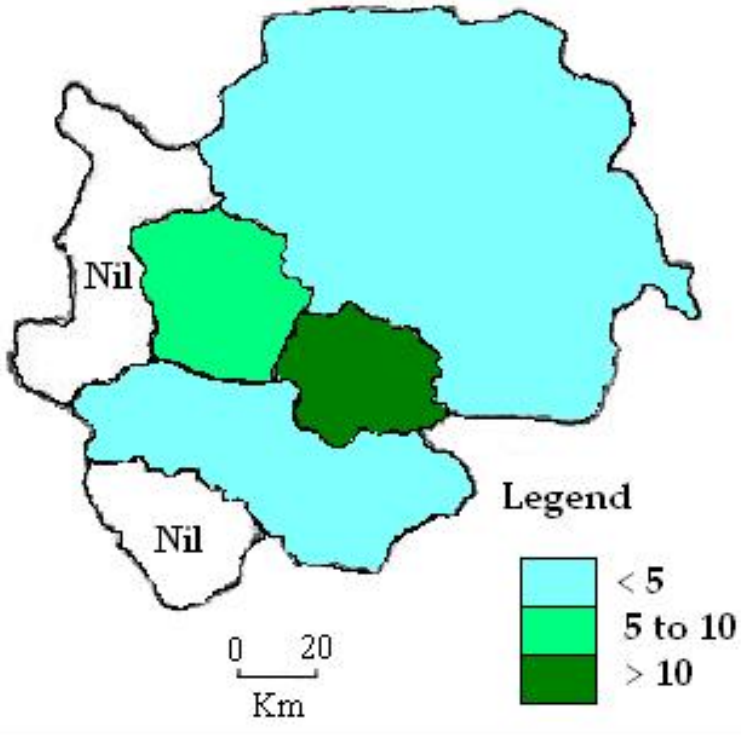
Sugarcane is a tropical crop and for high outturns moist hot climate and ample supply of water are necessary. It is entirely an irrigated crop. The crop is grown on heavy black and well-drained soils. The planting is done either in January, July or in October.

Nashik District : Distribution of Crops

Map 4.11 : Jawar



Map 4.12 : Sugercane



Mostly the plantation of sugarcane seen in the month of July locally known as "*adsali lagan"*.

Spatial Distribution:

Sugarcane is successfully grown in the district except the western hilly part (map4.12). It is entirely an irrigated crop. The crop is grown on heavy black and well-drained soils. The spatial distribution of sugarcane is shown in map 4.12. It is from map4.12 that this crop is found in three categories as under;

1) Areas having more than 10 percent land under sugarcane: The major concentration of sugarcane is found in Niphad tahsil. This tahsil has more than 10 percent land (18.08 %) to net sown area under this crop (map4.12). This tahsils is well developed for cannel irrigation and well irrigation.
2) Land between 5 to 10 percent: About 5 to 10 percent land under sugarcane is found in Dindori tahsil (7.27 % to net sown area).
3) Less than 5 percent area under sugarcane: The third category of less than 5 percent land to net sown area under sugarcane is found in eight tahsils in the district. The tahsils where sugarcane is cultivated less than 5 percent out to net sown area are viz. Satana (3.99 %), Kalwan (3.79 %), Nashik (3.15 %), Nandgaon (1.81%), Sinner 9 1.75 %), Yeola (0.93 %), Malegaon (0.76 %) and Chandwad (0.61 %) in the district.

4-B.5.11: Fruits

Grapes, pomegranate, guava, mango, lemon, papaya, banana etc. are grown in the district. These grapes and pomegranates are important and are grown widely in the district. Besides other fruits are also grown but to a very limited extent.

Total fruits ranks eleventh in the district. It accounts for 26897 hectares (3.2 %) to the net sown area.

Ecological Condition:

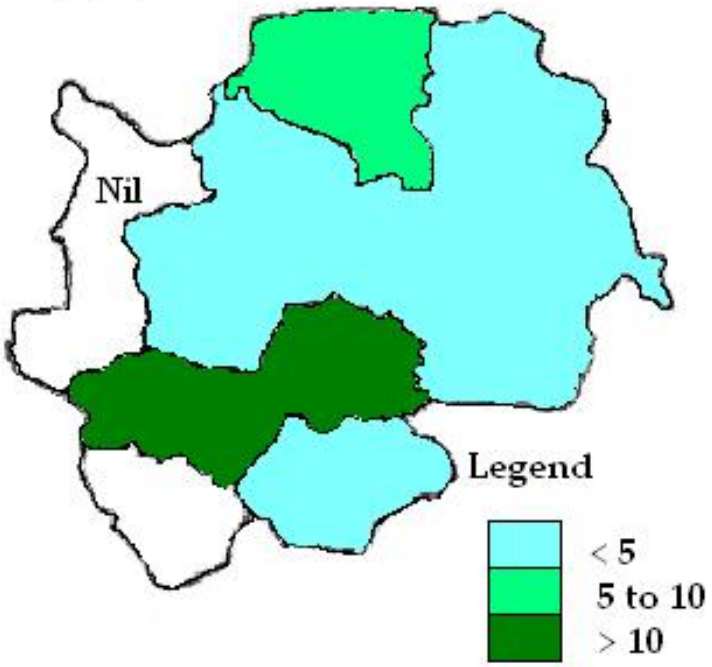
Grapes are grown well in dry climate with sharp but short winters and long dry summers. Lighter types of soils with good drainage are the best for the crop. Grapes are planted from the cutting of mature grape vines. Cuttings from October pruning are selected and are then planted in nursery. The cuttings are joint up to second joint and watered every day till they are established. Grape cultivation requires intensive work and higher investment than other agricultural crops. The grapes become transparent by February and are ready for harvest by March. Grapes should be plucked only when they are ripe. Within 14 months of its plantation grapes start bearing. However it bears a full crop only from third year. Harvesting is done twice, i.e., in April and in October.

Mango trees grow well on deep heavy soils with good drainage. Good varieties of mangos are usually propagated by grafts. Mango plantation generally requires no aftercare such as watering etc. after 4 to 5 years, as the roots penetrate deep into the soil. The mango tree bears fruit after five years of its plantation.

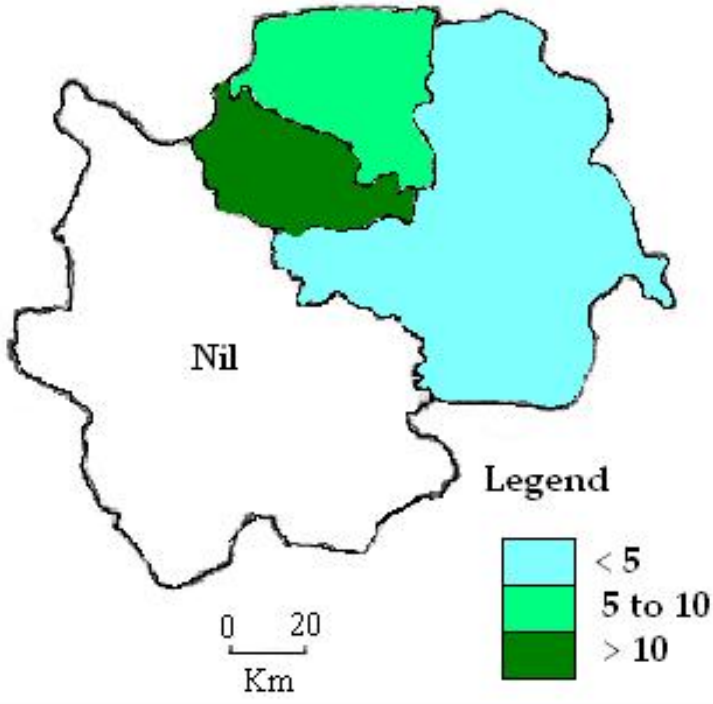
Guava is grown on a variety of soils, viz. alluvial, bhata soils, black soils and black reddish soils. Guava is propagated from seeds. However for quality fruits grafts from selected trees are used. Guava plantation from lasts 12-20 years. However the soil and the care bestowed upon it also determine its life.

Nashik District : Distribution of Crops

Map 4.13 : Total Fruits



Map 4.14: Maiz



Papaya suits any type of soil. However humid and warm climate is most suitable. The crop reacts adversely to frosty climate and it requires very well-drained soil.

Spatial Distribution:

The spatial distribution of total fruits in the district is shown in map4.13. The trend of the fruit cultivation is going on increase in the farmers. Map4.13 reveals three distinct areas of fruits distribution are as under;

1) Area having more than 10 percent to net sown area: The land more than 10 percent to net sown area under fruits is found in Nashik (11.48 %) and Niphad (10.7 %) tahsils in the district (map4.13).
2) About 5 to 10 percent fruit to net sown area: About 5 to 10 percent land under fruits observed only in one tahsil viz, Satana.
3) Less than 5 percent is under fruits to net sown area: The third area of having less than 5 percent is under fruits to net sown area is found in seven tahsils in the district viz, Malegaon (4.46 %), Dindori (2.86 %), Chandwad (2.71 %), Kalwan (0.89 %), Sinner (0.8 %), Yeola (0.56 %) and Nandgaon (0.44 %).

4-B.5.12: Maize

Maize is staple crop and provides food to human and fodder to livestock. This improved variety of seeds are producing high yield per hectares. Maiz ranks 12th in the district and accounts an area of 20159 hectares (2.4 %) to the net sown area in the district.

Ecological Condition:

Maize is a tropical crop grown in both kharif and Rabi seasons. It thrives better under the condition of high temperature of 27^0 C. It requires average annual rainfall between 600 to 1000mm. Maiz is drought resistant and remains dormant during the period of drought and starts active growth when the moisture in soil improve. Maize thrives well in medium black to heavy soils. Kharif Maize is produced between June and December while Rabi maiz is produced between September and February.

Spatial Distribution:

Maize is successfully grown in the north eastern part of the district (map4.14). The improved seeds of this crop assured high yield per hectares. The medium to deep black soil in the district is also useful to widespread of this crop and hence the spatial distribution and its areal extent are confined by these factors. The spatial distribution of maize is shown in map4.14. The main features of spatial distribution of maize are as below;

1) The area of maize more than 10 percent land to net sown: It is observed that more than 10 percent land to net sown area has concentrated in Kalwan tahsil (12.75 percent to net sown area).
2) 5 to 10 percent land under maize to net sown area: About 5 to 10 percent land to net sown area is found only in one tahsil, i.e. Satana (8.88 %) in the district.
3) Maize having less than 5 percent area to net sown area: Less than 5 percent land under maiz was observed in four tahsils, viz. Yeola (4.37%), Malegaon (3.85%, Nandgaon (0.87%) and Chandwad (0.1%) in the district.

4-B.5.13: Other Crops

Other crops include Vari, Ragi, Cotton, Ambadi, Sann, Chilies, Garlic and Coriander (Dhane). Insignificant hectarage are under this category (4.34 percent to net sown area) occupying 36452 hectare area of the district.

Ecological Condition and Farm Operation:

The above mentioned crops can grow in varied climatic conditions and soil types. Generally, these crops are cultivated in kharif as well as rabbi seasons. The field preparation is similar to crops grown in kharif as well as rabbi season in the district.

Spatial Distribution:

It is observed that more than 4 percent land under other crops found only in Nandgaon (4.37%) tahsil. About 2 to 4 percent land under other crops has observed in five tahsils, viz. Kalwan(3.41%), Yeola(3.17%), Nashik(2.82%), Niphad(2.77%) and Malegaon(2.49%) while less than 2 percent land under other crops is found in seven tahsils, viz. Dindori(1.49%), Satana(1.03%), Sinner(0.74%), Surgana(0.67%), Chandwad(0.61%), Igatpuri (0.37%) and Peth (0.01%) in the area under study.

Chapter 5

LEVELS OF ARGICULTURAL DEVELOPMENT

5.1: INTRODUCTION

The study of levels of agricultural development is based upon the method of cluster analysis. For this study six parameters have been chosen. They are as follows;

1. Net sown area as percentage of total geographical area.
2. Land under irrigation as percentage of net sown area.
3. Number of tractors per 100 hectare of net sown area.
4. Number of livestock per 100 hectare of net sown area.
5. Loans advanced in Rs. per 100 hectare of net sown area.
6. Over dues in Rs. per 100 hectare of net sown area.

The cluster or groupings have been formed for the years 1980-81 and 2000-01. The hierarchy for the year 1980-81 and 2000-01 has to be established.

5.2: CLUSTER ANALYSIS FOR THE YEAR 1980-81

For Hierarchical cluster of 1980-81 (table 5.1 and map5.1/ A) tahsils of the study area are grouped in five clusters. These five clusters are arranged into ascending hierarchy.

5.2.1: Most Backward

Peth, Surgana, Kalwan and Nandgaon tahsils comes under this category. Peth tahsil have 31.1 percent of net sown area to total geographical area, Surgana tahsil have 35.9 percent of net sown area to total geographical area, while Kalwan tahsil have 32.3 percent of net sown area to total geographical area and Nandgaon tahsil have 55.0 percent of net sown area to total geographical area. The percentage of irrigated land to net sown area in the tahsil was 0.04 percent in Peth, 0.09 percent in Surgana, 9.33 percent in Kalwan and 4.96 percent of in

Table 5.1: Data of six parameters for identification of level of agricultural development using cluster analysis 1980-81

Tahsil	% NSA to TGA	% of Irrigated Land to NSA	No. of Tractors per 100 hectare of NSA	No. of Livestock per 100 hectare of NSA	Loans in Rs. per 100 hectare of NSA	Overdue in Rs per 100 hectare of NSA
Nashik	45.2	10.45	0.51	217.92	66.96	36.2
Peth	31.1	0.04	0.04	281.49	--	--
Dindori	54.6	6.58	0.00	179.63	50.07	57.86
Surgana	35.9	0.09	0.00	266.99	--	--
Kalwan	32.3	9.33	0.55	418.69	44.13	51.08
Satana	49.7	10.95	0.52	333.79	58.91	65.86
Malegaon	58.1	9.16	0.22	238.98	24.57	55.65
Chandwad	67.7	8.07	0.59	158.35	27.44	30.15
Nandgaon	55.0	4.96	0.15	258.44	11.16	39.3
Yeola	68.7	11.02	0.74	188.67	20.65	28.14
Niphad	79.1	44.31	1.42	179.80	197.61	142.30
Sinner	67.2	9.47	0.34	185.40	21.51	36.53
Igatpuri	53.6	2.02	0.08	216.18	3.9	11.36
Total	54.5	11.37	0.44	231.83	46.52	50.06

(Source: By the Researcher)

[**NSA**: Net Sown Area, **TGA**: Total Geographical Area]

Nandgaon tahsil. Number of tractors per 100 hectare of net sown area in the tahsils was 0.04 percent in Peth, 0.00 percent in Surgana, 0.55 percent in Kalwan and 0.15 percent in Nandgaon tahsil. Number of livestock per 100 hectares of net sown area in the tahsils was 217.92 percent in Peth, 266.99 percent in Surgana, while 418.69 percent in Kalwan, and 258.44 percent in Nandgaon tahsil. Loans in Rs. per 100 hectares of net sown area was zero percent in Peth and Surgana tahsil while 44.13 percent in Kalwan tahsil and 11.16 percent in Nandgaon tahsil. Over dues Rs. per 100 hectares to net sown area was again zero percent in Peth and Surgana tahsils. While 51.08 percent in Kalwan tahsil and 39.3 percent was observed in Nandgaon Tahsil.

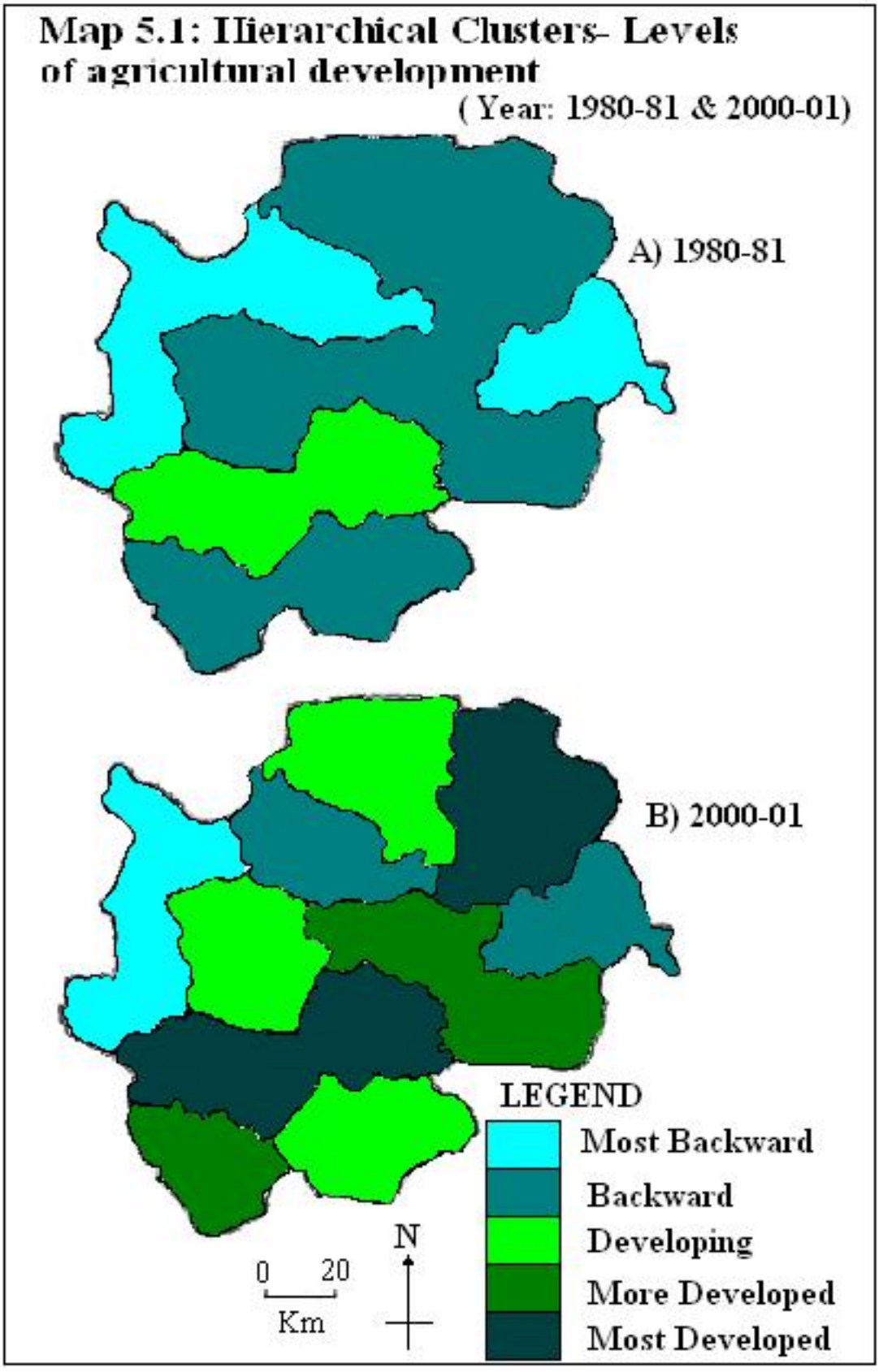
5.2.2: Backward

Seven tahsils, viz. Dindori, Satana, Malegaon, Chandwad, Yeola, Sinner and Igatpuri are come under this category. The net sown area to total geographical area was observed in Dindori tahsil 54.6 percent, 49.7 percent in Satana, 58.1 percent in Malegaon, 67.7 percent in Chandwad, 68.7 percent in Yeola, 67.2 percent in Sinner and 53.6 percent in Igatpuri tahsil (table 5.1 and map 5.1/A).

Percentage of Irrigated land to net sown area was 6.58 percent in Dindori tahsil, 10.95 percent in Satana, 9.16 percent in Malegaon, 8.07 percent in Chandwad, 11.02 percent in Yeola, 9.47 percent in Sinner and 2.02 percent in Igatpuri tahsil.

Number of tractors per 100 hectares of net sown area was 0.00 percent in Dindori, 0.52 percent in Satana, 0.22 percent in Malegaon, 0.59 percent in Chandwad, 0.74 percent in Yeola, 0.34 percent in Sinner and 0.08 percent in Igatpuri tahsil.

Numbers of livestock per 100 hectares to net sown area in Dindori tahsil have 179.63, while 333.79 percent in Satana, 238.98 percent in



Malegaon, 158.35 percent in Chandwad, 188.67 percent in Yeola, 185.40 percent in Sinner and 216.18 percent in Igatpuri tahsil.

Loans Rs. per 100 hectares of net sown area was 50.07 percent in Dindori tahsil, 58.91 percent in Satana, 24.57 percent in Malegaon, 27.44 percent in Chandwad, 20.65 percent in Yeola, 21.51 percent in Sinner and 3.9 percent of loans per 100 hectares in Igatpuri tahsil.

Over dues Rs. per 100 hectares to net sown area was 57.86 percent in Dindori tahsil, 65.86 percent in Satana, 55.65 percent in Malegaon, 30.15 percent in Chandwad, 28.14 percent in Yeola, 36.53 percent in Sinner and 11.36 percent of over dues per 100 hectares in Igatpuri tahsil (table 5.1 and map 5.1/A).

5.2.3: Developing

Nashik and Niphad tahsils are come under this category. Net sown area to total geographical area of Niphad tahsil has the highest i.e. 79.1 percent and Nashik tahsil has 45.2 percent. Percentage of irrigated land to net sown area is more in Niphad tahsil i.e. 44.31 percent and Nashik has 10.45 percent. Number of tractors per 100 hectares to net sown area is high in Niphad tahsil i.e. 1.42 percent and 0.51 percent in Nashik tahsil. Number of livestock per 100 hectares to net sown area is high in Nashik tahsil i.e. 217.92 percent and 179.8 percent in Niphad tahsil. Loans Rs. per 100 hectares to net sown area is high in Niphad tahsil i.e. 197.61 percent and 66.96 percent in Nashik tahsil. While over dues Rs. per 100 hectares of net sown area is maximum in Niphad tahsil i.e. 142.3 percent and 36.2 percent in Nashik tahsil (table 5.1 and map 5.1/A).

5.2.4: More Developed

Not a single tahsil of the district comes under this category.

5.2.5: Most Developed

Not a single tahsil of the district comes under this category.

5.3: CLUSTER ANALYSIS FOR THE YEAR 2000-01

Hierarchical cluster of 2000-01 (table 5.2 and map 5.1/B) tahsils of the study area are grouped in five clusters. These five clusters are arranged into ascending hierarchy.

5.3.1: Most Backward

Peth and Surgana are the most backward tahsils in the district. Net sown area to total geographical area of Peth tahsil has 39.4 percent and Surgana 37.9 percent. While Percentage of irrigated land to net sown area is 1.47 in Peth and 0.46 percent in Surgana. Number of tractors per 100 hectares to net sown area is 0.11 % in Peth tahsil and 0.28 percent in Surgana tahsil. Number of livestock per 100 hectares to net sown area is 300.8 Peth tahsil and 208.48 percent in Surgana tahsil. Loans per 100 hectares to net sown area are zero percent in both tahsils. While over dues Rs. per 100 hectares to net sown area are also zero percent in both the tahsils.

5.3.2: Backward

Kalwan and Nandgaon tahsils comes under this category. Kalwan tahsil have 42.3 percent and Nandgaon tahsil have 48.2 percent of net sown area to total geographical area. The percentage of irrigated land to net sown area was 12.33 percent in Kalwan tahsil and 7.4 percent in Nandgaon tahsil. Number of tractors per 100 hectare of net sown area was 1.68 percent in Kalwan and 1.1 percent in Nandgaon tahsil. Number of livestock per 100 hectares of net sown area was 355.93 percent in Kalwan tahsil and 319.35 percent in Nandgaon tahsil. Loans Rs. per 100 hectares of net sown area was 329.84 percent in Kalwan tahsil and 151.34 percent in Nandgaon tahsil. Over dues Rs. per 100 hectares of net sown

Table 5.2: Data of six parameters for identification of level of agricultural development using cluster analysis 2000-01

Tahsil	% NSA to TGA	% of Irrigated Land to NSA	No. of Tractors per 100 hectare of NSA	No. of Livestock per 100 hectare of NSA	Loans in Rs. per 100 hectare of NSA	Overdue in Rs per 100 hectare of NSA
Nashik	26.7	72.01	1.90	402.92	1843.74	438.16
Peth	39.4	1.47	0.11	300.80	--	--
Dindori	54.4	18.06	2.19	189.79	623.00	167.13
Surgana	37.9	0.46	0.28	208.48	--	--
Kalwan	42.3	12.33	1.68	355.93	329.84	125.81
Satana	49.3	14.81	1.03	310.99	403.12	162.60
Malegaon	58.0	8.51	0.87	306.93	296.55	92.13
Chandwad	68.5	25.09	1.87	270.61	449.17	117.17
Nandgaon	48.2	7.40	1.10	319.35	151.34	64.85
Yeola	68.6	20.6	3.39	190.22	247.95	145.72
Niphad	68.8	47.59	3.67	200.27	1531.35	462.83
Sinner	58.4	18.84	1.93	246.17	228.03	163.68
Igatpuri	60.2	2.49	0.41	178.72	67.33	90.75
Total	54.0	17.71	1.93	258.72	413.12	144.18

(Source: By the Researcher)

area was 125.81 percent in Kalwan tahsil and 64.85 percent in Nandgaon Tahsil (table 5.2, map 5.1/B).

5.3.3: Developing

Three tahsils of the district, viz. Dindori, Satana and Sinner come under this category. Net sown area to total geographical area of Dindori tahsil has 54.4 percent, Satana tahsil 49.3 percent and Sinner tahsil has 58.4 percent. Percentage of irrigated land to net sown area is 18.06 % in Dindori tahsil, 14.81 percent in Satana tahsil and 18.84 percent in Sinner tahsil. Number of tractors per 100 hectares of net sown area is 2.19 % in Dindori tahsil, 1.03 percent in Satana and 1.93 percent in Sinner tahsil. Number of livestock per 100 hectares of net sown area is 189.79 % in Dindori tahsil, 310.99 percent in Satana tahsil and 246.17 percent in Sinner tahsil. Loans Rs. per 100 hectares of net sown area is 623.0 percent in Dindori tahsil, 403.12 percent in Satana tahsil and 228.03 percent in Sinner tahsil. While over dues in Rs. per 100 hectares of net sown area is 167.13 percent in Dindori tahsil, 162.6 percent in Satana tahsil and 163.68 percent in Sinner tahsil (table 5.2, map 5.1/B).

5.3.4: More Developed

Chandwad, Yeola and Igatpuri tahsils come under this category. Percentage of net sown area to total geographical area is in Chandwad tahsil 68.5 percent, Yeola tahsil 68.6 percent and Igatpuri tahsil 60.2 percent. Percentage of irrigated land to net sown area is 25.09 percent in Chandwad tahsil, 20.6 percent in Yeola tahsil and 0.41 percent in Igatpuri tahsil. Number of tractors per 100 hectares to net sown area is 1.87 percent in Chandwad tahsil, 3.39 percent in Yeola tahsil and 0.41 percent in Igatpuri tahsil. Number of livestock per 100 hectares to net sown area is 270.61 percent in Chandwad tahsil, 190.22 percent in Yeola tahsil and 178.72 percent in Igatpuri tahsil. Loans Rs. per 100 hectares to net sown area is 449.17 percent in Chandwad tahsil, 247.95

percent in Yeola tahsil and 67.33 percent in Igatpuri tahsil. While over dues Rs. per 100 hectares to net sown area is 117.17 percent in Chandwad tahsil, 145.72 percent in Yeola tahsil and 90.75 percent in Igatpuri tahsil (table 5.2, map 5.1/B).

5.3.5: Most Developed

Three tahsils of the district, viz. Nashik, Malegaon and Niphad are agriculturally most developed. Net sown area to total geographical area of Nashik tahsil has 26.7 percent, Malegaon tahsil has 58.0 percent and Niphad tahsil has 68.8 percent. While Percentage of irrigated land to net sown area is 72.01 % in Nashik tahsil, 8.51 percent in Malegaon tahsil and 47.59 percent in Niphad tahsil. Number of tractors per 100 hectares to net sown area is 1.9 percent in Nashik tahsil, 0.87 percent in Malegaon tahsil and 3.67 percent in Niphad tahsil. Number of livestock per 100 hectares to net sown area is 402.92 percent in Nashik tahsil, 306.93 percent in Malegaon tahsil and 200.27 percent in Niphad tahsil. Loans Rs. per 100 hectares to net sown area is 1843.74 percent in Nashik tahsil, 296.55 percent in Malegaon tahsil and 1531.35 percent in Niphad tahsils. While over dues Rs. per 100 hectares to net sown area is 438.16 percent in Nashik tahsil, 92.13 percent in Malegaon tahsil and 462.83 percent in Niphad tahsil (table 5.2, map 5.1/B).

5.4: TEMPORAL VARIATIONS OF HIERARCHICAL CLUSTERS:

[Between 1980-81 to 2000-01]

Two tahsil, viz. Peth and Surgana shows that there is no change in the rank (table 5.3 and map 5.2). These tahsils having hilly with forest covered land and tribal area. Hence there is no chance in agricultural development. Kalwan and Nandgaon having only one rank in 2000-01. 2.44 percent irrigated area is increased in Nandgaon tahsil to net sown

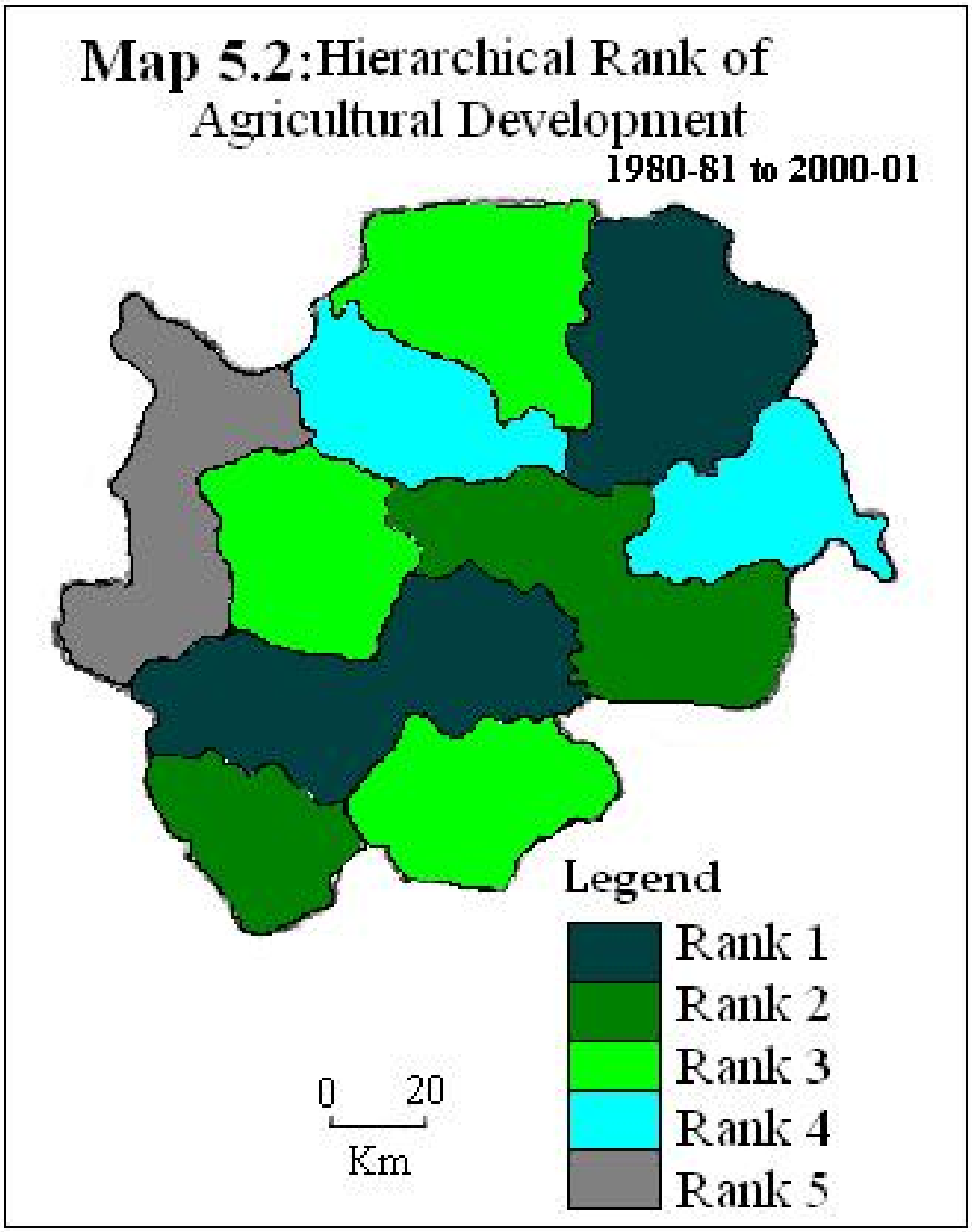

Map 5.2:Hierarchical Rank of Agricultural Development
1980-81 to 2000-01
Legend
Rank 1
Rank 2
Rank 3
Rank 4
Rank 5
0 20
Km

Table 5.3: Temporal variation between the six parameters for Hierarchical clusters [1980-81 to 2000-01]

RANK	Tahsil	% NSA to TGA	% of Irrigated Land to NSA	No. of Tractors per 100 hectare of NSA	No. of Livestock per 100 hectare of NSA	Loans in Rs. per 100 hectare of NSA	Overdue in Rs per 100 hectare of NSA
1	Nashik	-18.5	+61.56	+1.39	+185.0	+1776.78	+401.96
	Malegaon	-0.1	-0.65	+0.65	+67.95	+271.98	+36.48
	Niphad	-10.3	+3.28	+2.25	+20.47	+1333.74	+320.53
2	Chandwad	+0.8	+17.02	+1.28	+112.26	+421.73	+87.02
	Yeola	-0.1	+9.58	+2.65	+1.55	+227.3	+117.58
	Igatpuri	+6.6	+0.47	+0.33	-37.46	+63.43	+79.39
3	Satana	-0.4	+3.86	+0.51	-22.18	+344.21	+96.74
	Sinner	-808	+9.37	+1.59	+60.77	+206.52	+127.33
	Dindori	-0.2	+11.5	+2.19	+10.16	+572.93	+109.27
4	Nandgaon	-6.8	+2.44	+0.95	+60.91	+140.18	+25.55
	Kalwan	+10.0	+3.0	+1.13	-62.76	+285.71	+74.73
5	Peth	+8.3	+1.43	+0.07	+18.59	--	--
	Surgana	+2.0	+0.13	+0.28	-58.51	--	--
	Total	-0.5	+6.34	+1.49	+26.89	+366.6	+94.12

(Source: By the Researcher)

area, in while Kalwan tahsil 3 percent irrigated land is increased to net sown area (table 5.3). Dindori, Satana, Sinner jumped on 4th to 3rd rank from 1980-81 to 2000-01. 3.86 percent irrigated area is increased to net sown area in Satana tahsil, while 9.37 percent irrigated area increased in Sinner tahsil and 11.5 percent irrigated area increased in Dindori tahsil (table 5.3 and map 5.2).

As well as number of tractors per 100 hectare are also increased in Satana (0.51%), Sinner (1.59%) and Dindori (2.19 %) tahsils.

Chandwad, Yeola and Igatpuri jumped on 4th to 2nd rank from 1980-81 to 2000-01. Percentage of irrigated area to net sown area is increased 17.02 percent in Chandwad, 9.58 percent in Yeola and 0.47 percentages to net sown area. Number of tractors per 100 hectares to net sown area is increased in these tahsils (Chandwad 1.28 %, Yeola 2.65 % and Igatpuri 0.33 %). Nashik, Niphad jumped on 3rd to 1st rank while Malegaon jumped on 4th to 1st rank from 1980-81 to 2000-01. Percentage of irrigated area to net sown area is increased in Nashik (61.56 %) and Niphad (3.28%) tahsils. While in Malegaon tahsil percentage of irrigated area is decreased due to climatic variations/changes. Number of tractors per 100 hectares to net sown area is also increased in these tahsils i.e. 1.39 percent in Nashik, 0.65 percent in Malegaon and 2.25 percent in Niphad tahsil (table 5.3 and map 5.2).

5.5: CLASSIFICATION OF TAHSILS ACCORDING TO THE LEVELS OF AGRICULTURAL DEVELOPMENT (Ref. Map 5.3)

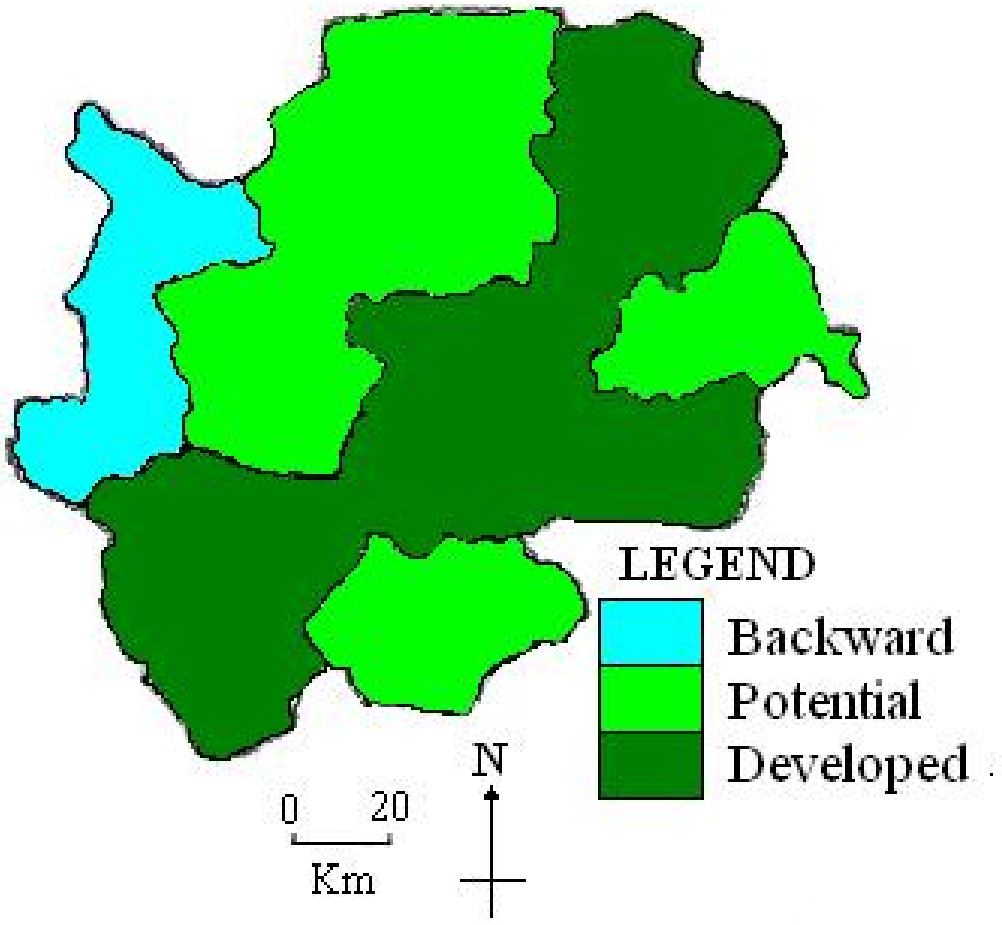
The hierarchical cluster of the tahsils for the year 2000-01 further analyzed and grouped into the following broad categories;

5.5.i) Backward tahsils

5.5.ii) Potential Tahsils

5.5.iii) Developed Tahsils

Map 5.3: Nashik District- Classification of Talsils According to Levels of Development



The most backward tahsils are really a cluster of backward areas of the tahsils and have thus been called here backward tahsils. Those mentioned as backward and developing clusters of tahsils are in the process of changing and development and therefore, have been grouped here as potential tahsils. The remaining two clusters (i.e. more developed and most developed) are comparatively more developed and grouped here as developed tahsils. The temporal view for the tahsils for years 1980-81 to 2000-01 shows the trends and the classification can be made as following;

5.5.i) Backward Tahsils

Peth and Surgana tahsils comes under this category (map 5.3). These tahsils having hilly area, forest covered land, heavy rainfall, and the tribal population is more in these tahsils, therefore there is no chance in the agricultural process and development. Agriculture is not possible in these tahsils because of maximum area is covered by hills , mountain spurs, forest and heavy rainfall but these tahsils are important for water resources.

5.5.ii) Potential Tahsils

Dindori, Kalwan, Satana, Nandgaon and Sinner these five tahsils are the potential tahsils in the district (map 3). Due to the spatial variation of location the potential tahsils and various socio-economic and physical factors. Dindori, Kalwan and Satana tahsils having eastern side location of Sahyadri has diversified relief due to offshoots of Sahyadri Mountain and less amount of rainfall due to leeward side of Sahyadri Mountain range. These tahsils having nearby 50 percent of net sown area and 10 to 20 percent of area under irrigation to net sown area. Hence the rabbi agriculture is very limited. Further the soil is thin and slopping and it is easy to erosion. As well as the transportation and

market facilities also limited. However if there is careful planning and management of water resources these tahsils can be put to better use agriculturally and minimum socio-economic development is possible in these tahsils. Nandgaon and Sinner tahsils has comparatively more level topography and 50 percent of net sown area but they do not have a well developed irrigation network. However, with the commissioning of various major medium and minor irrigation schemes in the near future these tahsils also have a better chance to change and improve agricultural activities. Even though these tahsils are included in the drought prone areas; if the irrigation facilities in these potential tahsils increased a great deal of agricultural development may occur (map 5.3) and socio-economic changes and development took place.

5.5.iii) Developed Tahsils

Nashik, Niphad, Malegaon, Chandwad, Igatpuri and Yeola tahsils are identified as developed tahsils of the district (map 5.3). All these tahsils have a high percentage of net sown area under irrigation. They are located in river basins and flood plains and have better soil except Igatpuri.

Vegetables, Fruits, fodder, sugarcane is the most important cash crops in these tahsils. All of themes have a number of tractors and signifying mechanized agriculture. There are seven sugar factories in the district, out of them two in Malegaon, two in Niphad and one in Nashik tahsil. Bajra, Rice, wheat, Pulses, vegetables, fruits, fodder etc. are the principal crops in these tahsils with bajra (in Malegaon, Niphad, Yeola, Chandwad), rice in Igatpuri and wheat in Nashik tahsil as the first rank crop. There is an all-round development in agriculture in terms of poultry, dairy farming, truck-tractor farming, agro-based industries and mechanization with the advent of sugar factories, MIDC, agro-based

industries. Leveled land, fertile soil, high percentage of irrigation, well developed transportation facilities, development of agricultural markets, awareness of modern agriculture, use of hybrid seeds, fertilizers, pesticides and insecticides in these tahsils is maximum. All these factors make the developed tahsils agriculturally more developed part of the district.

Chapter 6

CROP RANKING, CROP COMBINATION, DIVERSIFICATION AND QUANTITATIVE EVALUATION OF LANDUSE

6.1: INTRODUCTION

After studying the landuse pattern in chapter 4 an attempt has been made to highlight the spatial distribution of various crops, their growth and response to physio-socio-economic conditions prevalent in the district. The cultivation of crops and their growth are closely related to the decision making process on one hand and adaptation of innovation in agriculture, i.e. use of high yielding varieties, improved and efficient implements, applications of chemical fertilizers and pesticides. The hectarage under individual crop gives relative strength and realistic picture of crop landuse 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 combination and diversification manifests the present agricultural scenario.

The following objectives have been put forth:

1) To present areal strength of the crops grown in the basin by ranking and interpret the factors responsible for this rank distribution.
2) To delineate the patterns of crop combination of the Nashik district by applying Weaver's method and plot it in a regions of crop combination; and
3) To identify the crop diversification patterns of the Nashik district by applying Bhatia's method of crop diversification

and find out the variables responsible for such patterns in the area under study.

The secondary data have been collected for various crops for the year 1960-61 and 2000-01 in both kharif and rabbi crops from tahsil headquarter office, Nashik district Gazetteer, Socio-economic abstract of Nashik district and Census Handbook of Nashik district are sources of data for this study. It is supplemented by numerous spot-inquiries. The areas of crop have been converted into percentage (to net sown area) which is later on, used for ranking of crops to identify the relative strength of individual crop. The Weaver's method has been applied to delineate the crop combination regions and crop diversification has been computed to understand the magnitude of crop competition among the crops grown in the district

6.2: CROP RANKING

The ranking obtained for thirteen main crops in the district to identify the relative significance of individual crop in cropping pattern. The first eight ranking of crops have been identified and mapped (Map6.1 to map 6.8). The ranking of crops and number of tahsils are shown in table 6.1A and B.

6.2.1: First Ranking

Map6.1/A /B reveals the first ranking crops in the district. Four crops viz. Bajra, Wheat, Nachani and Rice in 1960-61 and Five crops in 2000-01 are identified occupying first rank namely bajra, vegetable, nachani, fodder and rice. Table 6.2/A/ B display tahsils and area of first ranking crops, in the district. Bajra is the major crop stands as first rank and is found to have largest coverage in the district from 1960-61 to 2000-01. The favorable environment in the region is useful for growing bajra on light

Table-6.1/A: Crops Rank Frequency (1960-61)

Sr. No.	Crops	Crop Ranks and Number of Tahsils							
		I	II	III	IV	V	VI	VII	VIII
1	Bajra	08	01	--	--	--	01	--	01
2	Wheat	02	01	02	01	04	02	--	01
3	Nachani	02	--	02	--	01	01	--	01
4	Rice	01	01	01	--	--	01	02	02
5	Oil-Seeds	--	04	02	02	04	--	01	--
6	Pulses	--	03	03	07	--	--	--	--
7	Fodder	--	02	01	01	02	02	02	01
8	Jawar	--	01	02	02	01	02	03	02
9	Vegetable	--	--	--	--	01	01	01	01
10	Sugarcane	--	--	--	--	--	01	03	01
11	Cotton	--	--	--	--	--	01	01	01
12	Condiments & Spices	--	--	--	--	--	01	--	02
Total Tahsils		13	13	13	13	13	13	13	13

(Compiled by the Researcher)

Table-6.1/B: Crops Rank Frequency (2000-01)

Sr. No.	Crops	Crop Ranks and Number of Tahsils							
		I	II	III	IV	V	VI	VII	VIII
1	Bajra	09	--	--	--	--	--	--	--
2	Vegetable	01	03	03	01	--	--	04	01
3	Nachani	03	02	01	--	--	--	--	--
4	Fodder	01	02	03	02	01	--	--	01
5	Rice	01	02	01	--	01	01	01	01
6	Pulses	--	02	04	04	03	01	--	--
7	Maize	--	02	01	--	01	01	--	--
8	Oil-Seeds	--	01	01	03	01	04	02	03
9	Wheat	--	--	01	01	02	05	03	--
10	Sugarcane	--	01	--	--	01	01	01	02
11	Fruits	--	--	--	02	03	--	--	01
12	Jawar	--	--	--	02	01	02	02	03
13	Cotton	--	--	--	--	01	--	01	01
14	Other crops	--	--	--	--	--	--	01	02
Total Tahsils		15	15	15	15	15	15	15	15

(Compiled by the Researcher)

black soils. The sufficient annual average rainfall during kharif season and daily temperature rising between 20 degree to 27 degree in growing period supports for the growth of this crop. In 1960-61 , bajra was grown on 334687 hectares (81.64 percent to total area) in eight tahsils, namely, Kalwan, Satana, Malegaon, Chandwad, Nandgaon, Yeola, Niphad and Sinner while in 2000-01 bajra is grown on 345043 hectares (83.88 percent to total area) in the nine tahsils, namely, Kalwan, Satana, Malegaon, Chandwad, Nandgaon, Yeola, Niphad, Sinner and Deola in the district. It means 10356 hectare area increased within the study period.

Table-6.2/A:

Crops, Tahsils and Area in First Ranking (1960-61)

Crops	Number of Tahsils	Area in Hectares	% of Total Area
Bajra	08	334657	81.64
Wheat	02	34732	8.47
Nachani	02	27481	6.70
Rice	01	13064	3.19
Total	13	409934	100

Table-6.2/B

Crops, Tahsils and Area in First Ranking (2000-01)

Crops	Number of Tahsils	Area in Hectares	% of Total Area
Bajra	09	345043	83.88
Nachani	03	37425	9.1
Rice	01	17340	4.22
Vegetable	01	7740	1.88
Fodder	01	3782	0.92
Total	15	411330	100.0

(Compiled by the Researcher)

Wheat is identified as the second major crop in 1960-61 in the area under study. Wheat is the major crop grown in Nashik and Dindori tahsils of the district (map 6.1/A) and covering 34732

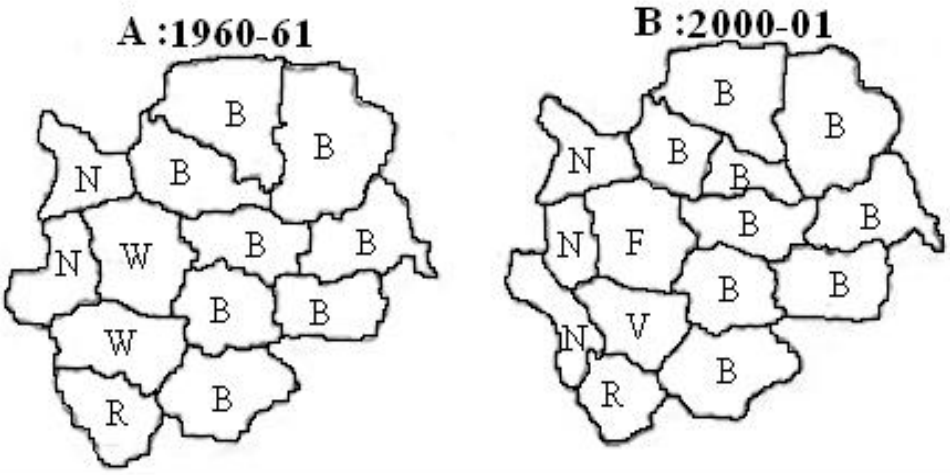
hectares (8.47 percent to total area). While Nachani is identified as the second major crop in 2000-01 in the area under study. Nachani is grown in three tahsils and is confined to the north-western part of the district (map6.1/B) covering 37425 hectares (9.1 percent to total area). The other crops are growing like bajra and wheat are not growing on the slopping land. Nachani as major crop are in Peth, Surgana and Trimbak tahsils. Nachani holds first rank on 27481 hectares (6.7 percent to total area) at Peth and Surgana tahsils in 1960-61.Rice Holds first rank on13064 hectares (3.19%) in 1960-61 and 17340 hectares (4.22 percent to total area) in 2000-01at Igatpuri tahsil due to sufficient rainfall. The preference of farmers of this tahsil leads to cultivation of rice (map6.1/A&B). Then vegetable holds first rank on 7740 hectares (1.88 percent to total area) at Nashik tahsil while fodder rank first on 3782 hectares (0.92 percent to total area) at Dindori tahsil in the district (map6.1/B). In 1960-61 Wheat ranks first in two tahsils viz. Nashik and Dindori but in 2000-01 wheat disappears and it took place takes by fodder and vegetables (table 6.2 / A, B).

6.2.2: Second Ranking

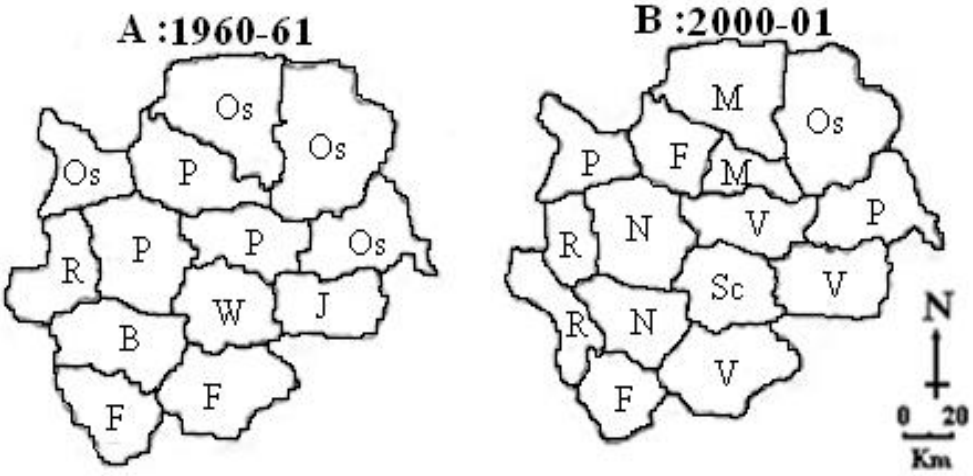
The second ranking crops are relatively more than those of first ranking. Map6.2 /A, B reveals seven crops i.e. Pulses, Jawar, Nachani, Oilseeds, Wheat, Fodder and Rice in 1960-61 and eight crops in 2000-01 ranked second. These eight crops are vegetable, fodder, nachani, rice, pulses, maize, sugarcane and oil-seeds. Table 6.3 /A, B displays the tahsils and area of the second ranking crops in the district.

In 1960-61 Oilseeds are dominants in the district and holds the second rank in four tahsils viz. Malegaon, Satana, Nandgaon and Surgana of Nashik district. It covers 58581

Map 6.1 : Nashik District First Ranking Crops



Map 6.2 : Nashik District Second Ranking Crops



B	Bajra
W	Wheat
N	Nachani
R	Rice
V	Vegetable
F	Fodder

P	Pulses
M	Maize
Os	Oilseeds
J	Jawar
Sc	Sugarcane

area in the district (map6.2/A). Oilseeds are found in Surgana, Satana, Malegaon and Nandgaon tahsils and associated with

Table-6.3 /A:

Crops, Tahsils and Area in Second Ranking (1960-61)

Crops	Number of Tahsils	Area in Hectares	% of Total Area
Oil-Seeds	04	58581	34.98
Pulses	03	30882	18.44
Fodder	02	21262	12.69
Wheat	01	22869	13.65
Jawar	01	17949	10.72
Bajra	01	10585	6.32
Rice	01	5359	3.20
Total	13	167487	100

(Compiled by the Researcher)

Table-6.3 /B:

Crops, Tahsils and Area in Second Ranking (2000-01)

Crops	Number of Tahsils	Area in Hectares	% of Total Area
Vegetable	03	27525	20.33
Fodder	02	20967	15.48
Nachani	02	19765	14.60
Rice	02	16279	12.02
Pulses	02	15221	11.24
Maize	02	11750	8.68
Sugarcane	01	14432	10.66
Oil-Seeds	01	9468	6.99
Total	15	135407	100

(Compiled by the Researcher)

the land and climatic conditions of these tahsils which is very favorable for oilseed cultivation. While in 2000-01 Vegetable are dominant in the district and holds the second rank in three tahsils i.e. Chandwad, Yeola and Sinner and occupying wide spread in

size in Nashik district. It covers 27525 hectares (20.33 percent to total area) area in the district (map6.2 /B). The land and climatic conditions of these tahsils are very favorable for vegetable cultivation.

In 1960-61 (map6.2 /A, table 6.3 /A) Pulses ranks second in three tahsils i.e. Chandwad, Kalwan and Dindori covering 30882 hectares (18.44 percent to total area) in the district (map6.3/A). The relative intensity of concentration of pulses is in Dindori, Kalwan and Chandwad tahsils. While Fodder ranks second in two tahsils i.e. Sinner and Igatpuri covering 21262 hectares (12.69 percent to total area) in the district (map63/A). Wheat, Jawar, bajra and rice also identified as second ranking crops in the district. Wheat occupying 22869 hectares (13.65 percent to total area) in Niphad tahsil while Jawar occupying 17949 hectares (10.72 percent to total area) in Yeola tahsils as well as Bajra occupying 10585 hectares (6.32 percent to total area) in Nashik tahsil and rice occupying 5359 hectares (3.2 percent to total area) in Peth tahsil (map6.2 /A ,table 6.3 /A).

In 2000-01 (map 6.2/B, table 6.3/B) Fodder ranks second in two tahsils i.e. Kalwan and Igatpuri covering 20967 hectares (15.48 percent to total area) in the district (map6.2/B). The relative intensity of concentration of fodder is in Kalwan and Igatpuri tahsils. Nachani stands second in two tahsils i.e. Nashik and Dindori covering 19765 hectares (14.6 percent to total area) in the district (map6.2/B). The area of nachani confined to Nashik and Dindori tahsils. Rice ranks second in two tahsils i.e. Peth and Trimbak covering 16279 hectares (12.02 percent to total area) in western part of the district (map6.2 and table6.2/B). These tahsils are namely Peth and Trimbak is associated with high rainfall in

the district as it appears to hardly crop to grow. Pulses, maize, sugarcane and oil-seeds also identified as second ranking crops in the district. Pulses occupying 15221 hectares (11.24 percent to total area) in Surgana and Nandgaon tahsils while maize occupying 11750 hectares (8.68 percent to total area) in Satana and Deola tahsils as well as sugarcane occupying 14432 hectares (10.66 percent to total area) in Niphad tahsil and oil-seeds occupying 9468 hectares (6.99 percent to total area) in Malegaon tahsil (map6.2/B, table 6.3 /B).

6.2.3: Third Ranking

It is evident from map6.3 that the third ranking crops are widely spread in their areal distribution pattern. The ranking crops was Pulses, Jawar, Nachani, Oilseeds, Wheat, Fodder and rice in 1960-61 and eight in numbers in 2000-01. These eight crops are pulses, fodder, vegetable, wheat, nachani, rice, maize and oil-seeds. From 1960-61 to 2000-01 pulses is the dominant crop in rank. Table6.4 /A, B displays the distribution of third ranking crops, tahsils and area in the district. It is seen from map6.3/A,B that pulses occupies dominant position covering 24887 hectares (21.94 percent to total area) in three tahsils i.e. Satana, Nandgaon and Yeola while in 2000-01 pulses occupies 22064 hectares (23.75 percent to total area) in four tahsils i.e. Satana, Chandwad, Yeola and sinner and holds third rank in Nashik district.

Jawar, Nachani, Oilseeds and Wheat hold third rank in the district (1960-61) and observed each in two-two tahsils. Jawar occupying 27949 hectares (24.64 percent to total area) in Kalwan and Malegaon tahsils, Nachani occupying 21857 hectares (19.27 percent to total area) in Dindori and Igatpuri tahsils, Oilseeds

occupying 12423 hectares (10.95 percent to total area) in Peth and Niphad tahsils, while Wheat occupying 12145 hectares (10.71 percent to total area) in Chandwad and Sinner tahsils. Fodder and Rice stands as third ranking crops each in one tahsils. Fodder occupying 10532 hectares (9.28 percent to total area) in Nashik tahsil, Rice occupying 3641 hectares (3.21percent to total area) in Surgana tahsil in the district (Map 6.3/A, table 6.4 /A).

Table-6.4 /A:

Crops, Tahsils and Area in Third Ranking (1960-61)

Crops	Number of Tahsils	Area in Hectares	% of Total Area
Pulses	03	24887	21.94
Jawar	02	27947	24.64
Nachani	02	21857	19.27
Oil-seeds	02	12423	10.95
Wheat	02	12145	10.71
Fodder	01	10532	9.28
Rice	01	3641	3.21
Total	13	113434	100

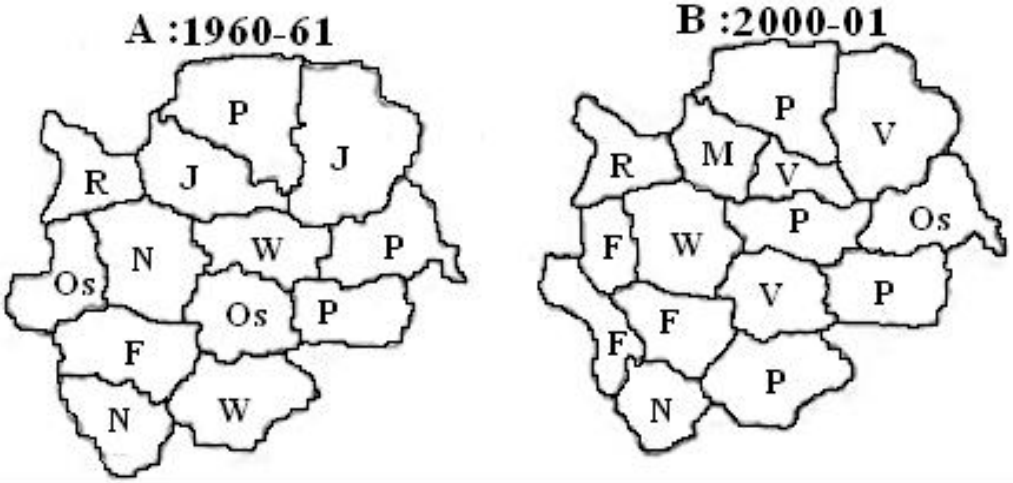
Table-6.4 /B:

Crops, Tahsils and Area in Third Ranking (2000-01)

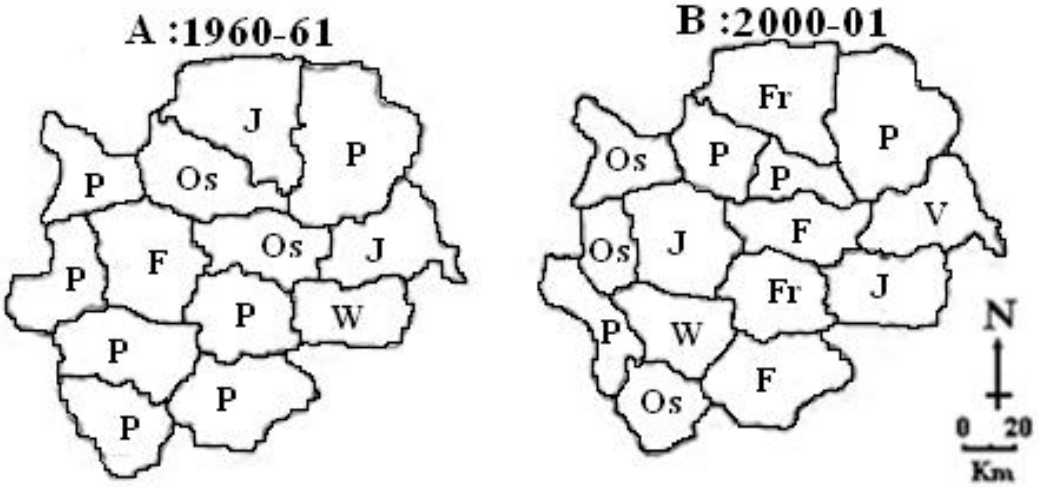
Crops	Number of Tahsils	Area in Hectares	% of Total Area
Pulses	04	22064	23.75
Fodder	03	21402	23.04
Vegetable	03	18150	19.53
Wheat	01	9200	9.9
Nachani	01	6730	7.24
Rice	01	6135	6.61
Maize	01	5033	5.42
Oil-seeds	01	4194	4.51
Total	15	92908	100

(Compiled by the Researcher)

Map 6.3 : Nashik District Third Ranking Crops



Map 6.4 : Nashik District Fourth Ranking Crops



W	Wheat
N	Nachani
R	Rice
V	Vegetable
F	Fodder
Fr	Fruit

P	Pulses
M	Maize
Os	Oilseeds
J	Jawar
Sc	Sugarcane

Fodder and vegetable holds third rank in the district and observed each in three-three tahsils (2000-01). Fodder occupying 21402 hectares (23.04 percent to total area) in Nashik, Peth and Trimbak tahsils while vegetable occupying 18150 hectares (19.53 percent to total area) in Malegaon, Niphad and Deola tahsils(map6.3 and table6.2/C). Wheat, Nachani, Rice, Maize and oil-seeds stands as third ranking crops each in one tahsils. Wheat occupying 9200 hectares (9.9 percent to total area) in Dindori, Nachani occupying 6730 hectares (7.24 percent to total area) in Igatpuri, Rice occupying 6135 hectares (6.61 percent to total area) in Surgana tahsil while maize occupying 5033 hectares (5.42 percent to total area) in Kalwan tahsil and oil-seeds occupying 4194 hectares (4.51 percent to total area) in Nandgaon tahsil in the district (Map 6.3/B and table 6.4 /B).

6.2.4: Fourth Ranking

Fourth ranking crops present a much varied distribution both is space and the number of crops involved (map6.4/A, B and table6.5 /A, B). There are five crops, viz, Pulses, Jawar, Oilseeds, Fodder and Wheat in 1960-61and seven crops namely, pulses, oil-seeds, Jawar, fruits, fodder, wheat and vegetable in 2000-01. Pulses holds largest coverage (i.e. 51.56 percent in 1960-61) among fourth ranking crops in Nashik district. It is cultivated in Nashik, Peth, Surgana, Malegaon, Niphad, Sinner and Igatpuri in 1960-61and it covers 45286 hectares (51.56 percent to total area). While in 2000-01 pulses cultivated in four tahsils i.e. Kalwan, Malegaon, Deola and Trimbak and it covers 13569 hectares (19.43 percent to total area). Oil-seeds cultivation has found in western part of the district. Oil-seeds hold fourth rank in three

tahsils namely, Peth, Surgana and Igatpuri covering 14069 hectares (20.15 percent to total area) in Nashik district, (Map 6.4/A, B).

Table-6.5 /A:
Crops, Tahsils and Area in Fourth Ranking (1961-61)

Crops	Number of Tahsils	Area in Hectares	% of Total Area
Pulses	07	45286	51.56
Jawar	02	13487	15.35
Oil-seeds	02	12603	14.35
Fodder	01	9895	11.26
Wheat	01	6567	7.48
Total	13	87838	100

(Compiled by the Researcher)

Table-6.5 /B:
Crops, Tahsils and Area in Fourth Ranking (2000-01)

Crops	Number of Tahsils	Area in Hectares	% of Total Area
Pulses	04	13569	19.43
Oil-seeds	03	14069	20.15
Jawar	02	13209	18.91
Fruits	02	12643	18.10
Fodder	02	7247	10.38
Wheat	01	5249	7.52
Vegetable	01	3847	5.51
Total	15	69833	100

(Compiled by the Researcher)

Jawar and oilseed holds fourth rank in the district and observed each in two tahsils (1960-61). Jawar occupying 13487 hectares (15.35 percent to total area) in Satana and Nandgaon tahsils. While oilseed occupying 12603 hectares (14.35 percent to total area) in Kalwan and Chandwad tahsils. Fodder and Wheat is grown in one tahsil each, Fodder occupying 9895 hectares (11.26

percent to total area) in Dindori tahsil. While wheat occupying 6567 hectares (7.48 percent to total area) in Yeola tahsil (map6.4/A, and table6.5 /A).

Jawar, fruits and fodder holds fourth rank in the district and observed each in two tahsils (2000-01). Jawar occupying 13209 hectares (18.91 percent to total area) in Dindori and Yeola tahsils. Fruits occupying 12643 hectares (18.1 percent to total area) in Satana and Niphad tahsils while fodder occupying 7247 hectares (10.38 percent to total area) in Chandwad and Sinner tahsils (map6.4). Wheat is grown in one tahsil, namely Nashik and occupying 5249 hectare (7.52 percent to total area) as well as vegetable is cultivated in one tahsil namely Nandgaon and occupying 3847 hectares (5.51 percent to total area) in the district (map6.4/B, and table6.5 /B).

6.2.5: Fifth Ranking

The number of crops in fifth rank is six in 1960-60 and ten in 2000-01 and is spread throughout the district. The crop distributional pattern in this ranking is more fragmented and diversified (map6.5/A, B). An oil seed holds largest coverage (i.e. 42.76 percent in 1960-61) among fifth ranking crops in Nashik district. It is cultivated in four tahsils (Dindori, Yeola, Sinner and Igatpuri) in the area 22500 hectares (42.76 percent to total area).Wheat also cultivated in four tahsils (Kalwan, Satana, Malegaon and Nandgaon) in the area 13876 hectares (26.36 percent to the total area). Fodder holds fourth rank in the district and observed in two tahsils (1960-61). Fodder occupying 3734 hectares (7.09 percent to total area) in Peth and Surgana tahsils. Nachani, Jawar and Vegetable is grown in one tahsil each, Nachani occupying 6676 hectares (12.68 percent to total area) in

Nashik tahsil. Vegetable occupying 4095 hectare (7.78 percent to total area) in Niphad tahsil While Jawar occupying 1750 hectares (3.33 percent to total area) in Yeola tahsil (map6.5 /A, and table6.6 /A).

Table-6.6/A:

Crops, Tahsils and Area in Fifth Ranking (1960-61)

Crops	Number of Tahsils	Area in Hectares	% of Total Area
Oil-seeds	04	22500	42.76
Wheat	04	13876	26.36
Fodder	02	3734	7.09
Nachani	01	6676	12.68
Vegetable	01	4095	7.78
Jawar	01	1750	3.33
Total	13	52631	100

(Compiled by the Researcher)

Table-6.6/B:

Crops, Tahsils and Area in Fifth Ranking (2000-01)

Crops	Number of Tahsils	Area in Hectares	% of Total Area
Pulses	03	11887	23.71
Fruits	03	10677	21.38
Wheat	02	6376	12.72
Rice	01	5700	11.37
Maize	01	3623	7.23
Cotton	01	3479	6.93
Sugarcane	01	2984	5.95
Jawar	01	2742	5.47
Fodder	01	1779	3.55
Oil-seeds	01	891	1.78
Total	15	50138	100

(Compiled by the Researcher)

There is an increased crop ten in number (2000-01) that include pulses, fruits, wheat, rice, maize, cotton, sugarcane,

Jawar, fodder and oil-seeds. Pulses and fruits are dominant crops in the district (table6.6 /B). Pulses cover 11887 hectares (23.71 percent to total area) comprising three tahsils, namely, Peth, Niphad and Igatpuri tahsils. Fruits cover 10677 hectares (21.38 percent to total area) comprising two tahsils namely, Kalwan and Sinner (map6.5/B and table 6.7/B).

Rice, Maize, Cotton, sugarcane, jawar, fodder and oil-seeds stands as fifth ranking crops each in one tahsils. Rice occupying 5700 hectares (11.37 percent to total area) in Dindori, maize occupying 3623 hectares (7.23 percent to total area) in Yeola, cotton occupying 3479 hectares (6.93 percent to total area) in Nandgaon tahsil while sugarcane occupying 2984 hectares (5.95 percent to total area) in Satana, jawar occupying 2742 hectares (5.47 percent to total area) in Chandwad, fodder occupying 1779 hectares (3.55 percent to total area)in Surgana tahsil and oil-seeds occupying 891 hectares (1.78 percent to total area) in Trimbak tahsil in Nashik district(map6.5/B and table 6.7/B).

6.2.6: Sixth Ranking

There are ten crops which emerge in sixth rank in 1960-61 while seven crops in sixth rank in 2000-01 in the district. In 1960-61the crops are Jawar, wheat, Fodder, Bajra, Rice, Nachani, Sugarcane, Vegetable, Cotton and condiments and spices. Sixth rank crops indicate diversity in number and crop distribution in the area under study (map6.6/A, table 6.7 /A). Among the ten crops, Jawar, Wheat and fodder is cultivated in two tahsils each. Jawar covering 8721 hectares (22.69 percent to total area) in Niphad and Sinner tahsils, wheat covering 5819 hectares (15.14 percent to total area) in Surgana and Igatpuri tahsils while fodder

cultivated in two tahsils (Satana and Yeola) covering 3403 hectares (8.85 percent to total area) (map6.6/A and table6.7 /A).

Table-6.7 /A:
Crops, Tahsils and Area in sixth Ranking (1960-61)

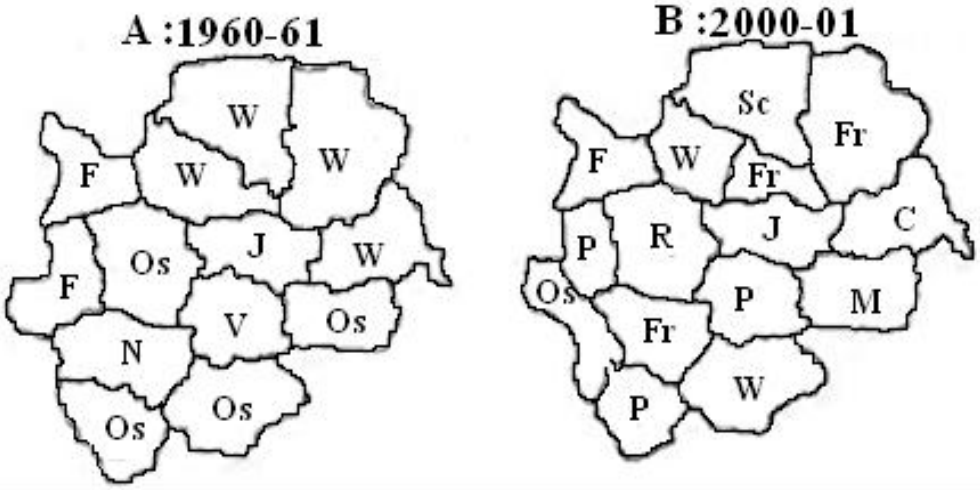
Crops	Number of Tahsils	Area in Hectares	% of Total Area
Jawar	02	8721	22.69
Wheat	02	5819	15.14
Fodder	02	3403	8.85
Bajra	01	7194	18.72
Rice	01	5531	14.39
Nachani	01	3117	8.11
Sugarcane	01	2937	7.64
Vegetable	01	1268	3.30
Cotton	01	426	1.11
Condiments & spices	01	20	0.05
Total	13	38436	100

Table-6.7 /B:
Crops, Tahsils and Area in sixth Ranking (2000-01)

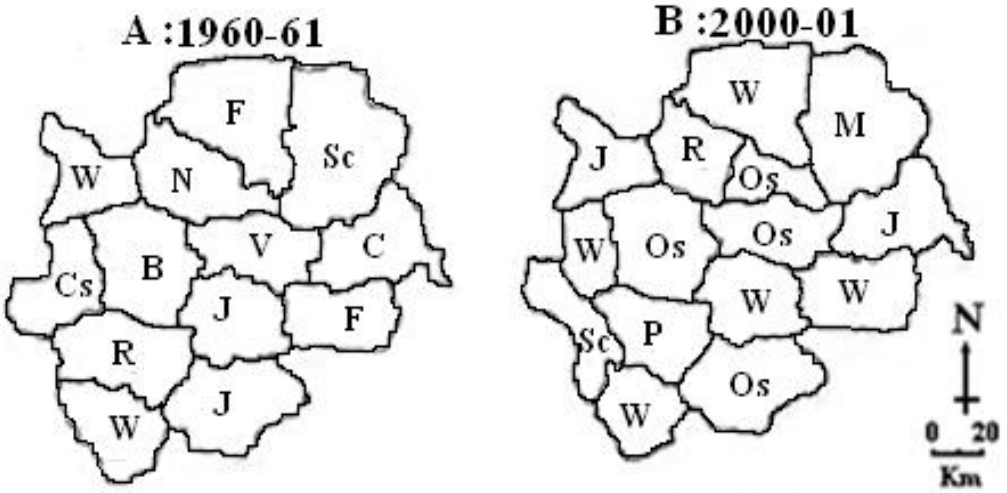
Crops	Number of Tahsils	Area in Hectares	% of Total Area
Wheat	05	13637	36.49
Oil-seeds	04	10243	27.41
Jawar	02	3245	8.68
Maize	01	4188	11.20
Pulses	01	3487	9.33
Rice	01	2553	6.83
Sugarcane	01	21	0.06
Total	15	37374	100

(Compiled by the Researcher)

Map 6. 5: Nashik District Fifth Ranking Crops



Map 6.6 : Nashik District Sixth Ranking Crops



W	Wheat
N	Nachani
R	Rice
V	Vegetable
F	Fodder
Cs	Condiments/Spices

C	C0tton
P	Pulses
M	Maize
Os	Oilseeds
J	Jawar
Sc	Sugarcane
Fr	Fruit

Bajra, Rice, Nachani, Sugarcane, Vegetable, Cotton and condiments and spices cultivated in one tahsil under each crop. Bajra covering 7194 hectares (18.72 percent to total area) in Dindori tahsil, Rice covering 5531 hectares (14.39 percent to total area) in Nashik tahsil, Nachani covering 3117 hectares (8.11 percent to total area) in Kalwan tahsil Sugarcane covering 2937 hectares (7.64 percent to total area) in Malegaon tahsil, Vegetable covering 1268 hectares (3.3 percent to total area) in Chandwad tahsil, Cotton covering 426 hectares (1.11 percent to total area) in Nandgaon tahsil while condiments and spices covering 20 hectare (0.05 percent to total area) in Peth tahsil in Nashik district (map6.6/A and table6.7 /A).

There are seven crops which emerge in sixth rank in the district. In 2000-01the crops are wheat, oil-seeds, jawar, maize, pulses, rice and sugarcane. Sixth rank crops indicate diversity in number and crop distribution in the area under study (map6.6/B and table 6.7 /B). Among the seven crops, wheat is principal crop found largest coverage on 13637 hectares (36.49 percent to total area) in Niphad, Satana, Yeola, Peth and Igatpuri tahsils.

Oil-seeds is cultivated in four tahsils covering 10243 hectares (27.41 percent to total area) in Dindori, Chandwad, Sinner and Deola tahsils while Jawar cultivated in two tahsils covering 3245 hectares (8.68 percent to total area) (map6.6/B and table6.7 /B). Maize, pulses, rice, sugarcane cultivated in one tahsil under each crop. Maize covering 4188 hectares (11.20 percent to total area) in Malegaon tahsil, pulses covering 3487 hectares (9.33 percent to total area) in Nashik tahsil, rice covering 2553 hectares (6.83 percent to total area) in Kalwan tahsil while

sugarcane covering 21 hectare (0.06 percent to total area) in Trimbak tahsil in Nashik district (map6.6/B and table6.7 /B).

6.2.7: Seventh Ranking

In 1960-61the numbers of crops in seventh rank are seven and are spread throughout the district. The crop distributional pattern in this ranking is more diversified (map6.7/A, table 6.8 /A). These crops are sugarcane, Jawar, rice, fodder, oil-seeds, vegetable, and cotton. Among the seven crops Sugarcane and Jawar is principal crops found in three-three tahsils each. Sugarcane coverage on 3242 hectares (13.98 percent to total area), while Jawar coverage on 2093 hectares (7.82 percent to total area). The largest coverage of sugarcane is found in the tahsils namely Satana, Chandwad and Yeola, while Jawar is found in Peth, Surgana and Igatpuri tahsils. Rice and Fodder is cultivated in two tahsils each. Rice cultivated in Dindori and Kalwan tahsils and covering 8359 hectares (31.22 percent to total area) in the district. Fodder cultivated in Nandgaon and Niphad tahsils and covering 3090 hectares (11.54 percent to total area) in the district.

Oilseeds, Vegetable and cotton cultivated in one tahsils under each crop. Oilseeds covering 4647 hectares (17.36 percent to total area) in Nashik tahsil, Vegetable covering 2476 hectares (9.25 percent to total area) in Sinner tahsil while Cotton covering 2364 hectares (8.83 percent to total area) in Malegaon tahsil of Nashik district(map6.7/A and table 6.8 /A).

The numbers of crops in seventh rank is eight (2000-01) and are spread throughout the district. The crop distributional pattern in this ranking is more diversified (map6.7/B, 6.8 /B). These crops are vegetable, wheat, oil-seeds, Jawar, sugarcane,

cotton, rice and other crops. Among the eight crops vegetable is principal crop found largest coverage on 6236 hectares (20.37

Table-6.8 /A:

Crops, Tahsils and Area in Seventh Ranking (1960-61)

Crops	Number of Tahsils	Area in Hectares	% of Total Area
Sugarcane	03	3742	13.98
Jawar	03	2093	7.82
Rice	02	8359	31.22
Fodder	02	3090	11.54
Oilseed	01	4647	17.36
Vegetable	01	2476	9.25
Cotton	01	2364	8.83
Total	13	29771	100

Table-6.8 /B:

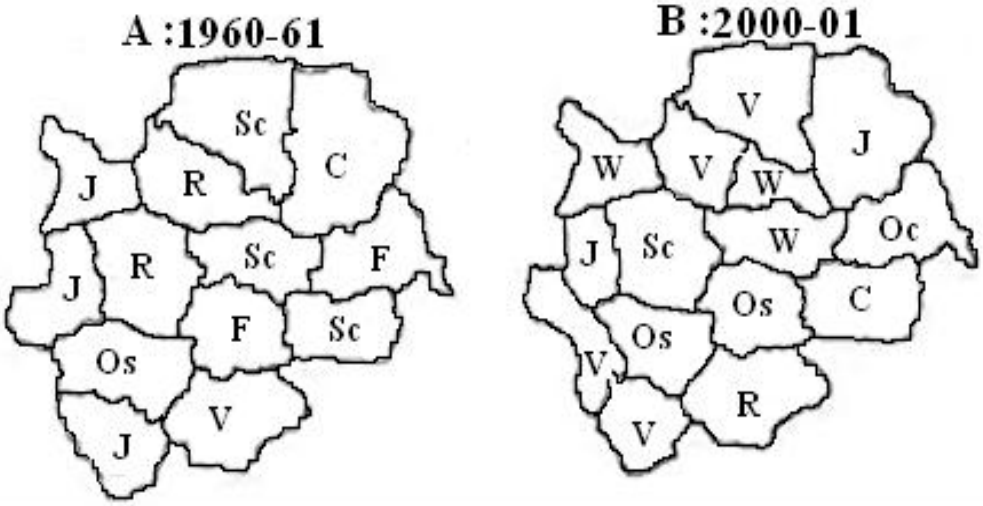
Crops, Tahsils and Area in Seventh Ranking (2000-01)

Crops	Number of Tahsils	Area in Hectares	% of Total Area
Vegetable	04	6236	20.37
Wheat	03	3574	11.68
Oil-seeds	02	7663	25.03
Jawar	02	3189	10.42
Sugarcane	01	3984	13.02
Cotton	01	2349	7.67
Rice	01	2047	6.69
Other crops	01	1568	5.12
Total	15	30610	100

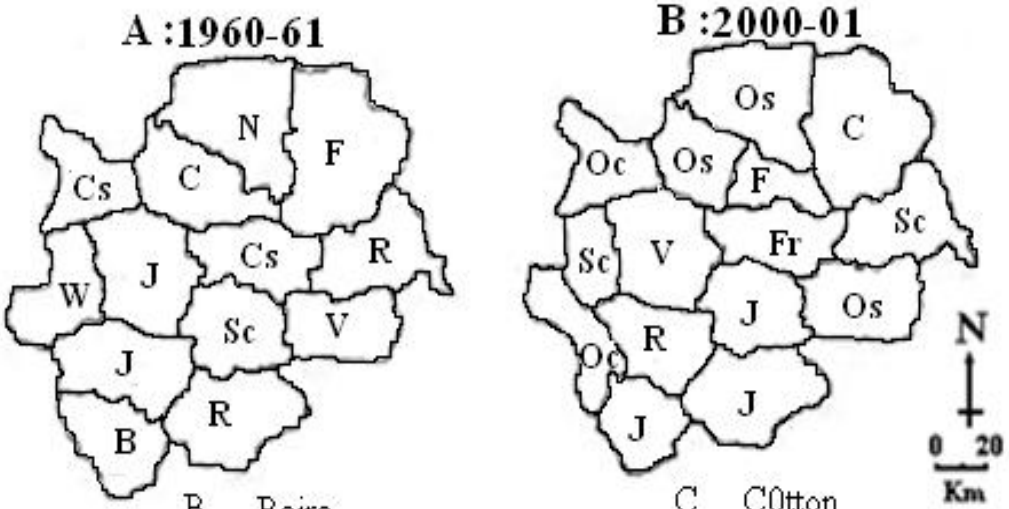
(Compiled by the Researcher)

percent to total area). The largest coverage of vegetable is found in the tahsils namely Kalwan, Satana, Igatpuri and Trimbak. Wheat is cultivated in three tahsils namely Chandwad, Deola and Surgana and covering 3574 hectares (11.68 percent to total area) in the district (map6.7/B and table 6.8 /B).

Map 6.7 : Nashik District Seventh Ranking Crops



Map 6.8 : Nashik District Eighth Ranking Crops



B	Bajra	C	C0tton
W	Wheat	P	Pulses
N	Nachani	M	Maize
R	Rice	Os	Oilseeds
V	Vegetable	J	Jawar
F	Fodder	Sc	Sugarcane
Cs	Condiments/Spices	Fr	Fruit

Oil-seeds and Jawar are cultivated in two tahsils under each crop covering 7663 hectares (25.03 percent to total area) and 3189 hectares (10.42 percent to total area) respectively in the district and the tahsils namely Nashik and Niphad while Jawar is cultivated in the tahsils namely Malegaon and Peth. Sugarcane, cotton, rice and other crops cultivated in one tahsils under each crop. Sugarcane covering 3984 hectares (13.02 percent to total area) in Dindori tahsil, cotton covering 2349 hectares (7.67 percent to total area) in Yeola tahsil while rice covering 2047 hectares (6.69 percent to total area) in Sinner tahsil and other crops covering 1568 hectares (5.12 percent to total area) in Nandgaon tahsil of Nashik district(map6.7/B and table 6.8 /B).

6.2.8: Eighth Ranking

In 1960-61there are ten crops which emerge as eighth in rank in Nashik district. The crops are Jawar, Rice, Condiments/Spices, Nachani, Sugarcane, Fodder, Vegetable, Cotton, Bajra and Wheat. Eight rank crops indicate diversity in number and crop distribution in the area under study (map6.8/A, table6.9/A). Among the ten crops Jawar, Rice and Condiments/Spices is the principal crops found larges coverage in the district. Jawar coverage on 8137 hectares (55.23 percent to total area) and found in two tahsils namely Nashik and Dindori. Rice coverage on 1144 hectares (7.76 percent to total area) and found in two tahsils, viz, Nandgaon and Sinner. While condiments and spices occupying 1316 hectares (8.93percent to total area) in two tahsils namely Surgana and Chandwad. Nachani, Sugarcane, Fodder, Vegetable, Cotton, Bajra and Wheat cultivated in one tahsils under each crop. Nachani covering 1342 hectares (9.11 percent to total area) in Satana tahsil, Sugarcane

Table-6.9 /A:

Crops, Tahsils and Area in Eighth Ranking (1960-61)

Crops	Number of Tahsils	Area in Hectares	% of Total Area
Jawar	02	8137	55.23
Rice	02	1144	7.76
Condiments /spices	02	518	3.52
Nachani	01	1342	9.11
Sugarcane	01	1316	8.93
Fodder	01	1240	8.42
Vegetable	01	417	2.83
Cotton	01	322	2.19
Bajra	01	278	1.89
Wheat	01	18	0.12
Total	13	14732	100

Table-6.9 /B:

Crops, Tahsils and Area in Eighth Ranking (2000-01)

Crops	Number of Tahsils	Area in Hectares	% of Total Area
Oil-seeds	03	5985	25.04
Jawar	03	5715	23.91
Sugarcane	02	1257	5.26
Vegetable	01	3782	15.82
Cotton	01	2443	10.22
Fruits	01	1797	7.52
Rice	01	1691	7.07
Fodder	01	1086	4.54
Other crops	02	147	0.62
Total	15	23903	100

(Compiled by the Researcher)

covering 1316 hectares (8.93 percent to total area) in Niphad tahsil, Fodder covering 1240 hectares (8.42 percent to total area) in Malegaon tahsil, Vegetable occupying 417 hectares (2.83 percent to total area) in Yeola tahsil, Cotton occupying 322

hectares (2.19 percent to total area) in Kalwan tahsil Bajra occupying 278 hectares (1.89 percent to total area) in Igatpuri tahsil while Wheat covering 18 hectares (0.12 percent to total area) in Peth tahsil in Nashik district (map6.8/A and table6.9/A).

There are nine crops (in 2000-01) which emerge as eighth in rank in Nashik district. The crops are oil-seeds, Jawar, sugarcane, vegetable, cotton, fruits, rice, fodder and other crops. Eight rank crops indicate diversity in number and crop distribution in the area under study (map6.8/B and table6.9 /B). Among the nine crops oil-seeds and Jawar is the principal crops found larges coverage in the district. Oil-seeds coverage on 5985 hectares (25.04 percent to total area) and found in three tahsils namely Kalwan, Satana and Yeola. While Jawar occupying 5715 hectares (23.91 percent to total area) in three tahsils namely Niphad, Sinner and Igatpuri. Sugarcane and other crops are cultivated in two tahsils under each crop covering 1257 hectares (5.26 percent to total area) and 147 hectares (0.62 percent to total area) respectively in the tahsils namely Nandgaon and Peth while other crops is cultivated in Surgana and Trimbak tahsils(map6.8 and table6.4/B). Vegetable, cotton, fruits, rice and fodder cultivated in one tahsils under each crop. Vegetable covering 3782 hectares (15.82 percent to total area) in Dindori tahsil, cotton covering 2443 hectares (10.22 percent to total area) in Malegaon tahsil, fruits covering 1797 hectares (7.52 percent to total area) in Chandwad tahsil, while rice covering 1691 hectares (7.07 percent to total area) in Nashik tahsil and fodder occupying 1086 hectares (4.54 percent to total area) in Deola tahsil in Nashik district (map6.8/B and table6.9 /B).

6.3: CROP COMBINATION

Recently the crop combination analysis in geographical studies has gained momentum and its importance is increasing day by day. Any study of crops on regional scale must take into consideration the combinational analysis and the relative position of crops. Such analysis would ultimately minimize the change of oversimplified generalization (Ali, 1978). Combination studies are fruitful in many ways; firstly, they provide an adequate understanding of individual crop geography. Secondly, combination is in itself integrative realities that demand definition and distribution analysis, and lastly crop combination regions are essential for the construction of still more complex structure of vivid agricultural region (Weaver, 1954).

6.3.1: Combination Technique

A number of statistical techniques have been introduced by geographers, agriculturists, and economists to demarcate crop combination regions. The introduction of these crop combination methods by Weaver (1954), Thomas (1963), Coppack (1964), Johnson (1958), Rafiullah (1956), Bhatia (1960), Athawale (1966), Ayyar (1909) and Doi (1959). In the present study Weaver's technique (1954) used for finding crop combination.

6.3.2: Weaver's Crop Combination Method

In the field of agricultural geography Weaver was the first Geographer who used (1954) statistical technique to show the crop combination of the Middle West (USA). In his attempt for the delineation of agricultural regions of the Middle West in the United States, Weaver based his analysis on acreage statistics. Weaver computed the percentage of total harvested cropland occupied by each crop that held as much as one percent of the

total cultivated land in each of the 1081 counties covered his work. Excluding a few counties like Houston and Minnesota in which the crop combination was easy to ascertain, other counties showed a complex and confused picture of the percentage, occupied by different crops. It was therefore necessary to device "a rigorous approach that would provide objective constant and precisely repeatable procedure and would yield comparable results for different years and localities". In his work Weaver calculated deviation of the real percentage of crops (occupying one percent of the cropped area) for all the possible combinations in the component areal units against a theoretical standard. The theoretical curve for the standard measurement was employed as follows;

Monoculture	=	100 % of the total harvested crop land in one crop.
Two crop combination	=	50 % in each of two crops.
Three crop combination	=	33.3 % in each of three crops
Four crop combination	=	25 % in each of four crops
Five crop combination	=	20 % in each of five crops
Ten crop combination	=	10 % in each of ten crops

For the determination of the minimum deviation the standard deviation method was used:

$$SD = \tilde{O}\Sigma d^2/n$$

where d is the difference between the actual crop percentages in a given county (areal unit) and the appropriate percentage in the theoretical curve and n is the number of crops in a given combination.

As Weaver pointed out, the relative, not absolute value being significant, square roots were not extracted so, the actual formula used as follows:

$$\mathbf{d = \Sigma\, d^2/n}$$

To illustrate the Weaver's technique an illustration can be given from Surgana tahsil in which the percentage share of crops in the cropped area in a year (2000-01) was as follows : Nachani 40.08 percent, Pulses 20.29 percent, Rice 17.6 percent, oil-seeds 11.48, fodder 5.1 percent, jawar 3.86 percent, Wheat 1.04 percent.

1. Monoculture

$$= \frac{(100 - 40.08)^2}{1} = 3590.4$$

2. Two crop combination

$$= \frac{(50-40.08)^2 + (50-20.29)^2}{2} = 490.53$$

3. Three crop combination

$$= \frac{(33.3-40.08)^2 + (33.3-20.29)^2 + (33.3-17.6)^2}{3} = 154.34$$

4. Four crop combination

$$= \frac{(25-40.08)^2 + (25-20.29)^2 + (25-17.6)^2 + (25-11.48)^2}{4} = 121.78$$

5. Five crop combination

$$= \frac{(20-40.08)^2 + (20-20.29)^2 + (20-17.6)^2 + (20-11.48)^2 + (20-11.48)^2}{5} = 140.73$$

Table 6.10 /A: Crop Combination in Nashik District (1960-61)

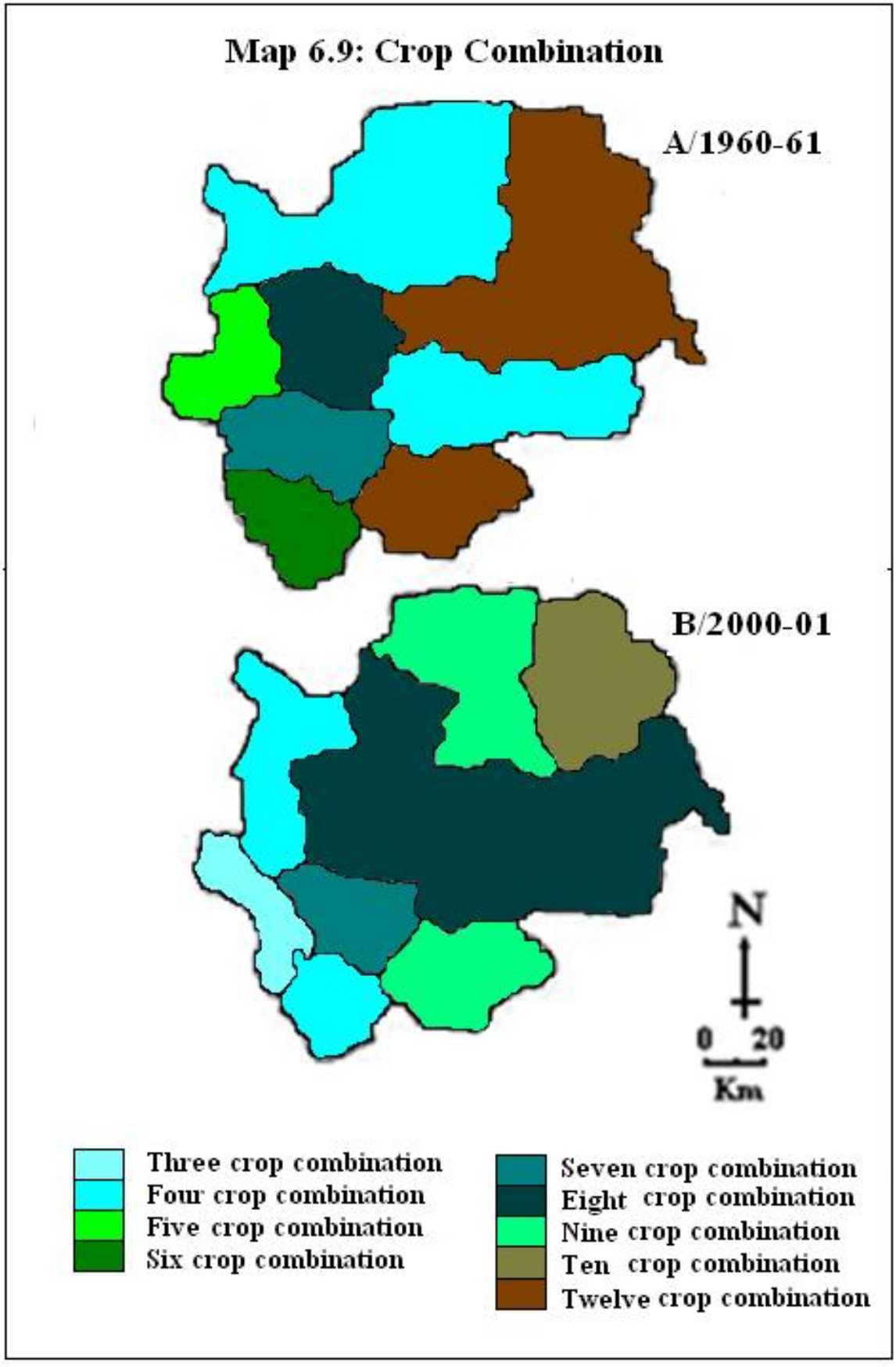
Combination Type	Crops in Combination	No. of Tahsils	Area in Hectares	% of total area
Monoculture	Nil	--	--	--
Two crop	Nil	--	--	--
Three crop	Nil	--	--	--
Four crop	N/ Os/ R/ P/B /J/W	05	305281	34.95
Five Crop	N/R/Os /P/Fo	01	29482	3.37
Six Crop	R/Fo/N/P/Os/W	01	53299	6.10
Seven crop	W/B/Fo/P/N/R/Os	01	59039	6.76
Eight crop	W/P/N/Fo/Os/B/R/J	01	79374	9.09
Twelve Crop	B/Os/J/P/W/Sc/C/Fo /R/Cs/V/Fr	04	347099	39.73
	Total	13	347099	100

Table 6.10 /B: Crop Combination in Nashik District (2000-01)

Combination Type	Crops in Combination	No. of Tahsils	Area in Hectares	% of total area
Monoculture	Nil	--	--	--
Two crop	Nil	--	--	--
Three crop	N/R/Fo	01	27025	3.18
Four crop	N/P/Fo/Os/ R	03	107218	12.61
Seven crop	V/N/Fo/W/Fr/P/Os	01	37114	4.36
Eight crop	Fo/N/W/J/R/Os/Sc/ V/B/ M/P/Fr/C/Oc	06	382603	44.98
Nine crop	B/M/P/Fr/Sc/W/V/ Os/J/ Fo/R	03	189116	22.23
Ten crop	B/Os/V/P/Fr/M/J/C /W/Fo	01	107528	12.64
	Total	15	850604	100

(Source: By the Researcher)

B = Bajra
V = Vegetable
P = Pulses
Fo = Fodder
Os = Oil-seeds
R = Rice
N = Nachani
W = Wheat
Oc = Other crops
Cs = Condiments/Spices
J = Jawar
Fr = Fruits
M = Maize
Sc = Sugarcane


Map 6.9: Crop Combination
A/1960-61
B/2000-01
N
0 20
Km
Three crop combination
Four crop combination
Five crop combination
Six crop combination
Seven crop combination
Eight crop combination
Nine crop combination
Ten crop combination
Twelve crop combination

The deviation of the actual percentages from the theoretical curve is seen to be the lowest for a four crop combination. This result established the identity and the number of crops in the basic combination for the district as NPROs (Nachani + Pulses + Rice + Oilseeds).

6.3.3: Crop Combination: Application and Results

Four, five, six, seven, eight and twelve crop combinations have been identified in 1960-61 while three, four, seven, eight, nine and ten crop combinations have been identified in 2000-01 for Nashik district (map 6.9A/B). The tahsils and area under each crop combination are shown in table 6.10/A, B.

6.3.4: Three crop combination

Three crop combinations will not found in 1960-61, but in 2000-01 there is three crops namely Nachani, Rice and Fodder enter into three crop combination in one tahsil. Map6.9 reveals that the three crop combination area is located to the western side of the district. Table 6.11 displays the three crop combination of crops in order, tahsils and area in the region under study.

Table 6.11: Three Crop Combinations (2000-01)

Sr. No.	Crops in order	No. of Tahsils	Area in Hectares	% of total area
1	N/R/Fo	01	27025	3.18
	Total	01	27025	3.18

(Source: By the Researcher)

It is observed from map 6.11 that the area of three crop combination is in the western part covering 27025 hectares (3.18 percent to total area).

Nachani and rice is the dominant crops in the western part and enters in combination with fodder crop in the district. The

combination appears in the tahsil namely Trimbak in the area of downghat Konkan.

6.3.5: Four Crop Combinations

In 1960-61 four crop combinations denote the increases in the number of crops with comparative diversification in crop combination. Seven crops in this combination entered are namely, nachani, oilseeds, rice, pulses, bajra, Jawar and wheat. The region of four crop combinations is wide spread in the north-western part (three tahsils) and two tahsils in the south-eastern part of the district (map 6.11/A, table 6.12/A).

Table 6.12/A: Four Crop Combinations (1960-01)

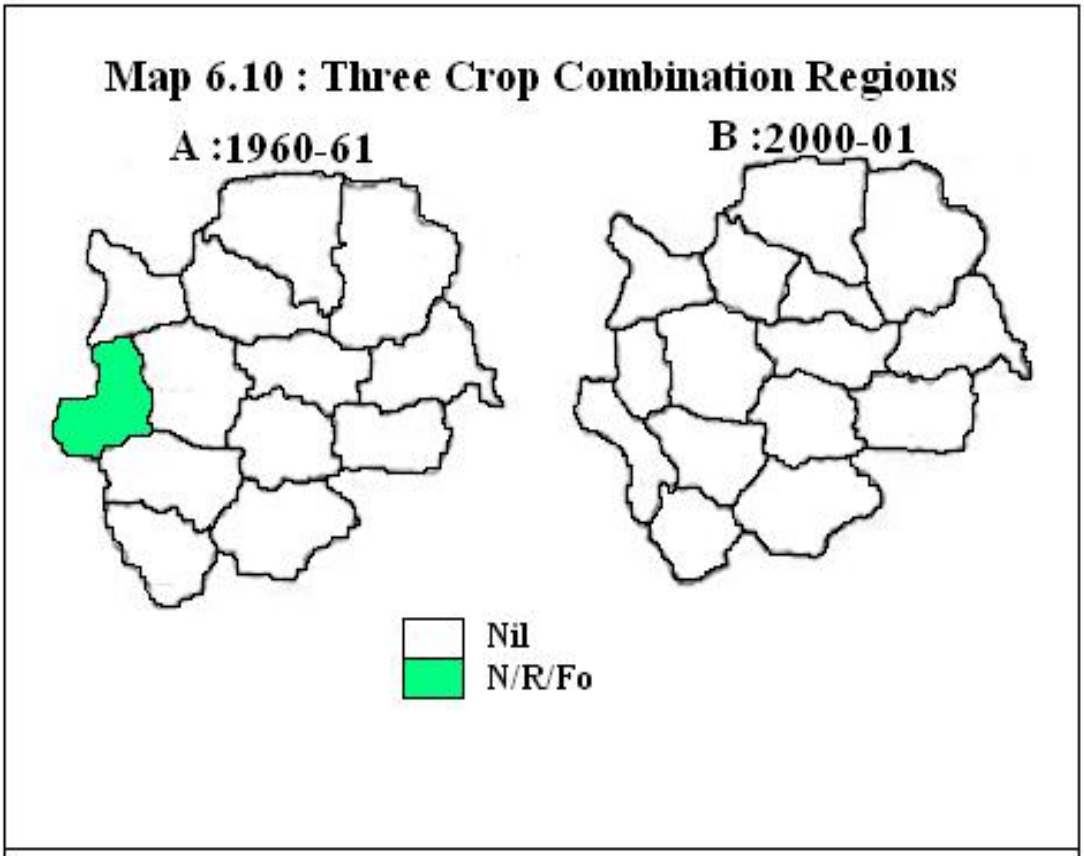
Sr. No.	Crops in order	No. of Tahsils	Area in Hectares	% of total area
1	N/Os/R/P	01	27098	3.11
2	B/P/J/Os	01	53922	6.17
3	B/Os/P/J	01	82426	9.43
4	B/J/P/W	01	68808	7.88
5	B/W/Os/P	01	73029	8.36
	Total	05	305281	34.95

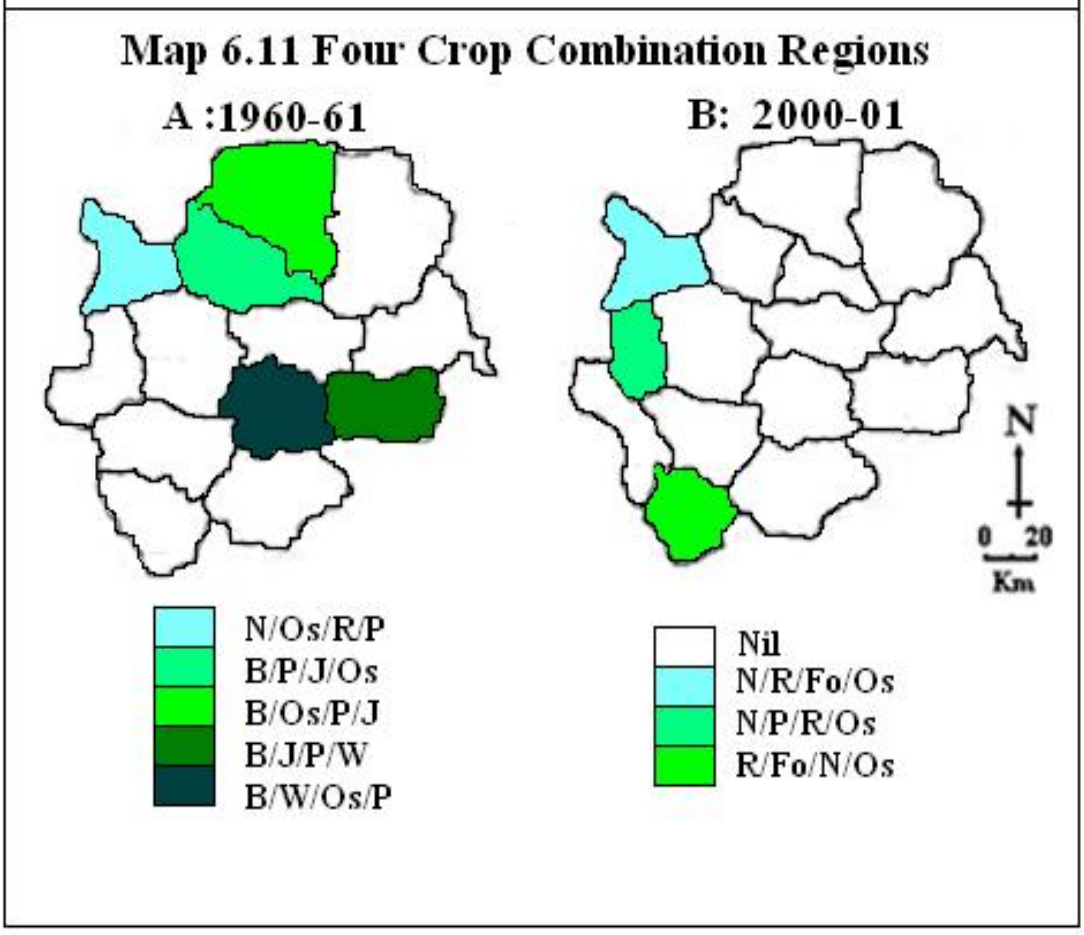
Table 6.12/B: Four Crop Combinations (2000-01)

Sr. No.	Crops in order	No. of Tahsils	Area in Hectares	% of total area
1	N/R/Fo/Os	01	31571	3.71
2	N/P/R/Os	01	31180	3.67
3	R/Fo/N/Os	01	44467	5.23
	Total	03	107218	12.61

(Source: By the Researcher)

It is observed from map6.11/A that the area of four crop combination is in the north-western part and south-eastern part of the district covering 305281hectares (34.95 percent to total area). Further more it is visible that five tahsils of four crop combinations appears in the district. Satana having combination


Map 6.10 : Three Crop Combination Regions
A :1960-61
B :2000-01
Nil
N/R/Fo


Map 6.11 Four Crop Combination Regions
A :1960-61
B: 2000-01
N
0 20
Km
N/Os/R/P
B/P/J/Os
B/Os/P/J
B/J/P/W
B/W/Os/P
Nil
N/R/Fo/Os
N/P/R/Os
R/Fo/N/Os

of bajra, oilseeds, pulses and Jawar covering 82426 hectares (9.43 percent to total area) Niphad having combination of bajra, wheat, oilseed and pulses on 73029 hectares (8.36 percent to total area), Yeola having combination of bajra, Jawar, pulses and wheat covering 68808 hectares (7.88 percent to total area) while Kalwan having combination of bajra, pulses, Jawar and oil seeds on 53922 hectares (6.17 percent to total area) and Surgana having combination of nachani, oil seeds, rice and pulses covering 27098 hectares (3.11 percent to total area) (table6.12/A and map6.11/A). This combination is attributed to north-western part and south-eastern part of the district.

In 2000-01 four crop combinations denote the increases in the number of crops with comparative diversification in crop combination. Five crops in this combination entered are namely, nachani, pulses, fodder, oilseeds and rice. The region of four crop combination is wide spread in the western part of the district (map 6.11/B and table 6.12/B).

It is observed from map6.11 that the area of four crop combination is in the western part covering 107218 hectares (12.61 percent to total area). Further more it is visible that three tahsils of four crop combinations appears in the district. Peth having combination of nachani, rice, fodder and oilseeds covering 31571 hectares (3.71 percent to total area) while Surgana having combination of nachani, pulses, rice and oil seeds on 31180 hectares (3.67 percent to total area) and Igatpuri having combination of rice, fodder, nachani and oil seeds covering 44467 hectares (5.23 percent to total area) (table6.12/B and map6.11/B). This combination is attributed to downghat Konkan part of the district.

6.3.6: Five Crop Combinations

In 1960-61 five crop combinations denote the increases in the number of crops with comparative diversification in crop combination. Five crops in this combination entered are namely, nachani, rice, oilseeds, pulses and Fodder. The region of five crop combinations is in the western part of the district (map 6.12/A, table 6.13).

Table 6.13: Five Crop Combinations (1960-61)

Sr. No.	Crops in order	No. of Tahsils	Area in Hectares	% of total area
1	N/R/Os/P/Fo	01	29482	3.37
	Total	01	29482	3.37

(Source: By the Researcher)

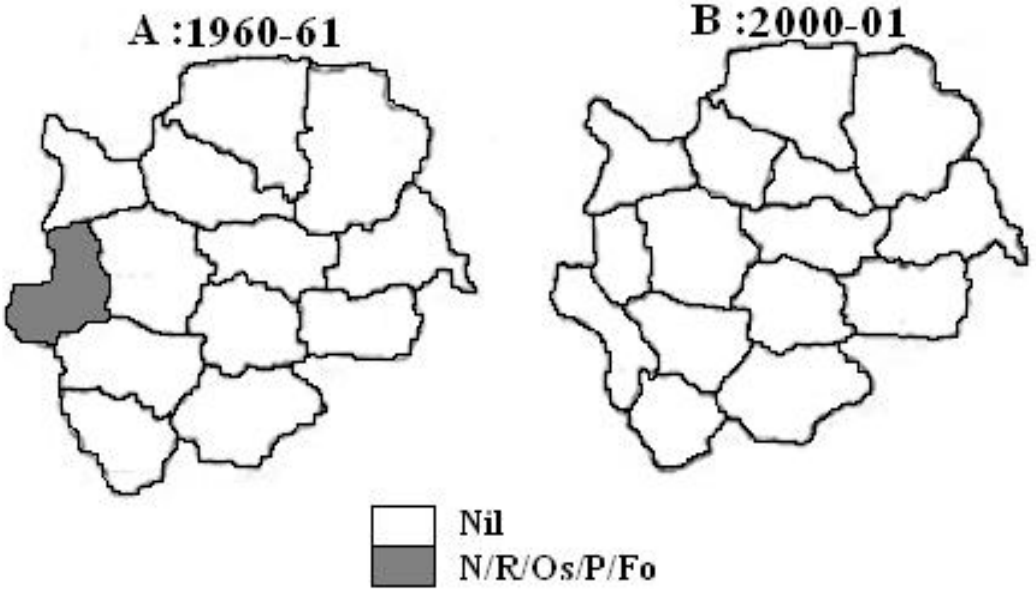
It is observed from map6.12/A that the area of five crop combination is in the western part of the district covering 29482 hectares (3.37 percent to total area). Further more it is visible that only one tahsils of five crop combinations appears in the district i.e. Peth tahsil was having combination of nachani, rice, oilseed, pulses and fodder covering 29482 hectares (3.37 percent to total area) (map 6.12/A, table 6.13).

There was no any tahsil under five crop combinations in 2000-01(map 6.12/B).

6.3.7: Six Crop Combinations

In 1960-61six crop combinations denote the increases in the number of crops with comparative diversification in crop combination. Five crops in this combination entered are namely, rice, fodder, nachani, pulses, oilseed and wheat. The region of six crop combinations is in the south-western part of the district (map 6.13/A, table 6.14).

Map 6.12 : Five Crop Combination Regions



Map 6.13 : Six Crop Combination Regions

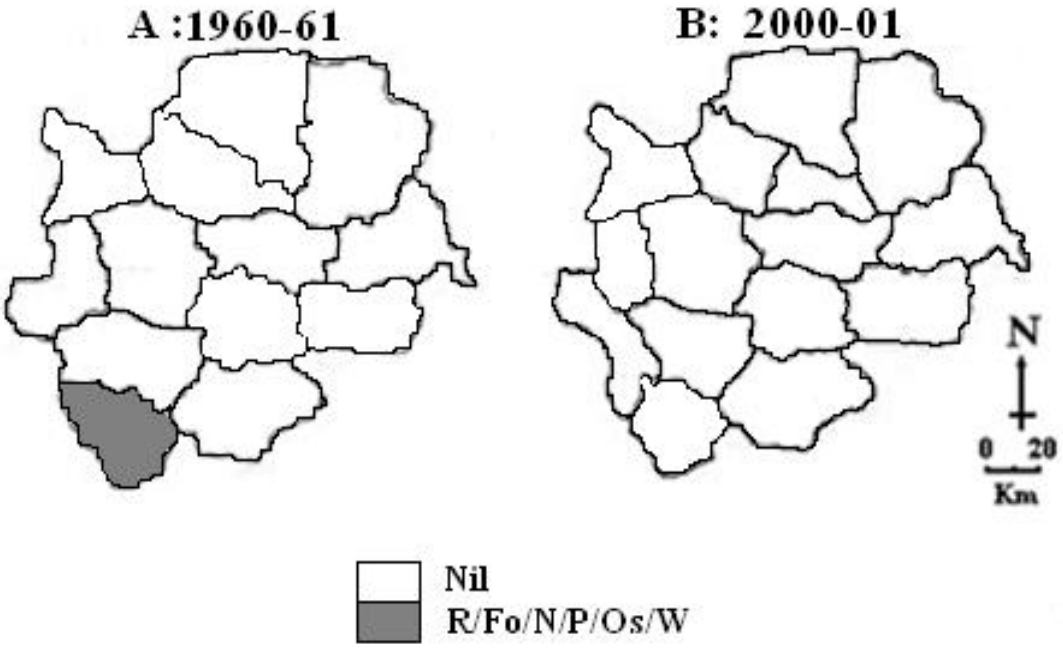


Table 6.14: Six Crop Combinations (1960-61)

Sr. No.	Crops in order	No. of Tahsils	Area in Hectares	% of total area
1	Fr/Fo/N/P/Os/W	01	53299	6.10
	Total	01	53299	6.10

(Source: By the Researcher)

It is observed from map6.13/A that the area of six crop combination is in the south-western part of the district covering 53299 hectares (6.1percent to total area). Further more it is visible that only one tahsils of six crop combinations appears in the district i.e. Igatpuri tahsil was having combination of rice, fodder, nachani, pulses, oilseed and wheat covering 53299 hectares (6.1percent to total area) (map 6.12/A, table 6.13).

There was no any tahsil under six crop combinations in 2000-01(map 6.13/B).

6.3.8: Seven crop combination

In 1960-61, seven crops namely wheat, bajra, fodder, pulses, nachani, rice and oilseeds entre into seven crop combination in one tahsil. Map6.13/A reveals that seven crop combination areas are located in Nashik tahsil in the district.

Table 6.15/A: Seven Crop Combinations (1960-61)

Sr. No.	Crops in order	No. of Tahsils	Area in Hectares	% of total area
1	W/B/Fo/P/N/R/Os	01	59039	6.76
	Total	01	59039	6.76

(Source: By the Researcher)

Table 6.15/B: Seven Crop Combinations (2000-01)

Sr. No.	Crops in order	No. of Tahsils	Area in Hectares	% of total area
1	V/N/Fo/W/Fr/P/Os	01	37114	4.36
		01	37114	4.36

(Source: By the Researcher)

Table6.15/A displays the seven crop combination of crops in orders, tahsils and area in the district. It is observed from table6.15/A, map6.13/A that the area of seven crop combination is in Nashik tahsil covering 59039 hectares (6.76 percent to total area).

In 2000-01, seven crops namely vegetable, nachani, fodder, wheat, fruits, pulses and oilseeds entre into seven crop combination in one tahsil. Map6.13/B reveals that seven crop combination areas are located in Nashik tahsil in the district. Table6.15/B displays the seven crop combination of crops in orders, tahsils and area in the district. It is observed from table6.15/B and map6.13/B that the area of seven crop combination is in Nashik tahsil covering 37114 hectares (4.36 percent to total area).

6.3.9: Eight Crop Combinations

In 1960-61, eight crops namely wheat, pulses, nachani, fodder, oilseeds, bajra, oilseeds and Jawar entre into eighth crop combination in one tahsil. Map6.14/A reveals that eighth crop combination areas are located in Dindori tahsil in the district. Table6.16/A displays the eight crop combination of crops in orders, tahsils and area in the district. It is observed from table6.16/A, map6.14/A that the area of seven crop combination is in Dindori tahsil covering 79374 hectares (9.09 percent to total area).

While in 2000-01, eight crop combinations denote the increase in the number of crops with comparative diversification in crop combination. Eight crops in this combination entered are namely, Fodder, nachani, wheat, Jawar, rice, oilseeds, sugarcane, vegetable, bajra, fodder, maize, pulses, fruits, cotton and other

Table6.16/A: Eight Crop Combinations (1960-61)

Sr. No.	Crops in order	No. of Tahsils	Area in Hectares	% of total area
1	W/P/N/Fo/Os/B/R/J	01	79374	9.09
	Total	01	79374	9.09

(Source: By the Researcher)

Table6.16/B: Eight Crop Combinations (2000-01)

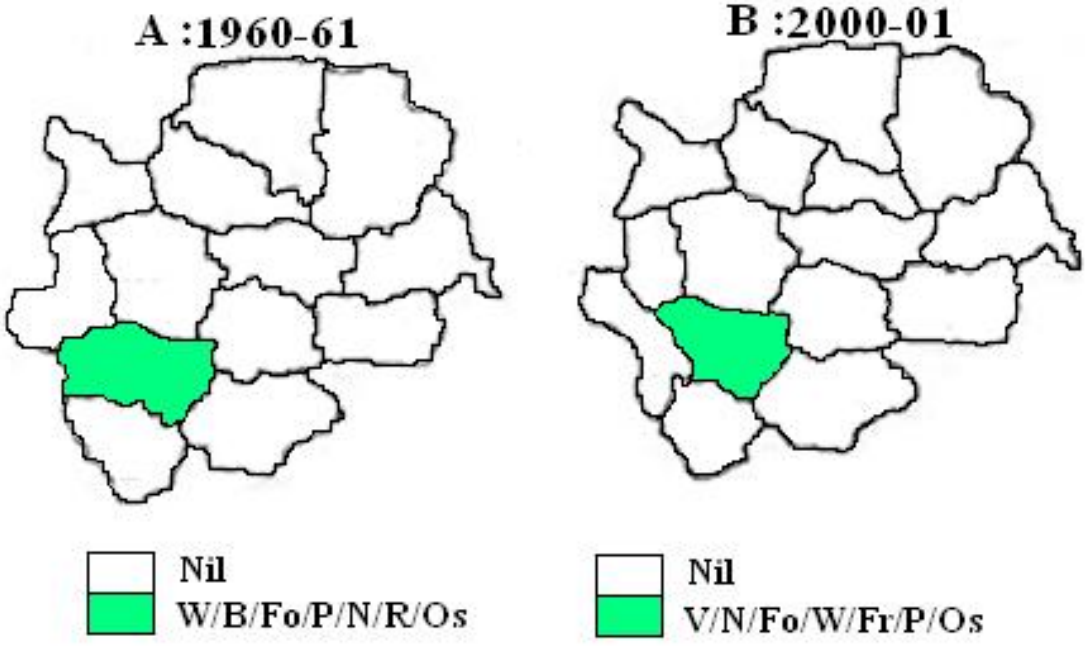
Sr. No.	Crops in order	No. of Tahsils	Area in Hectares	% of total area
1	Fo/N/W/J/R/Os/Sc/V	01	60766	7.14
2	B/Fo/M/P/W/R/V/Os	01	34869	4.1
3	B/V/P/Fo/J/Os/W/Fr	01	65242	7.67
4	B/P/Oc/V/C/J/Os/Sc	01	65640	7.72
5	B/V/P/J/M/W/C/Os	01	80467	9.46
6	B/Sc/V/Fr/P/W/Os/J	01	75619	8.89
	Total	06	382603	44.98

(Source: By the Researcher)

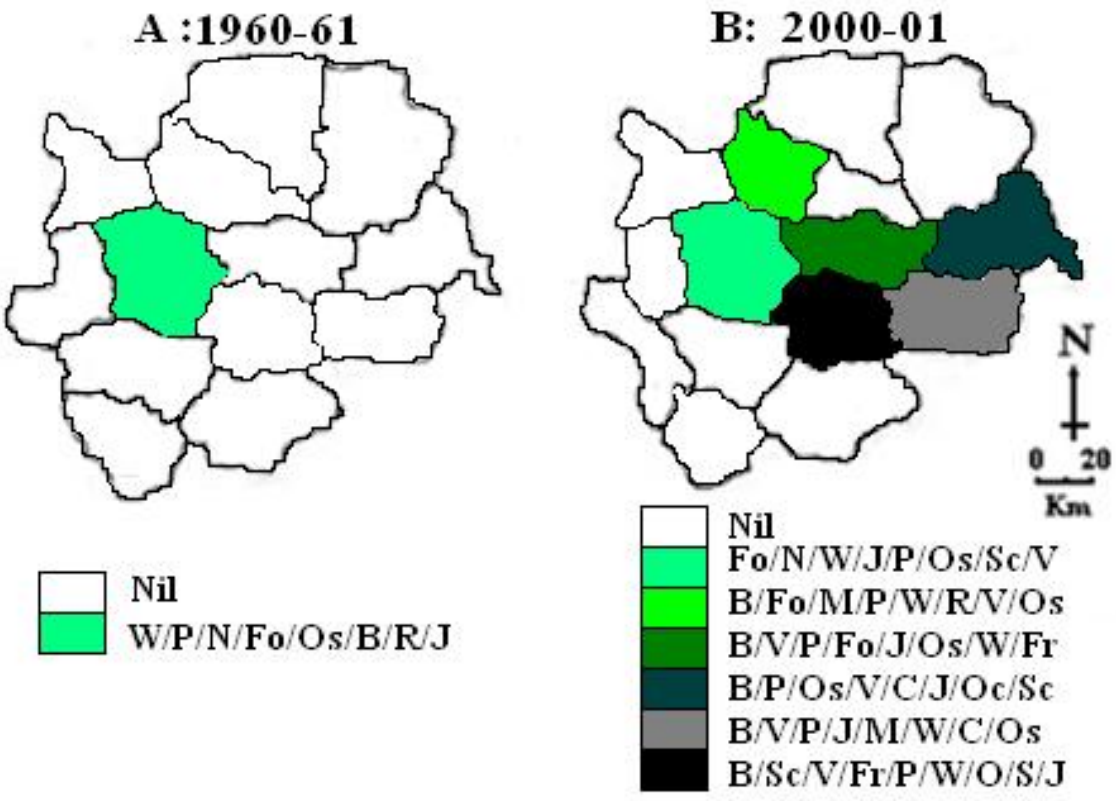
crops. The region of eight crop combination is wide spread in the central part from north-east to south-west direction of the district (map6.14/B). Table6.16/B displays the crop in order, tahsils and area in eight crop combinations. It is observed from table6.5 that the area of eight crop combination covering 382603 hectares (44.98 percent to total area). It means eight crop combination covers maximum area in the district (table 6.16/B & map 6.14/B).

Further more it is visible that six tahsils of eight crop combinations appears in the district. Yeola tahsil covering maximum area i.e.80467 hectares (9.46 percent to total area) of the district and having combination of bajra, vegetable, pulses, Jawar, maize, wheat, cotton and oilseeds (table 6.9) secondly Niphad having combination of bajra, Sugarcane, vegetable, fruits, pulses, wheat, oilseeds and Jawar covering 75619 hectares (8.89 percent to total area). Thirdly Nandgaon was having combination

Map 6.14 : Seven Crop Combination Regions



Map 6.15: Eight Crop Combination Regions



of bajra, pulses, oilseeds, vegetable, cotton, Jawar, other crops and sugarcane covering 65640 hectares (7.72 percent to total area). Fourthly Chandwad was having combination of bajra, vegetable, pulses, fodder, Jawar, oilseeds, wheat and fruits covering 65242 hectares (7.67 percent to total area). While Dindori having combination of fodder, nachani, wheat, Jawar, rice, oilseeds, sugarcane and vegetable covering 60766 hectares (7.14 percent to total area), and Kalwan having combination of bajra, fodder, maize, pulses, wheat, rice, vegetable and oilseeds covering 34869 hectares (4.1 percent to total area) (table 6.16/B & map 6.14/B).

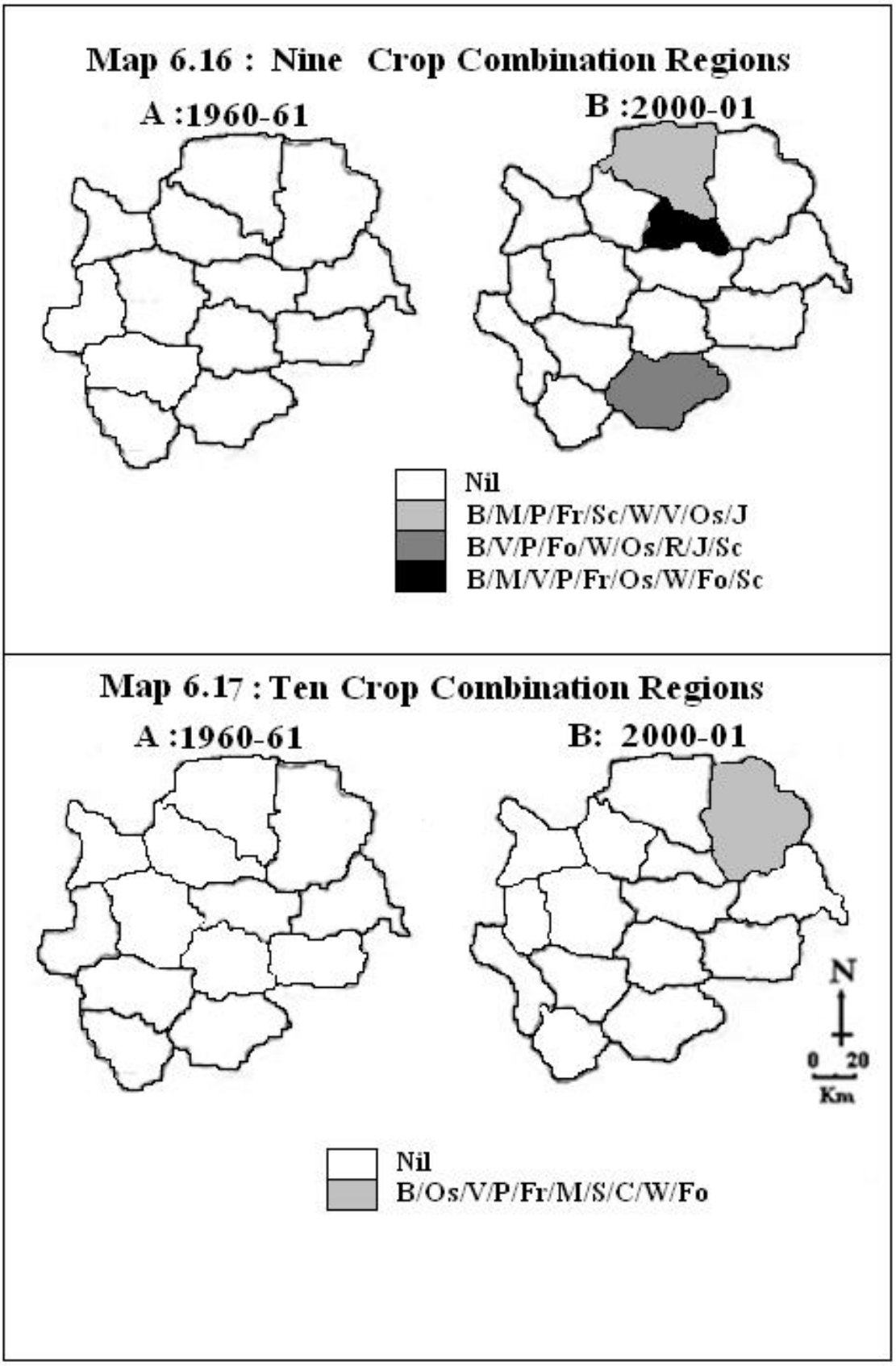
6.3.10: Nine Crop Combinations

Nine crop combinations will not found in 1960-61, but in 2000-01, nine crop combinations denote the increases in the number of crops with comparative diversification in crop combination. Eleven crops in this combination entered are namely, bajra, maize, pulses, fruits, sugarcane, wheat, vegetable, oilseeds, Jawar, fodder and rice. The region of nine crop combination is wide spread in the north and south west part of the district (map6.16/b and table6.17). It is observed from map6.16/B that the area of nine crop combination is in the north and south west

Table 6.17: Nine Crop Combinations (2000-01)

Sr. No.	Crops in order	No. of Tahsils	Area in Hectares	% of total area
1	B/M/P/Fr/Sc/W/V/Os/J	01	72793	8.56
2	B/V/P/Fo/W/Os/R/J/Sc	01	80761	9.49
3	B/M/V/P/Fr/Os/W/Fo/Sc	01	35562	4.18
	Total	03	189116	22.23

(Source: By the Researcher)


Map 6.16 : Nine Crop Combination Regions
A :1960-61
B :2000-01
Nil
B/M/P/Fr/Sc/W/V/Os/J
B/V/P/Fo/W/Os/R/J/Sc
B/M/V/P/Fr/Os/W/Fo/Sc
Map 6.17 : Ten Crop Combination Regions
A :1960-61
B: 2000-01
N
0 20
Km
Nil
B/Os/V/P/Fr/M/S/C/W/Fo

part covering 189116 hectares (22.23 percent to total area). Further more it is visible that three tahsils of nine crop combinations appears in the district (map6.16/b and table6.17).

Satana having combination of bajra, maize, pulses, fruits, sugarcane, wheat, vegetable, oilseeds and Jawar covering 72793 hectares (8.56 percent to total area) while Sinner having combination of bajra, vegetable, pulses, fodder, wheat, oilseeds, rice, jawar and sugarcane on 80761 hectares (9.49 percent to total area) and Deola having combination of bajra, maize, vegetable, pulses, fruits, oilseeds, wheat, fodder and sugarcane covering 35562 hectares (4.18 percent to total area) (map6.16/b and table6.17) this combination is attributed to north and south west part of the district.

6.3.11: Ten Crop Combinations

Ten crop combinations will not found in 1960-61, but in 2000-01,Ten crops namely bajra, oilseeds, vegetable, pulses, fruits, maize, jawar, cotton, and wheat and fodder entre into ten crop combination in one tahsil. Map6.15 reveals that ten crop combination areas are located in Malegaon tahsil in the district.

Table6.18: Ten Crop Combinations (2000-01)

Sr. No.	Crops in order	No. of Tahsils	Area in Hectares	% of total area
1	B/Os/V/P/Fr/M/J/C/W/Fo	01	107528	12.64
	Total	01	107528	12.64

(Source: By the Researcher)

Table6.11 displays the ten crop combination of crops in orders, tahsils and area in the district. It is observed from table6.11 and map6.15 that the area of ten crop combination is in Malegaon tahsil covering 107528 hectares (12.64 percent to total area).

6.3.12: Twelve crop Combinations

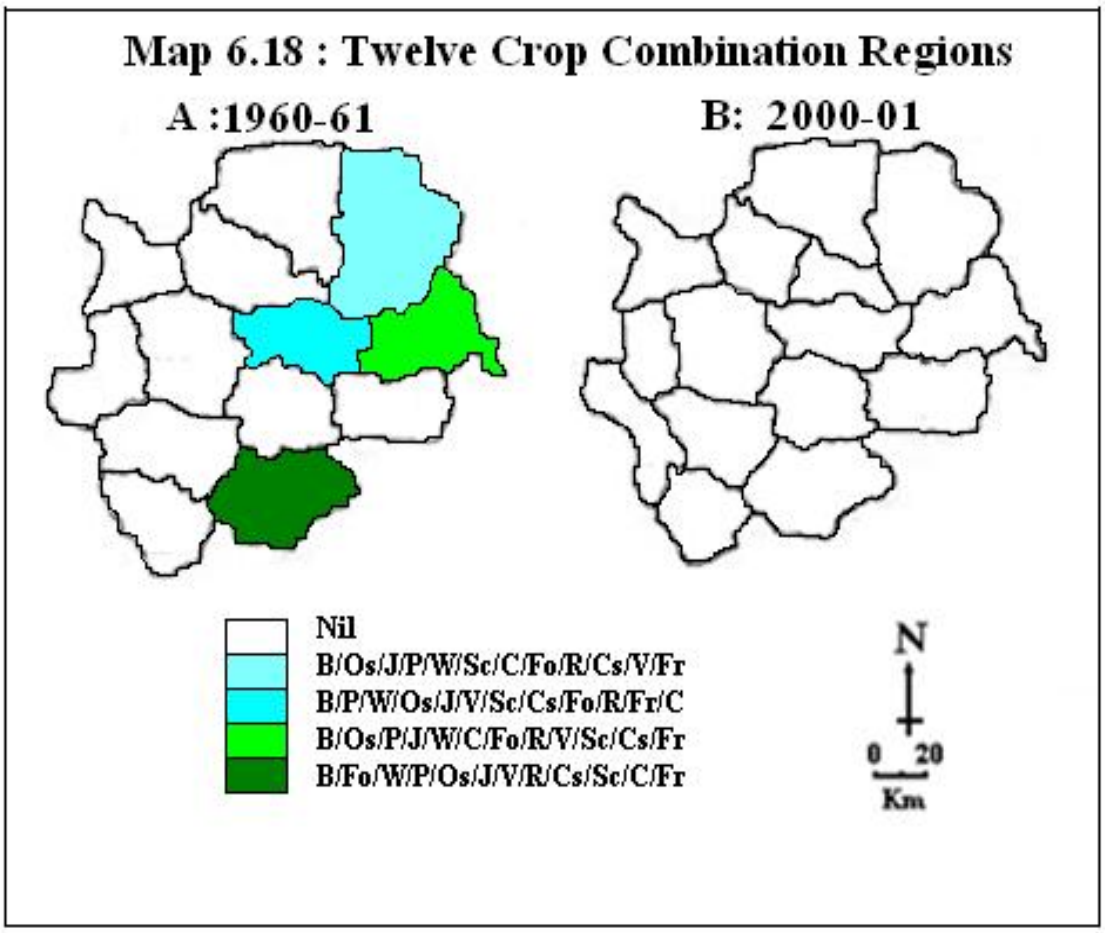
In 1960-61, twelve crops namely bajra, oilseed, Jawar, pulses, wheat, sugarcane, cotton, fodder, rice, condiments/spices, vegetable and fruits entre into twelve crop combination in four tahsil. Map 6.18/A reveals that twelve crop combination areas are located in Malegaon, Chandwad, Nandgaon and Sinner tahsils in the district. Table 6.19 displays the twelve crop combination of crops in orders, tahsils and area in the district. It is observed from table6.19, map6.18/A that the area of twelve crop combination is in four tahsil covering 347099 hectares (39.73 percent to total area).

Table 6.19: Twelve Crop Combinations (1960-61)

Sr. No.	Crops in order	No. of Tahsils	Area in Hectares	% of total area
1	B/Os/J/P/W/Sc/ C/Fo/R/Cs/V/Fr	01	126132	14.44
2	B/P/W/Os/J/V Sc/Cs/Fo/R/Fr/C	01	62072	7.10
3	B/Os/P/J/W/C/ Fo/R/V/Sc/Cs/Fr	01	62730	7.18
4	B/Fo/W/P/Os/J/ V/R/Cs/Sc/C/Fr	01	96165	11.01
	Total	04	347099	39.73

(Source: By the Researcher)

Further more it is visible that four tahsils of twelve crop combinations appears in the district. Malegaon tahsil covering maximum area i.e.126132 hectares (14.44 percent to total area) of the district and having combination of bajra, oilseeds, Jawar, pulses, wheat, sugarcane, cotton, fodder, condiments/spices, vegetable and fruits (table 6.19) secondly Sinner having combination of bajra, fodder, wheat, pulses, oilseed, Jawar, vegetable, rice, condiments/spices, sugarcane, cotton and fruits



covering 96165 hectares (11.01percent to total area). Thirdly Nandgaon was having combination of bajra, oilseeds, pulses, Jawar, wheat, cotton, fodder, rice, vegetable, sugarcane, condiments/spices and fruits covering 62730 hectares (7.18 percent to total area). Fourthly Chandwad was having combination of bajra, pulses, wheat, oilseeds, Jawar, vegetable, sugarcane, condiments/spices, fodder, rice, fruits and cotton covering 62072 hectares (7.1 percent to total area). (Table 6.19 & map 6.18/A).

There was no any tahsil under twelve crop combinations in 2000-01(map 6.18/B).

6.4: CROP DIVERSIFICATION

The crop-combination technique is applied to compute crop-diversification pattern of the region. Its meaning is to raise variety of crops on arable land. It reflects the impact of physio-socio-economic variables. Moreover, it shows the contemporary competition among crops for an area, scope for rotation, the effect on double cropping, (Husain, 1979). The greater numbers of crops lead 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 identify the degree of diversifications and concentrations by Cleann (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 crop diversification technique in order to understand crop competition in the region followed by Jasbir Singh (1976); Ayyer (1969) modified Bhatia's method of crop diversification with accounting for those crops which occupy at least one per cent of the gross cropped area.

6.4.1: Crop Diversification Technique

In order to identify spatial pattern of crop diversification in Present study, Bhatia's method has been adopted in modified form. The crops having less than five percentages have been excluded from computation. This modified formula expresses as:

Index of Crop Diversification =

$$\frac{\text{Percentage of Net Sown Area}}{\text{Number of 'n' crops}}$$

where – 'n' crops are those which individually occupy five or more than five percent of crop to net sown area in the tahsils.

6.4.2: **Crop Diversifications: Application and Results**

The obtained results have been displayed in map 6.19 and Table 6.20 Table 6.21/A/B shows crops in number, crops in competition, tahsils and area in crop diversification in the Nashik district.

Map 6.19 portrays the spatial distributional pattern of crop diversification in the district. In 1960-61 maximum crop diversification appears in Dindori (12.05) tahsil and lowest at Nandgaon (23.58) tahsil while in 2000-01 maximum crop diversification appears in Dindori (11.28) tahsil and lowest at Trimbak (30.87) tahsil. It is seen from the above map 6.19A/B that four crop-diversification regions 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 diversifications, its class, magnitude, tahsils and area are shown in Table 6.20.It is observed from this table that in 1960-61 largest area appears in the low crop diversification class covering 53.17 percent area in the district and moderate crop diversification class covering 46.83 percent area in Nashik district. The four crops namely, Bajra, oilseeds, pulses and Jawar are in competition for diversification in Satana, Malegaon and Nandgaon tahsil, Bajra, pulses, wheat and

oilseeds are in competition for diversification in Chandwad and Niphad tahsil, while bajra, Jawar, Pulses and wheat are in competition for diversification in Yeola tahsil. The five crops, namely, nachani, rice, oilseed, pulses and fodder are in competition for diversification in Peth and Surgana tahsils in Nashik district (Table 6.21/A).

Table 6.20: Patterns of Crop Diversification (1960-61 and 2000-01)

Diversification		No. of Tahsils		% of Total Tahsils		Area (Hectares)		% of Area	
Class	Magnitude	1961	2001	1961	2001	1961	2001	1961	2001
0-10	High	--	--	--	--	--	--	--	--
10-20	Moderate	07	08	53.85	53.3	398890	379158	46.83	48.72
20-30	Low	06	06	46.15	40.0	452971	371934	53.17	47.81
> 30	Very low	--	01	--	6.7	--	27025	--	3.47
Total		13	15	100	100	851861	778117	100	100

(Source: By the Researcher)

Six crops namely, Bajra, fodder, wheat, pulses, oilseed and Jawar are in competition for diversification in Sinner tahsil, as well as rice, fodder, nachani, pulses, oilseed, and wheat are in competition for diversification in Igatpuri tahsil while seven crops namely, wheat, bajra, fodder, pulses, nachani, rice and oilseed are in competition for diversification in Nashik tahsil. Eight crops, namely, wheat, pulses, nachani, fodder, oilseed, bajra, rice and

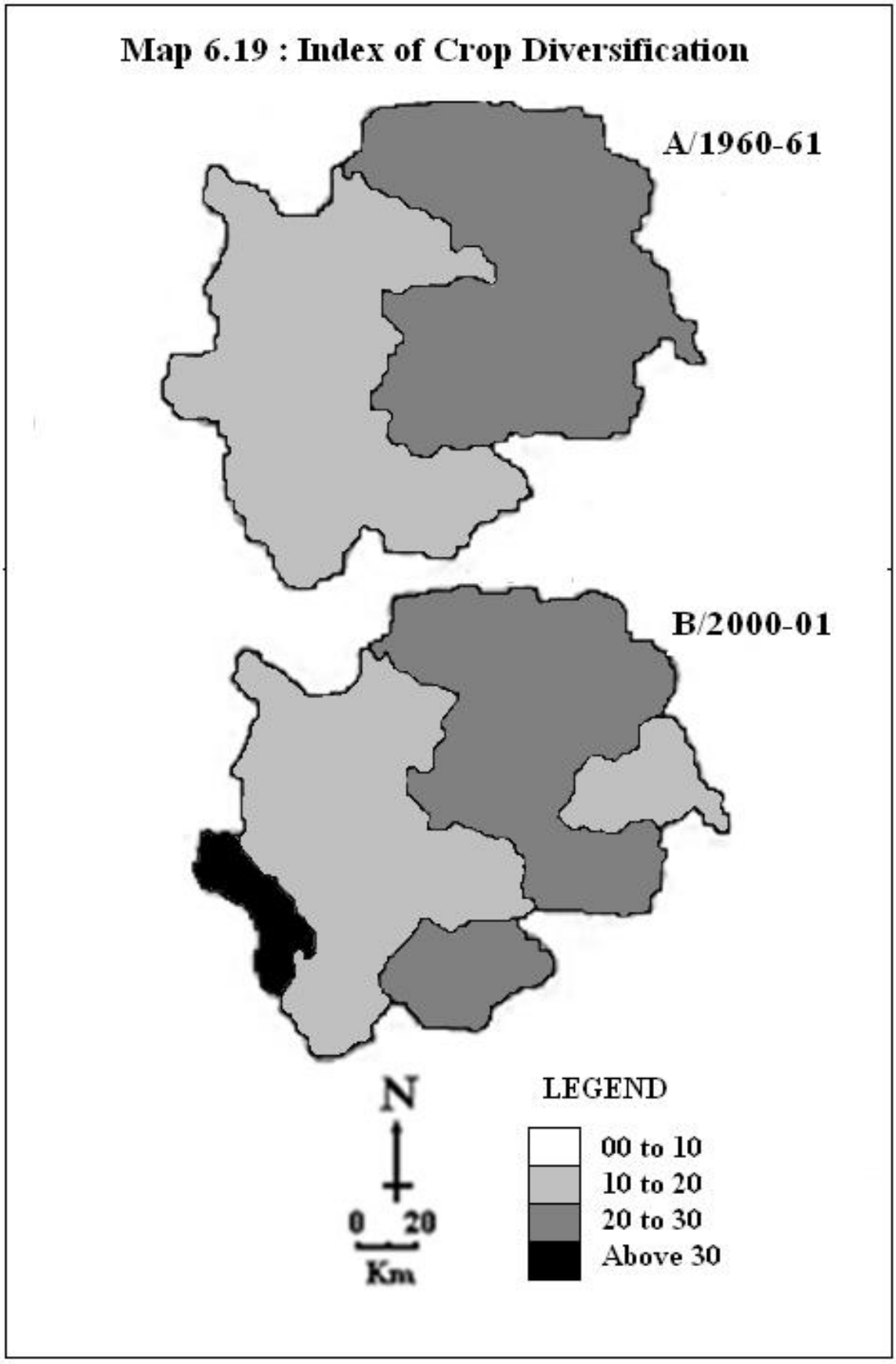

Map 6.19 : Index of Crop Diversification
A/1960-61
B/2000-01
N
0 20
Km
LEGEND
00 to 10
10 to 20
20 to 30
Above 30

Table6. 21/A: Pattern of Crop Diversification (1960-61)

Name of the Tahsil	Index of Crop Diversification	Crops in Competition for Diversification	Area in Hectares	% Area
Satana	22.27	B+Os+P+J	82426	9.68
Malegaon	22.36	B+Os+J+P	112811	13.24
Chandwad	22.85	B+P+W+Os	56719	6.66
Nandgaon	23.58	B+Os+P+J	59178	6.95
Yeola	22.76	B+J+P+W	68808	8.08
Niphad	21.18	B+W+Os+P	73029	8.57
Peth	19.95	N+R+Os+P+Fo	29482	3.46
Surgana	18.79	N+Os+R+P+Fo	28738	3.37
Kalwan	17.83	B+P+J+Os+W	57376	6.73
Igatpuri	16.13	R+Fo+N+P+Os+ W	53299	6.26
Sinner	15.87	B+Fo+W+P+Os+ J	91584	10.75
Nashik	12.89	W+B+Fo+P+N+ R+Os	59038	6.93
Dindori	12.05	W+P+N+Fo+Os+ B+R+J	79373	9.32

(Source: By the Researcher)

Note:

B = Bajra
R = Rice
J = Jawar
V = Vegetable
N= Nachani
Fr = Fruits
P = Pulses
W= Wheat
M = Maize
Fo = Fodder
Oc= Other crops
Os= Oil-seeds
Sc = Sugarcane

Table 6. 21/B: Pattern of Crop Diversification (2000-01)

Name of the Tahsil	Index of Crop Diversification	Crops in Competition for Diversification	Area in Hectares	% Area
Sinner	27.03	B+V+P	66523	8.55
Trimbak	30.87	N+R+Fo	27025	3.47
Satana	20.06	B+M+P+Fr	59960	7.72
Malegaon	20.51	B+Os+V+P	89163	11.46
Yeola	21.03	B+V+P+J	69668	8.95
Deola	21.07	B+M+V+P	30297	3.89
Chandwad	21.23	B+V+P+Fo	56323	7.24
Peth	19.36	N+R+Fo+Os+P	34197	4.39
Surgana	18.91	N+P+R+Os+Fo	32959	4.23
Igatpuri	18.58	R+Fo+N+Os+P	47979	6.17
Nandgaon	18.31	B+P+Os+V+C	60967	7.83
Nashik	12.43	V+N+Fo+W+Fr +P+Os	37114	4.77
Kalwan	11.96	B+Fo+M+P+W +R+V	33042	4.25
Niphad	12.91	B+Sc+V+Fr+P +W+Os	72134	9.27
Dindori	11.28	Fo+N+W+J+R+ Os+Sc+V	60766	7.81

(Source: By the Researcher)

Note:

B = Bajra R = Rice J = Jawar
V = Vegetable N= Nachani Fr = Fruits
P = Pulses W= Wheat M = Maize
Fo = Fodder Oc= Other crops
Os= Oil-seeds Sc = Sugarcane

Jawar are in competition for diversification in Dindori tahsil in Nashik district (table6.21/A).

It is observed from this table that in 2000-01 largest area appears in the moderate crop diversification class covering 48.7 percent area in the district and one tahsil characterized by very low crop diversification (3.5 per cent area in the study region) in Nashik district. The three crops namely, bajra, vegetable and pulses are in competition for diversification in Sinner tahsil, while nachani, rice and fodder are in competition for diversification in Trimbak tahsil. The four crops, namely, bajra, maize, pulses, fruits, oilseeds, vegetable, jawar and fodder are in competition for diversification in five tahsils in Nashik district (Table6.21/B).

Five crops namely, Nachani, rice, fodder, oilseeds, pulses, bajra, vegetable, and cotton are in competition for diversification in four tahsils, while seven crops namely, vegetable, nachani, fodder, wheat, fruit, pulses, oilseeds, bajra, maize and rice are in competition for diversification in three tahsils. As well as eight crops, namely, fodder, nachani, wheat, Jawar, rice, oilseeds, sugarcane and vegetable are in competition for diversification in one tahsil in Nashik district (table6.21/B).

1. **Area of High Crop Diversification**

There is no area under high crop diversification in 1960-61 and 2000-01.

2. **Area of Moderate Crop Diversification**

This category covers 46.83 and 48.72 percent area under moderate crop diversification in1960-61 and 2000-01. In 1960-61 the area of moderate crop diversification appears in western part (seven tahsils) of the district (map6.19/A). Seven tahsils comes under moderate crop diversification and covering 398890 hectares

area. The crops in diversification are wheat, bajra, fodder, pulses, nachani, rice, oilseed and Jawar. Seven tahsils have occurred in western part, namely, Peth, Surgana, Igatpuri, Nashik, Kalwan, Dindori and Sinner(map6.19/A and table6.21/A). While in 2000-01 the area of moderate crop diversification appears in western part (seven tahsils) and one tahsil to the eastern side of the district (map6.19/B). Eight tahsils comes under moderate crop diversification and covering 379158 hectares area. The crop in diversification are nachani, rice, fodder, oilseeds, pulses, bajra, vegetables, cotton, wheat, fruits, maize, sugarcane and jawar on Laterite, Radish brown and Deep black soils. This soil gives high yield per hectare. Seven tahsils have occurred in western part, namely, Peth, Surgana, Igatpuri, Nashik, Kalwan, Dindori, Niphad and one tahsil to the eastern part, namely, Nandgaon (map6.19/B and table6.21/B).

The western part in the district identified 10 to 20 index of crop diversification on Laterite, Radish brown soil tract where rainfall ranging between 550-3000 mms (average annual rainfall) in the tahsils , namely, Peth, Surgana, Igatpuri, Nashik, Kalwan, Dindori, and Niphad. A small patch of moderate crop diversification appears in east part in the low rainfall (less than 600 mms rainfall) in the district that parts limit on the growth of crops. In this category the tahsil includes, namely, Nandgaon only (map6.19/B and table 6.21/B).

3. **Area of Low Crop Diversification**

The area of low crop diversification covers 452971 and 371934 hectares (53.17 and 47.81 percent to total area) in 1960-61 and 2000-01 (map6.19A/B and table6.21A/B). In 1960-61 the low crop diversification regions appears in the eastern part of the

district. Bajra, oilseed, pulses, Jawar and wheat comes under this diversification. It appears in the tahsils, namely, Satana, Malegaon, Nandgaon, Yeola, and Chandwad in the eastern part (map6.19/A). While in 2000-01 the low diversification region appears disintegrated in two patches throughout the district. The largest patch of this category is found in the eastern side of the district (map6.19/B). Bajra, vegetable, pulses, maize, fruits, oilseeds, jawar and fodder comes under this diversification. This part confines with average annual rainfall between 500 to 750 mms and deep black to medium black soils has resulted low crop diversification in this part. It appears in the tahsils, namely, Satana, Malegaon, Yeola, Deola and Chandwad in the eastern strip. The south part of the district is found low diversification of crops in the tahsil, namely, Sinner. These tahsils have 20 to 30 index of crop diversification. Forty percent tahsils comes under this category which covering 371934 hectares area (47.81 percent) to the net sown area in the district (map6.19/B and table 6.21/B).

4. **Area of Very Low Crop Diversification**

There is no area under very low crop diversification in 1960-61. But in 2000-01The western downghat part in the district comprising one tahsil, namely, Trimbak have found very low crop diversification covering 3.47 percent (27025 hectares) area of the district. Nachani, rice and fodder are in competition in this tahsil. These crops are grown on coarse shallow soils hence are unprofitable (map6.19/B and table 6.21/B).

6.5: QUANTITATIVE EVALUATION OF LANDUSE

6.5.1: Introduction:

In the preceding chapter 4 &5, the general landuse and agricultural landuse patterns have been thoroughly studied and examined and the cropping patterns discussed. This study is based on the data and information to uncover the association between landuse and physio-socio-economic variables in the area under review. This established association was evaluated by suitable quantitative methods for further strengthening the results. From this point of view, to evaluate relationship between the variables by applied quantitative techniques in the Nashik district.

The present chapter deals with the quantitative evaluation of agricultural landuse pattern of the Nashik district with the following objectives:

To find out the correlation between selected agricultural landuse variables and environmental variables by applying quantitative techniques like correlation coefficient and regression.

6.5.2: Data Sources and Methodology

The data have been collected from secondary sources for the year 2000-01 in both Kharif and rabbi crops from tahsil headquarters office which, later on, converted into per cent to net sown area. Sixteen variables were carefully selected to assess the relationship for correlation coefficients were used for finding regression (Table 6.22).

6.5.3: Correlation analysis

In order to establish relationship between landuse and environmental variables, the correlation coefficient has been computed. The sixteen variables have been carefully selected from the set of variables of landuse and socio-economic

conditions for fifteen tahsils in the Nashik district. These chosen variables are as follow:

X1 = % of net sown area to total geographical area

X2 = Population density per sq. km.

X3 = % of irrigation to net sown area

X4 = Agricultural density

X5 = % of bajra to NSA

X6 = % of Rice to NSA

X7 = % of Nachani to NSA

X8 = % of Vegetable to NSA

X9 = % of Fruits to NSA

X10= % of fodder to NSA

X11= % of Wheat to NSA

X12= % of maize to NSA

X13= % of Pulses to NSA

X14= % of oilseeds to NSA

X15= % of Sugarcane to NSA

X16= % of Jawar to NSA

6.5.4: Result of Correlation Coefficient

The degree of correlation has been computed by applying quantitative technique, namely, correlation coefficient for 15x16a matrix. Pearson product movement correlation was applied. Student 't' test was, later on adopted to ascertain the significance of 'r' value at 0.001 levels. The obtained results are shown in table 6.22. The relationship between variables is summarized as below;

Table 6.22: Correlation Matrix

Variables	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15	X16
X1	1.0															
X2	-0.44	1.0														
X3	0.16	0.59	1.0													
X4	-0.75	0.33	0.08	1.0												
X5	0.44	-0.53	-0.19	-0.56	1.0											
X6	-0.35	-0.18	-0.52	0.08	-0.62	1.0										
X7	-0.29	-0.69	-0.45	0.48	0.82	0.20	1.0									
X8	0.18	0.59	0.68	-0.03	-0.00	-0.57	-0.68	1.0								
X9	-0.06	0.70	0.88	0.28	-0.23	-0.28	-0.36	0.52	1.0							
X10	-0.43	-0.00	-0.39	0.32	-0.89	0.84	-0.24	-0.36	-0.28	1.0						
X11	-0.23	0.54	0.44	0.24	-0.83	-0.08	-0.88	0.36	0.41	0.19	1.0					
X12	-0.01	-0.03	0.27	0.25	0.05	-0.00	0.78	-0.26	0.02	-0.14	-0.05	1.0				
X13	-0.38	-0.03	-0.09	0.39	0.16	0.04	0.64	-0.18	-0.26	-0.25	-0.44	0.08	1.0			
X14	-0.36	0.05	-0.26	0.46	-0.53	0.65	-0.09	-0.35	-0.14	0.24	-0.20	-0.24	0.37	1.0		
X15	0.24	0.11	0.74	0.02	-0.32	-0.29	-0.29	0.18	0.66	-0.20	0.42	0.00	-0.15	-0.08	1.0	
X16	0.16	-0.27	-0.11	-0.13	-0.29	-0.10	-0.12	-0.04	-0.20	0.09	0.48	-0.68	-0.22	-0.13	0.28	1.0

(Value significant at 0.001 level)

The Variables:

X1 = % of net sown area to total geographical area

X2 = Population density per sq. km.

X3 = % of irrigation to net sown area

X4 = Agricultural density

X5 = % of bajra to NSA

X6 = % of Rice to NSA

X7 = % of Nachani to NSA

X8 = % of Vegetable to NSA

X9 = % of Fruits to NSA

X10= % of fodder to NSA

X11= % of Wheat to NSA

X12= % of maize to NSA

X13= % of Pulses to NSA

X14= % of oilseeds to NSA

X15= % of Sugarcane to NSA

X16= % of Jawar to NSA

1: Net sown Area (Area under cultivation)

The net sown area shows positive correlation with bajra, irrigation, vegetable, sugarcane and Jawar. The strong positive correlation of net sown area has found with bajra (0.44) while moderate correlation is established between net sown area and sugarcane (0.24) and low correlation of net sown area has found with irrigation and Jawar (0.16) at 0.001 levels. The spatial distribution of net sown area in the district shows negative correlation with population density, agriculture density, rice, nachani, fruits, fodder, wheat, maize, pulses, and oilseeds. This fact explains that the increasing net sown area does not proportionally increase the area under population density,

agriculture density, rice, nachani, fruits, fodder, wheat, maize, pulses, and oilseeds. It has observed that the strong negative correlation of net sown area is found with agriculture density (-0.75) moderate negative correlation has established with population density (-0.44), fodder (-0.43), while lowest negative correlation of net sown area has found with pulses (-0.38), oilseed (-0.36), rice (-0.35), nachani (-0.29), wheat (-0.23), fruits (-0.06) and maize (-0.01). This indicates that the increase in areal extent under net sown area does not proportionally increase area under rice, nachani, fruits, fodder, wheat, maize, pulses, and oilseeds.

2: Population Density

The population density shows positive correlation with irrigation, vegetable, fruits, wheat, agriculture density, sugarcane and oilseed. The strong positive correlation of population density has found with fruits (0.70) irrigation (0.59) vegetable (0.59) and wheat (0.54) while moderate correlation is established between population density and agriculture density (0.33) and low correlation of population density has found with sugarcane (0.11) and oilseed (0.05) at 0.001 levels. The spatial distribution of population density in the district shows negative correlation with nachani, bajra, net sown area, Jawar, rice, maize, pulses and fodder. It has observed that the strong negative correlation of population density is found with nachani (-0.69), bajra (-0.53) moderate negative correlation has established with net sown area (-0.44), while lowest negative correlation of population density has found with Jawar (-0.27), rice (-0.18), maize, pulses (-0.0 3), and fodder (-0.00) in the district.

3: Irrigation

Irrigation shows positive correlation with fruits, sugarcane, vegetable, population density, wheat, maize, net sown area and agriculture density. The strong positive correlation of irrigation has found with fruits (0.88) sugarcane (0.74) vegetable (0.68) and population density (0.59) while moderate correlation is established between irrigation and wheat (0.44) and low correlation of irrigation has found with maize (0.27), net sown area (0.16) and agriculture density (0.08) at 0.001 levels. The spatial distribution of irrigation in the district shows negative correlation with rice, nachani, fodder, oilseed, bajra, Jawar and pulses. It has observed that the strong negative correlation of irrigation is found with rice (-0.52), moderate negative correlation has established with nachani (-0.45), while lowest negative correlation of irrigation has found with fodder (-0.39), oilseed (-0.26), bajra (-0.19), Jawar (-0.11) and pulses (-0.09) in the district.

4: Agriculture Density

Agriculture density shows positive correlation with nachani, oilseed, pulses, population density, fodder, fruits, maize, wheat, rice, irrigation and sugarcane. The maximum positive correlation of agriculture density has found with nachani (0.48) and oilseed (0.46) while moderate correlation is established between agriculture density and pulses (0.39) and low correlation of agriculture density has found with population density (0.33), fodder (0.32) , fruits (0.32), maize (0.25), wheat (0.24), rice (0.08), irrigation (0.08) and sugarcane (0.02) at 0.001 levels. The spatial distribution of agriculture density in the district shows negative correlation with net sown area, bajra, Jawar and

vegetable. It has observed that the strong negative correlation of agriculture density is found with net sown area (-0.75) and bajra (-0.56), while lowest negative correlation of agriculture density has found with Jawar (-0.13) and vegetable (-0.03) in the district.

5: Area under Bajra

The area under bajra shows positive correlation with nachani, net sown area, pulses and maize. The strong positive correlation of area under bajra has found with Nachani (0.82) while moderate correlation is established between area under bajra and net sown area (0.44) and low correlation of area under bajra has found with pulses (0.16) and maize (0.05) at 0.001 levels. The spatial distribution of area under bajra in the district shows negative correlation with fodder, wheat, rice, agriculture density, population density, oilseeds, sugarcane, Jawar, fruits, irrigation and vegetable. It has observed that the strong negative correlation of area under bajra is found with fodder (-0.89), wheat (-0.83), rice (-0.62),agriculture density (-0.56), population density (-0.53) and oilseed (-0.53) moderate negative correlation has established with sugarcane (-0.32), while lowest negative correlation of area under bajra has found with Jawar (-0.29), fruits (-0.23), irrigation (-0.19), and vegetable (-0.00) in the district.

6: Area under rice

Area under rice shows positive correlation with fodder, oilseed, nachani, agriculture density and pulses. The maximum positive correlation of area under rice has found with fodder (0.84) and oilseed (0.65) while moderate correlation is established between area under rice and nachani (0.20) and low correlation of area under rice has found with agriculture density (0.08), and pulses (0.04) at 0.001 levels. The spatial distribution of area under

rice in the district shows negative correlation with bajra, vegetable, irrigation to net sown area, net sown area, sugarcane, fruits, population density, Jawar, wheat and maize. It has observed that the strong negative correlation of area under rice is found with bajra (-0.62), vegetable (-0.57) and percentage of irrigation to net sown area (-0.52), while moderate negative correlation is established between area under rice and net sown area (-0.35) and low lowest negative correlation of area under rice has found with sugarcane (-0.29), fruits (-0.28), population density (-0.18), Jawar (-0.10), wheat (-0.08) and maize (-0.00) in the district.

7: Area under Nachani

The area under nachani shows positive correlation with bajra, maize, pulses, agriculture density and rice. The strong positive correlation of area under nachani has found with bajra (0.82), maize (0.78) and pulses (0.64) while moderate correlation is established between area under nachani and agriculture density (0.48) and low correlation of area under nachani has found with rice (0.20) at 0.001 levels. The spatial distribution of area under nachani in the district shows negative correlation with wheat, population density, vegetable, percentage of irrigation to net sown area, fruits, percentage of net sown area to total geographical area, sugarcane, fodder, Jawar and oilseeds. It has observed that the strong negative correlation of area under nachani is found with wheat (-0.88), population density (-0.69), vegetable (-0.68), moderate negative correlation has established with percentage of irrigation to net sown area (-0.45) and fruits (-0.36), while lowest negative correlation of area under nachani has found with percentage of net sown area to total geographical area (-0.29),

sugarcane (-0.29), fodder (-0.24), Jawar (-0.12) and oilseeds (-0.09) in the district.

8: Area under vegetable

Area under vegetable shows positive correlation with percentage of irrigation to net sown area, population density, fruits, wheat, sugarcane and percentage of net sown area to total geographical area. The maximum positive correlation of area under vegetable has found with percentage of irrigation area to net sown area (0.68), population density (0.59) and fruits (0.52) while moderate correlation is established between area under vegetable and wheat (0.36) and low correlation of area under vegetable has found with oilseeds (0.18), and percentage of net sown area to total geographical area (0.18) at 0.001 levels. The spatial distribution of area under vegetable in the district shows negative correlation with nachani, rice, fodder, oilseed, maize, pulses, Jawar, agriculture density and bajra. It has observed that the strong negative correlation of area under vegetable is found with nachani (-0.68) and rice (-0.57) while moderate negative correlation is established between area under vegetable and fodder (-0.36), oilseeds (-0.35) and low lowest negative correlation of area under vegetable has found with maize (-0.26), pulses (-0.18), Jawar (-0.04), agriculture density (-0.03) and bajra (-0.00) in the district.

6.5.5: Multiple Regression Analysis

Multiple regressions have been computed to obtain the degree of correspondence between several variables in correlation coefficient. The variables found significant in correlation coefficient have been taken into account, here, to compute multiple regressions. In the correlation coefficient analysis

variables namely net sown area, population density, irrigation, agricultural density, bajra and vegetable shows significant correlation. Hence these six variables were selected to compute the multiple equations for area under study. The following symbols are used in interpreting the result of multiple regressions is given in table 6.23.

Table 6.23: Variables and Symbols used

Sr. No.	Variables	Symbols used
1	Percentage of net sown area to total geographical area	NSA
2	Population density	Pd
3	Percentage of irrigation to net sown area	IR
4	Agricultural density	Ad
5	Percentage of bajra to NSA	Bj
6	Percentage of Rice to NSA	Ri
7	Percentage of Nachani to NSA	Na
8	Percentage of Vegetable to NSA	Veg
9	Percentage of Fruits to NSA	Fr
10	Percentage of fodder to NSA	Fo
11	Percentage of Wheat to NSA	Wh
12	Percentage of maize to NSA	Mz
13	Percentage of Pulses to NSA	Pl
14	Percentage of oilseeds to NSA	Os
15	Percentage of Sugarcane to NSA	Sc
16	Percentage of Jawar to NSA	J

(Source: by the research student)

1: Net sown area

The variable, net sown area has given a high multiple correlation value of 0.9122 for the area under study. In this regression set variables like population density(Pd), agricultural

density(Ad), bajra(Bj), rice(Ri), nachani(Na), fodder(Fo), pulses(Pl) and oilseeds(Os) are included.

The equation for net sown area is as follows;

NSA=133.96 - 0.0137Pd - 0.1898Ad - 0.5765Bj + 1.1050Ri - 0.7362Na - 2.1845Fo - 1.9562Pl - 0.9405Os

R^2 = 0.8322

R = 0.9122

Se = 8.556

The above equation and 't' statistics reveals that the population density, agricultural density, area under bajra, area under nachani, area under fodder and pulses largely depends on net sown area, while net sown area is associated with rice.

2: Population Density

This variable as a population density shows spatial variations. Multiple regression analysis shows that variables like net sown area(NSA), area under irrigation(IR), percent of bajra(Bj), percent of nachani (Na)and percent of wheat(Wh) have governed the population density and vegetable(Veg) shows a high degree of association with population density. Population density has given high multiple correlation value of 0.9193 for the study area.

The equation for population density is as follows;

Pd = 935.4139 – 14.08829 NSA - 8.1951IR – 4.0234Bj – 3.8687 Na + 41.8418 Veg + 71.0713 Fr – 10.7602 Wh

R^2 = 0.8451

R = 0.9193

Se = 205.3479

3: Irrigation

The variable, percentage of irrigation to net sown area has given a high multiple correlation value of 0.9674 for the area

under study. In this regression set variables like rice(Ri), nachani(Na), vegetable(Veg), fruits(Fr),fodder(Fo), wheat(Wh) and jawar(J)are included.

The equation for irrigation is as follows;

IR = - 3.3454 + 0.1259 Ri + 0.0181 Na + 1.4395 Veg + 2.0359 Fr + 0.0468 Fo – 0.6184 Wh + 1.6686 J

R^2 = 0.9360

R = 0.9674

Se = 6.0368

The above equation and 't' statistics reveals that the percent of rice, percent of nachani, percent of vegetable, percent of fruits, percent of fodder and percent of jawar associated with irrigation while wheat is largely depends upon irrigation.

4: Agricultural density

This variable as an agricultural density shows spatial variations. Multiple regression analysis shows that variables like net sown area(NSA), population density (Pd), percent of bajra(Bj), percent of nachani (Na), percent of fodder (Fo)and percent of oilseeds (Os)have governed the agricultural density and pulses (Pl) shows a high degree of association with agricultural density. Agricultural density has given high multiple correlation value of 0.8931 for the study area.

The equation for agricultural density is as follows;

Ad = 177.1396 – 0.8301 NSA – 0.0027 Pd – 0.9009 Bj – 0.0108 Na – 1.4173 Fo + 0.0612 Pl – 0.5586 Os

R^2 = 0.7977

R = 0.8931

Se = 16.6994

5: Area under bajra

The variable, area under bajra has given a high multiple correlation value of 0.9790 for the area under study. In this regression set variables like net sown area (NSA), population

density (Pd), agriculture density (Ad), rice (Ri), nachani (Na), fodder (Fo) and wheat (Wh) are included.

The equation for area under bajra is as follows;

Bj = 101.2962 – 0.2213 NSA – 0.0036 Pd – 0.2486 Ad – 0.7086 Ri – 0.6737 Na – 0.5839 Fo – 2.2031 Wh – 1.0378 Os

R^2 = 0.9585

R = 0.9790

Se = 8.8639

The above equation and 't' statistics reveals that the net sown area, population density, agricultural density, percent of rice, percent of nachani, percent of fodder, percent of wheat and percent of oilseeds is largely depends upon area under bajra.

6: Area under Vegetable

This variable as an area under vegetable shows spatial variations. Multiple regression analysis shows that variables like rice (Ri), nachani (Na) and fruits (Fr) have governed the area under vegetable and population density (Pd) and irrigation (IR) shows a high degree of association with area under vegetable. Area under vegetable has given high multiple correlation value of 0.8734 for the study area.

The equation for area under vegetable is as follows;

Veg = 5.6190 + 0.0083 Pd + 0.2251 IR – 0.1925 Ri – 0.0642 Na – 0.9707 Fr

R^2 = 0.7629

R = 0.8734

Se = 3.5076

The above equation and't' statistics reveal that the population density, Irrigation, area under rice, area under nachani and area under fruits is highly correlated with area under vegetable.

Chapter: 7

CONCLUSION, PLANNING REGIONS AND SUGGESTION

In recent years, efforts have been made to analyze and find out the nature of soil and their characteristics for suitable and proper growth of crops and their productions. Such a study is heavily dependent on scientific and comprehensive study of landuse at macro and micro levels. The present study is therefore significant in this respect. This study concentrates at the tahsil level.

The present investigation has been carried out to assess, analyze, describe and interpret the pattern of agricultural land use of the Nashik district with a view to investigate the influence of certain physical and socio-economic variables on landuse pattern and to provide an indepth study for adjudging scientific, proper and efficient landuse to meet the demand of food from the increasing population in the district and to demarcate agricultural regions for planning.

The soil of the district is essentially derived from the Deccan Trap which is the predominant rock formation of the district. The soil formation is mainly affected by the climatic condition and topography of the district. The soil in the Godavari, Kadava, upper reaches of the Girna and the Mosam Valley is quite deep and fertile. The relief in the rest of the district is undulating and susceptible to erosion. Light shallow soil is found on hill slopes and very coarse soils at higher elevation.

The observations, analysis and findings discussed in the preceding chapters are presented below;

Nashik district is predominantly agricultural in its occupational structure with 59.00 percent working force to total workers engaged in agriculture. The types of soil play a vital role in agricultural landuse pattern in the district. Even variations in rainfall amount affect agricultural landuse in the area under study.

The socio-economic variables have influenced the spatial distribution of agricultural landuse patterns in Nashik district. The spatial distribution of population reveals the significant variations within the district. The major concentration of population is associated with deep black soil zones in Godavari and Girna basin of the district. The density variations in the district range from 159 persons per square Kms to 1631 persons per square kilometer. The lower reaches of river Godavari and river Girna in the district have dense population due to fertile soils. With growing population in the district, the pressure on land has been increasing and therefore per capita land has significantly decreased from 1951 to 2001. It had 1.086 hectare per capita land in 1951 and it decreased 0.311 hectare per capita land in 2001. The relative importance of agricultural activity has been pointed out by working force (59.00 percent to total workers) in the district, comprising 35.1 and 64.9 percent agricultural labours.

The size of land holding has been adversely affected by continuous disintegration of land holdings due to division and sub-division of family. The average size of land holding is 2.52 hectares.

The total irrigated area is 17.7 percent to net sown area in the district. Well and canal irrigation is the source of water supply to crops significantly in the ricer basins. The highest area under irrigation is recorded at Nashik (72.01 percent to net sown area)

followed by Niphad (47.59 percent) while lowest area under irrigation is recorded at Surgana (0.46 percent to net sown area) followed by Peth (1.47 percent to net sown area).

The accessibility by means of transport, within the district is easy, a dense road network, covering railway, National highway, State high way, major district road, other district road and kachcha roads occur in the area. The western part of the district comparatively sparse road network due to hilly area.

Thirteen regular markets, 24 sub-markets and 158 weekly market centers serve to agglomerates and distribute the agricultural products and people within and outside the district.

Land utilization study unfolds different uses in the district. The net sown area manifests spatial variations within the district, with concentration in the river basins in fertile tract having high yield per hectare. Western parts in areal extents on coarse shallow soils have low concentration of net sown area.

This decrease may be attributed to increasing population, development of transportation routes and residential purpose. The highest area under follow land has increased to 8.44 percent to total geographical are followed by cultivable waste 6.74 percent to total geographical area in the district.

The cultivation of crops in Nashik district is confined to kharif and rabi seasons. It is noticed that kharif season is important in raising varieties of crops, with larger in areal extent in the district. It is observed that more than 70 percent to net sown area is under kharif crops.

Tahsilwise variation of intensity of irrigation for the region as a whole comes to +6.34. All tahsils records positive variation in intensity of irrigation except Malegaon. Nashik tahsil of the

study region records highest (+61.56) positive variation in intensity of irrigation. However the highest positive variation is obvious in Chandwad (17.02) and (Dindori (11.48) tahsil. Malegaon tahsil records lowest negative variation (-0.65) during the study period (table 5.5).

The study of levels of agricultural development is based on the method of cluster analysis. For this study six parameters like percentage of net sown area to total geographical area, land under irrigation as percentage of net sown area, number of tractors per 100 hectare of net sown area, number of livestock per 100 hectare of net sown area, loan advanced in Rs. per 100 hectare of net sown area and over-dues in Rs. per 100 hectare of net sown area have been chosen.

Applying this parameters and find out five development regions in the district. In 1980-81 there was no any tahsils under the most developed and more developed category of the district, while Nashik and Niphad observed as a developing tahsils and Dindori, Satana, Malegaon, Chandwad, Yeola, Sinner and Igatpuri found in backward class, while Peth, Surgana, Kalwan and Nandgaon observed as a most backward tahsils. In 2000-01, Nashik, Niphad and Malegaon ranks as most developed tahsils, Chandwad, Yeola and Igatpuri as a most developed tahsils, Dindori, Satana and Sinner as a Developing tahsils, Kalwan and Nandgaon records as a Backward tahsils, while Peth and Surgana records as a most backward tahsils.

The hierarchical cluster of the tahsils for the year 2000-01 further analyzed and grouped into the following broad categories;

i) Backward Tahsils: Peth and Surgana come under this category. Agriculture is not possible in these tahsils because of maximum area is covered by hills , mountain spurs, forest and heavy rainfall but these tahsils are important for water resources.

ii) Potential Tahsils: Dindori, Kalwan, Satana, Nandgaon and Sinner tahsils are the potential tahsils. Due to the spatial variation of location the potential tahsils and various socio-economic and physical factors, these tahsils having nearby 50 percent of net sown area and 10 to 20 percent of area under irrigation to net sown area. Hence the rabbi agriculture is very limited. Further the soil is thin and slopping and it is easy to erosion, as well as the transportation and market facilities also limited. However if there is careful planning and management of water resources these tahsils can be put to better use agriculturally and socio-economic development is possible in these tahsils.

iii) Developed Tahsils:

Nashik, Niphad, Malegaon, Chandwad, and Yeola tahsils are identified as developed tahsils. All these tahsils have a high percentage of net sown area under irrigation. They are located in river basins and flood plains and have better soil. There is an all-round development in agriculture in terms of poultry, dairy farming, truck-tractor farming, agro-based industries and mechanization with the advent of sugar factories, MIDC, agro-based industries. Leveled land, fertile soil, high percentage of irrigation, well developed transportation facilities, development of agricultural markets, awareness of modern agriculture, use of hybrid seeds, fertilizers, pesticides and insecticides in these tahsils

is maximum. All these factors make the developed tahsils agriculturally more developed part of the district.

The ranking of crops denotes the relative strength of individual crops. Bajra ranks as the first ranking crop in 9 tahsils (60 % to total tahsils) and consequently occupies an outstandingly predominant position in 345043 hectares. Vegetable stands second in rank in three tahsils (20 % to total tahsils) and pulses stand third in rank in four tahsils. Other crops namely nachani, rice, fodder, maize, oilseed, wheat, fruits, Jawar and sugarcane have low percentage than that of Bajra, vegetable and pulses.

Twelve crop combinations have been identified in 1960-61 while ten crop combinations have been identified in 2000-01 for Nashik district (map 6.9A/B). Among ten crop combinations eight crop combinations are relatively dominant in areal extent in six tahsils. Further it is noticed that four and nine crop combinations have wide distributed. Four crop combinations obtained at Peth, Surgana and Igatpuri with Nachani, pulses, fodder, rice and oilseeds in this combination, while nine crop combinations obtained at Satana, Sinner and Deola tahsil with Bajra, maize, pulses, fruits, sugarcane, wheat, vegetable, oilseeds, Jawar, fodder and rice are common constituent crops in these combinations. Three crop combinations obtained at Trimbak with Nachani, rice and fodder in this combination. Seven crop combinations obtained at Nashik with vegetable, Nachani, fodder, wheat, fruits, pulses and oilseeds in this combination. And ten crop combinations obtained at Malegaon with Bajra, oilseeds, vegetable, pulses, fruits, maize, Jawar, cotton, wheat and fodder are common constituent crops in these combinations.

The existing diversifications of crops serve to unfold the competition among them. The resultant crop diversifications registered moderate increase in magnitude, covering eight tahsils on 371934 hectares, followed by low crop diversification in six tahsils on 371934 hectares, while very low crop diversification in one tahsil on 27025 hectares. It has been noticed that all tahsils in the district where vegetable, fruits and fodder entering into the moderate, low and very low crop diversification during the study period. Bajra, vegetable, fodder, fruits, maize, pulses, wheat, rice, sugarcane, oilseeds and nachani in Nandgaon, Nashik, Kalwan, Niphad and Dindori and rice, fodder, pulses, nachani and oilseeds in Peth, Surgana, Igatpuri tahsils comprise in moderate crop diversification class. Low crop diversification is noticed at Sinner, Satana, Malegaon, Yeola, Deola, and Chandwad tahsils whereas very low crop diversification is noticed at Trimbak tahsil.

The correlation coefficient establishes relationship between chosen variables. The strong positive correlation was found between percentage of irrigation and fruits (0.88), rice and fodder (0.84), bajra and Nachani (0.82), Nachani and maize (0.78), irrigation and Sugarcane (0.74), population density and fruits (0.70), irrigation and vegetable (0.68), fruits and sugarcane (0.66), rice and oilseeds (0.65), nachani and pulses (0.64), population density and irrigation (0.59), population density and vegetable (0.59), population density and wheat (0.54) and vegetable and fruits (0.520). This fact explains that areal extents of above crops are increasing with increasing area under net sown area and therefore the variables show positive correlation.

Negative correlation established between bajra and fodder (0.89), nachani and wheat (0.88), bajra and wheat (0.83), net

sown area and agricultural density (0.75), population density and nachani (0.69), nachani and vegetable (0.68), maize and jawar (0.68), bajra and rice (0.62), rice and vegetable (0.57), agricultural density and bajra (0.56),population density and bajra (0.53), bajra and oilseeds (0.53) and irrigation and rice (0.52). These variables are not experiencing a proportional increase in area in the district and therefore show negative correlation.

The multiple regressions demonstrate the degree of correspondence between variables in correlation coefficient. The net sown area in multiple regression points for limitations imposed by population density and agricultural density variables indicating multiple value of 0.9122. Population density shows multiple correlation value of 0.9193 for limitations imposed by net sown area and irrigation. Irrigation shows high multiple correlation value of 0.9674.

Agricultural density and bajra in multiple regressions Points for limitations imposed by net sown area and population density variables indicating multiple values of 0.8931 and 0.9790. Vegetable reveals high degree of association with population density and irrigated area of value of 0.8734.

Planning Regions of Nashik District

On the basis of the preceding study, an attempt has been made to suggest planning regions of the areas under study as below;

Overall study of an agricultural landuse in Nashik district, the physical limitations, cultural characteristics of the people **,** appraisal of the natural resources, principle characteristics of the demographic patterns, transportation network and overall orientation of the region towards Mumbai and Thane industrial

areas have been considered in delimiting planning regions. Secondly as the researcher was born and brought up to Nashik and Malegaon, his experience over long period of time, the experience gained during the course of field trips in the study region have provided insight as regards the characteristics and the prime needs of the region. On the basis of these factors an attempt has been made to suggest the planning regions as below;

The planning regions

1. Relatively more developed regions:

   Nashik

2. Moderately developed regions:

   Niphad, Chandwad and Malegaon

3. Less developed regions:

   Dindori, Kalwan, Satana and Deola

4. Backward regions:

   Nandgaon, Yeola and Sinner

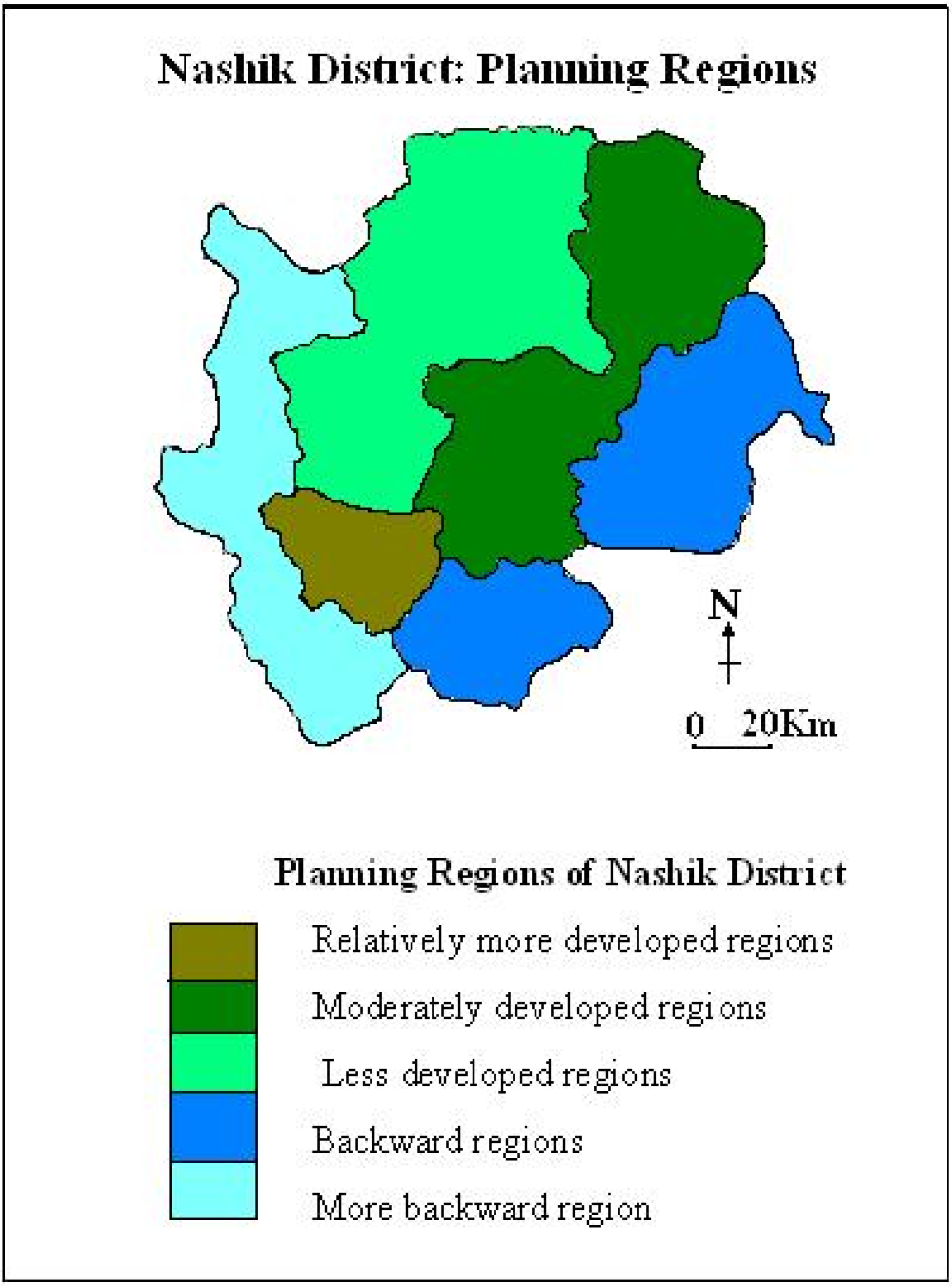
5. More backward region:

   Peth, Surgana, Trimbak and Igatpuri

The peculiarities and possibilities of each of these regions have been summarized below;

1. RELATIVE MORE DEVELOPED REGIONS:

Nashik tahsil is in this region is mostly oriented towards Nashik city with all sorts of facilities and services due to the progress of education, industries and commerce in the city. There is in-migration from the surrounding areas to the Nashik city. A sizable number of workers and students commute from surrounding villages to city. Growth of dairy industry around the city is yet another feature that indicates new trends in its


Nashik District: Planning Regions
N
0 20Km
Planning Regions of Nashik District
Relatively more developed regions
Moderately developed regions
Less developed regions
Backward regions
More backward region

economy. The region has the facility of several goods, roads and the railway line that have been helpful in the development of agriculture, industries and transportation services. Though this model region is characterized by frequent famines the constructions of percolation tanks have been beneficial in the development of agriculture.

2. MODERATLY DEVELOPED REGIONS:

This region consists of mainly Niphad, Chandwad and Malegaon. The region has the facility of extensive canal and well irrigation as it occurs in the Godavari and Girna river valleys. As well as national Highway pass goes through this region. The application of modern agriculture techniques has resulted in to development in the cultivation of vegetable, fruits and fodder as the principle crops of the region today. The economic prosperity of this region has enjoyed during the past three decades and has leaded to increase urbanization and agro based industries. These several agro-based industries and small processing and repairing units have generated jobs for the people.

3. LESS DEVELOPED REGIONS:

This region covers most of Dindori, Kalwan, Satana and Deola and small portion of adjoining tahsils. This region has facilities of canal and well irrigation as it is trained by Girna, Punad, Mosam and Aaram rivers. Agricultural development commenced in this region following that Niphad and Malegaon. Development of fruits like Grapes and Pomegranate as well as vegetables cultivation are constantly underway in all the four tahsils. The marginal hilly tract in this tahsils with slopping soils cover could also be developed by cultivating fruits and such other plants. Thus this region has tremendous agricultural possibilities;

industrial development based on farm production and there fore rate of urbanization would increase in this region in future.

4. BACKWARD REGIONS:

It consists of Nandgaon, Yeola and Sinner and small portion of adjoining tahsils. It is characterized by coarse shallow soil and dryer climate. These tahsils are logging behind due to lack of development of irrigation potential from Godavari and Girna rivers. Cultivation of agave and such other drought registrant useful varieties is the only answer to it.

5. MOST BACKWARD REGIONS:

This region consists of Peth, Surgana, Trimbak and Igatpuri tahsils. This region is characterized by hilly terrain of western ghat and heavy rainfalls and thick forest. Minimum agriculture development is possible along the slopping sides of the hills. Generally this region is well known for terraced farming. Peth, Surgana and Trimbak tahsils are away from highways and railways therefore; the prospects of development are very poor. It has few good roads but even then the resources of natural scenery could be developed for tourism. Forest based industries and terraced agriculture could be developed for improving the lot of these tribal people.

CONCLUSION

Population of Nashik district has been increased from 1960-61 to 2000-01. In 1960-61 the population of Nashik district was 1855246 while it increased and attained 4987923 persons in 2001(table 2.10). The average regional increase in population growth has been recorded 68.8 percent from 1960-1961 to 2000-2001. The district has good percentages of areas under net sown during the study period. It is above 50 percent of the total

geographical area (table 3.1). Out of the total net sown area of the district 8.4 percent area under net irrigation during 1981. Whereas, during 2001, 16.33 percent area under irrigation to the net sown area (table 5.3). About 7.93 percent of land has been increased under net irrigation during a span of twenty years. Population increased up to 68.8 percent but net irrigated area increased only 7.93 percent to the net sown area. It clearly shows that the ratio of increasing population and net irrigating land is not balanced.

South-western monsoon heavily fall on the Western part of the district. It can be possible to arrest water by constructing dams and prevent the waste water problem. That water can be diverted with the help of lift and utilize for this region, is one of the ways to solve the water problem in this region. Hydrologists also opine this. Problem of population explosion and variability of rainfall create problematic situation that is why not enough to think but must be act positively. To create and develop the enrich society and such water scare drought region only one option is available i.e. to save the waste water resource. There is no water availability in east flowing rivers. Dams cannot fill up completely that is why only solution is that turn the water of west-flowing river and this only the scientific solution on this problem.

SUGGESSION:

1. Percentage of net sown area goes on decrease. The lands required for urbanization including alignment of roads, should be obtained from the poor quality lands as far as possible.

2. Percentage of forest land is constant between the study periods, but the density of trees goes on decrease. For this, the plans of forestation should be followed.
3. People causing the eradication of eco-system and deforestation should be declared as criminals and they should be punished for causing scarcity of water and the reformation should be introduced in the irrigation act of 1976.
4. Percentage of irrigated land increase gradually, while percentage of population increase rapidly. The explosion of population should be considered as the main cause of disparity and disorientation between available resources and ever increasing needs and accordingly severe legal steps should be taken in order to control over population.
5. Percentage area under oilseeds, Jawar, pulses, wheat and nachani goes on decrease, while percentage area of vegetable, fodder, fruits, sugarcane and rice goes on increase. The awareness programme should be started for the nutritional balance.
6. According to the levels of agriculture development;

   a) Peth and Surgana tahsils comes under **backward category**. These tahsils having hilly area, forest covered land, heavy rainfall, and the tribal population is more in these tahsils, therefore there is no chance in the agricultural process and development. Agriculture is not possible in these tahsils, but these tahsils are important for water resources and natural scenery. There should be an opportunity for the development of tourism activity.

   b) Dindori, Kalwan, Satana, Nandgaon and Sinner these five tahsils are the **potential tahsils**. However if there is careful

planning and management of water resources these tahsils can be put to better use agriculturally and socio-economic development is possible in these tahsils.

c) Nashik, Niphad, Malegaon, Chandwad, Igatpuri and Yeola tahsils are identified as **developed tahsils**. All these tahsils have a high percentage of net sown area under irrigation. There is an all-round development in agriculture in terms of poultry, dairy farming, truck-tractor farming, agro-based industries and mechanization with the advent of sugar factories, MIDC, agro-based industries. Leveled land, fertile soil, high percentage of irrigation, well developed transportation facilities, development of agricultural markets, awareness of modern agriculture, use of hybrid seeds, fertilizers, pesticides and insecticides in these tahsils is maximum. All these factors make the developed tahsils agriculturally more developed part of the district.

7. Jawar, oilseeds, wheat and pulses goes out in the competition for diversification, while vegetation, fodder, sugarcane, fruits enters in the competition for diversification. The awareness programme should be started for the nutritional balance and motivate the farmers to increase more land under oilseeds, wheat and pulses.

GENERAL SUGGESSION:

1. The available water resource should not be wasted and use properly.
2. The excessive use of water should be controlled by taking severe legal actions. The proportion of use of water should be based on where it is taken from and how, why and what is availability.

3. The under ground water level which has gone down should be maintained by taking ambitious projects like to store water for absorption. The development of catchment area should be started in large measure. The awareness raising programme should be started to maintain the use of underground water.
4. Various innovative techniques should be adopted to stop or decrease the evaporation of reservoir and irrigated zone.
5. The old method of irrigation i.e. block system should be regularized.
6. The planning of water should be based on river basins. Farmers should be taught to use the water carefully; they taught to be introduced to new methods of irrigation such as drip irrigation, sprinkle irrigation. The crop types should be based on availability of water.
7. The farmers should be inspired to use Poly-house techniques which would help to save water.

Photo plate no. 1: Bajra cultivation in Sinnar Tahsil

Photo plate no.2: Nachani cultivation in Surgana Tahsil

Photo plate no.3: Fodder crop cultivation in Chandwad Tahsil

Photo plate no.4: Fodder crop (*ghas*) cultivation

Photo plate no.5: Vegetable (cabbage) cultivation in Kalvan Tahsil

Photo plate no.6: Inter-crop cultivation in Satana Tahsil

Photo plate no.7: Poly-house and ginger cultivation in Niphad Tahsil

Photo plate no. 8: *Tur* cultivation in Yeola Tahsil

Photo plate no.9: Grapes cultivation in Nashik Tahsil

Photo plate no.10: Collecting information about inter-crop cultivation

Photo plate no.11: Farmers using insecticides and pesticides in their farms

Photo plate no.12:Collecting information about the agricultural labour in Deola Tahsil

Photo plate no.13: Collecting information about brinjal cultivation

Photo plate no.14: Collecting information about maize production

Photo plate no.15: Collecting information about vegetable cultivation in KalvanTahsil

Photo plate no.16: Agriculture labour engaged in sorting of onion

Photo plate no.17: Collecting information about rice cultivation in Peth Tahsil

Photo plate no.18: Collecting information about pomegranate plantation

Photo plate no.19: Collection information about grapes cultivation in Niphad Tahsil

Photo plate no.20: Collecting information about sugarcane cultivation

Photo plate no.21: Collecting information about use of organic fertilizers

Photo plate no.22: Tomato cultivation in Igatpuri Tahsil

Photo plate no.23: Collecting information about the farmers

Photo plate no.24: Collecting information about the farmers

Photo plate no.25: Dairy farming near Malegaon city

Photo plate no.26: Onion cultivation in Satana Tahsil

Photo plate no.27: Waste land in Yeola Tahsil

Reasons of decreasing agricultural land

Photo plate no.28: Increasing the width of National High-way

Photo plate no.29: Construction of New roads or bypass

Photo plate no.30: Development of Hotels and Motels

Photo plate no.31: Onion Storage house prepared by the farmers in Deola tahsil

Photo plate no.32: Market Sight in Pimpalgaon Baswant, Niphad Tahsil

Photo plate no.33: Storage in Market Yard, near Satana tahsil

Agro-Based Industries

Photo plate no.34: Vasantdada Patil sugar factory in Deola Tahsil

Photo plate no.35: Eagle Wines factory in Kalvan Tahsil


Photo plate no.36: Prathamesh Wines factory in Satana Tahsil

BIBLIOGRAPHY

Alexander, J.W. 1965." *Economic Geography*", Prentice Hall, New Jersey.

Ali Mohammad, 1979, *"Dynamics of Agricultural Development in India" (Ed.),* Concept Publication, New Delhi.

Anderson, J.R., 1970, *Geography of Agriculture* Wm." (Brown Company, Dubuane, Iowa (U.S.A.).

Athavle, A.G. 1966, "Some New Methods of Crap Combination", *Geographical Review of India*, Calcutta,Vol. 28 No. 4.

Ayyar, N.P., 1969, "Crop Regions of Madhya Pradesh: A study in Methodology," *Geographical Review of India*, Calcutta, 31/1.

Baker, O.E., 1926, "Agricultural Regions of North America" *Economic Geography*, Vol. 2/1.

Banerjee, B., 1969, *"Essays on agricultural Geography*" Nabasakti Press (Ed.), Calcutta.

Basu, A., 1978, *"Technological Possibilities of Indian Agriculture."* Calcutta.

Basu, S., 1988, "Landuse in Malkauria village- A case study in Banker District", *Geographical Review of India,* Calcutta, 50/5.

Bhatia, S.S. 1965, "Patterns of Crop Concentration and Diversification in India", *Economic Geography*. 471

Bhatia, C.R. 1981*, "*Changing Landuse and Cropping Pattern in Bihar", *Perspective in Agricultural Geography*, Concept Publication, New Delhi.

Chourudule, P.B., 1975," Rural Landuse: A Study in Methods", *The Deccan Geographer,* Secunderabad, 13/1 and 2.

Das, D, 1984, “Canal and its Benefits, Effects of Cropping Pattern- A Case Study of a Village”, *Indian Council of Geographers* Vol. No. 12.

Das, M.M., 1984,”Crop-combination Regions of Assam”. A Quantitative Analysis”, *National Geographer of India*, Varanasi, 30/3.

David, W., 1996, “Theoretical Concept of Agricultural Landuse in Geography”, Review Article, *Geographer,* Aligarh, 50/2.

Deshmukh, V.M., 1975,” Lonkheda: A Study in Changing Landuse,” *The Deccan Geographer*, Secunderabad, 13/1 and 2.

Dikshit, K.R., 1973,” Agricultural Regions of Maharashtra,” *Geographical Review of India,* Calcutta, 35/4.

Ganguli, B., 1953,” Landuse Survey and Agricultural Planning, in Uttar Pradesh,” *Geographical Review of India,* Calcutta, 28/2.

Government of India, 1975, Gazetteer of Nashik District.

Government of Maharashtra, 1961, 1971, 1981, 1991, Nashik District Census Handbook, Nashik.

Government of Maharashtra, 1961, 1971, 1981, 1991, 2001, Socio-Economic Abstract, Nashik District.

Gupta, A.L. and Hiran, S.L. 1973, “Agricultural Regions of Rajsthan, *The Deccan Geographer*, Secunderabad, 11/2.

Gupta, S.L., 1971, “Cropping Pattern of Haryana” *Geographical Review of India,* Calcutta, 33/1.

Haggett, P and Chorley, R.J. 1969, “Network Analysis in Geography”, Londan, Edward Arnold.

Hall, R.B. 1935, “Agricultural Regions of Asia: Part VII Economic Geography 10 (1934), and 11 (1935).

Hartshorne, R.Q.S.N., Dicken 1935, "A Classification of Agricultural Regions of Europe and North America on A Uniform Statistical Basis," Annals of the Association of American Geographers 25.

Hussain, M., 1972," Crop Combination Regions of Uttar Pradesh: A Study in Methodology, "*Geographical Review of India,* Calcutta, 38/1.

Hussain, M., 1996," Systematic Agricultural Geography," Rawat publication, Jaipur and New Delhi.

Jadhav, M.G. and B.A. Ajagekar, 1993, "Slope and Irrigation Development in Upper Vedganga Basin (South Maharashtra)", *The Deccan Geographer* Vol. No. 31/2.

Khatu, K.K., 1975, Baroda Slums: A Case Study in Misuse of Land, *The Deccan Geographer*, Secunderabad, 13/2.

Kuniyal, J.C., 1987, "Crop Concentration and Diversification in Nainital District, Uttar Pradesh," Himalaya, *National Geographical Journal of India*, New Delhi, 33/2.

Majid Hussain 1970, "Pattern of Crop Concentration in Uttar Pradesh". Geographical Review of India Vol. No. 32, Calcutta.

Mathur, R.N. and Prasad, R., 1981, " Impact of Consolidation of Agricultural Landuse Pattern", *" Perspective in Agricultural Geography* (Ed.), Noor Mohammed, Concept Publication, New Delhi.

Mohammad, N. 1978," Agricultural Landuse In India"' Inter India Publication, New Delhi.

Mukherjee, A.B., 1956, "Agricultural Geography of Upper Ganga Yamuna Doab," Indian Geographer, 11/2

Mukherjee, A.B., 1963," Landuse Pattern in Hewar Village, Rajasthan", *Geographical Review of India,* Calcutta, 30/2.

Noor Mohammad, 1970, "Crop Combination in Trans-Ghagara Plain", *Geographical Review of India,* Calcutta, 32/1.

Noor Mohammad, 1973, Misraulia: A study in Agricultural Landuse (1951-70). *Geographical Review of India,* Calcutta, 35/3.

Noor Mohammad, 1981, *Perspective in* Agricultural *Geography* (Vol.1 to 5) (Ed.) Concept Publication, New Delhi.

P. Y. Vyalij (April 2009):"Changing Landuse profile in Nashik District" A National Journal *'Research Link'* Issue-61, Vol-VIII (2), p.75-78, Indore

P. Y. Vyalij, R.S. Deore (Aug. 2009) "Population Growth and Changing Landuse profile in Malegaon Tahsil (MS)" A National Journal *'Research Link'* Issue-65, Vol-VIII (06), p.66-69, Indore (MP).

Pralhad Y. Vyalij**,** Sept. 2009, "Population Growth and Changing Landuse Profile in Baglan Tahsil, Nashik District (Maharashtra)". International Research Journal, *'Research Analysis and Evaluation'* Vol.1, Issue1, p. no.99-105, Jaipur, Rajasthan, India.

Pralhad Y. Vyalij, Dr. R. S. Deore, Dec. 2009- Jan. 2010, "Population Growth and Changing Landuse Profile in Girna River Basin in Nashik District (Maharashtra)". International Research Journal, *'Shodh Samiksha Aur Mulyankan'* Vol.II, Issue11-12, p. no.19-23, Jaipur, Rajasthan, India.

Pralhad Y. Vyalij, Dr. R. S. Deore, Dec. 2009- Jan. 2010, "A Geogaphical Study of Landuse Profile in Malegaon Tahsil (M.S.). International Research Journal, *'Research Analysis and Evaluation'* Vol.1, Issue3 & 4, p. no.53-57, Jaipur, Rajasthan, India.

Pralhad Y. Vyalij, March 2010, "A Study of Population Distribution and Various densities in Malegaon tahsil Compared to Nashik district." National Research Journal, '*Research Link*-72' Vol. – IX (1), P.No. 87-89, Indore, MP.

Rafullah, S.N. 1967, "Region Regionalism and Regionalization," *The Geographer*, Aligarh, 14/1.

Shafi, M, 1965, "Pattern of Crop Landuse in the Ganga-Yamuna Doab" Geographer

Sharma, B.M.P., 1975, "The Cropping Pattern in the Upper Tons Basin, "*The Deccan Geographer,* Secondarabad, 13/1 and 2

Sharma, J.K., 1987, "Agricultural Land Utilization, Planning and Development of Dharwar Taluka, Karnataka, "*National Geographical Journal of India*, New Delhi, 33/2.

Sharma, P.R.1072, "Crop Cultivation, Intensity, their ranking and Crop Association Regions, in Chasttisgarh Region, A Geographical Analysis," *National Geographical Journal of India*, Varanasi, 18/2.

Shastri, P., 1981. "Changes in Landuse and Cropping Pattern in Cotton Belt of Vidharbha," *Perspective in Agricultural Geography* (Ed.), Noor Mohammed, Concept Publication, New Delhi.

Singh, B.B., 1967, "Landuse and Cropping Pattern and their Ranking."*National Geographical Journal of India*,Varanasi, 13/2.

Singh, J.and Dhillon, S.S., 1984, "*Agricultural Geography*, "Tata-Mcgraw-Hill, Publishing Company Limited, New Delhi.

Singh, J., 1976, "Agricultural Atlas of India, "Vishal Publication, Kurukshetra, Haryana.

Singh, J., 1992, "Determinants of Agricultural Change: An Agricultural Atlas of India (A Case Study in Green

Revolution) New Delhi, Oxford and I.B.H. Publishing Co. Pvt. Ltd.

Sohal,K.S. and Khaira, 1989, Temoral changes in Crop-combination Regions in Sangror District," Panjab, *National Geographer*,Allahabad, 24/2.

Symons, l., 1967 "Agricultural Geography" G. Bell and Sons, London.

Tyagi, B.S., 1972, "Agricultural Intensity in Chune Tehsil District Mirzapur, U.P.,"*National Geography Journal of India* 18/1.

Torrant, J.R., 1974, "Agriculture, Geography" John Wiley and sons,New York.

Vaidya, B.C., 1997, "Agricultural Landuse in India"Manak Publication Pvt. Ltd. New Delhi.

Vaidya, B.C., 1992, "Geographical Analysis of Agricultural Landuse at Kanchangaon in Yashoda Basin in Maharashtra".(Hindi) Maharashtra Bhugolshastra Sanshodhan Patrika, pune. 6/1.

Vaidya, B.C., 1989, "Pattern of Crop-Diversification in the Yashoda Basin Maharashtra". (Marathi)Maharashtra Bhugolshastra Sanshodhan Patrika, pune. 3/1.

Vaidya, B.C., 1989, "Temporal Changes in cropping pattern of Cotton Growing region of the Yashoda Basin Maharashtra". *National Geographer*,Allahabad, 26/1.