Grain Farming to Fruit Farming: A Geographical Study in Dry Zone of Sangli District (1989-2009)

A Thesis Submitted To

TILAK MAHARASHTRA VIDYAPEETH, PUNE

For the Degree of

Doctor of Philosophy in Geography

Under the Board of Moral & Scocial Sciences Studies

By

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Nov.-2014

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DECLARATION

I hereby declare that, the thesis entitled **"Grain Farming to Fruit Farming**: **A Geographical study in Dry Zone of Sangli District (1989-2009)"** completed and written by me has not previously been formed as the basis for the award of any Degree or other similar title upon me of this or any other Vidyapeeth or examining body.

Place : Atpadi

Date : / /

Shri. Balasaheb Sitaram Kadam

CERTIFICATE

This is to certify that the thesis entitled "**Grain Farming to Fruit Farming A Geographical study in Dry Zone of Sangli District (1989-2009)",** which is being submitted herewith for the award of the degree of Vidyavachaspati (Ph.D) in Geography of "**Tilak Maharashtra Vidyapeeth, Pune**" is the result of the original research work completed by **Shri. Balasaheb Sitaram Kadam** 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.

Place: Satara

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CHAPTER – I
INTRODUCTION

1.1 The Problem

'Agricultural Geography' in this word, agri. explains the study of this subject, where as the word 'geography' explains the comprehension of the study of the subject. The word 'Agriculture' has been derived from the Latin word 'Agricultura'. The word 'Agricultura' is made up of two parts 'Ager' means a field and 'cultura' mean to culture or cultivate. It means we can say that agriculture means cultivation of a field. It includes crops plantation and rearing of animals from it, so can say that "Agriculture means cultivation of field in order to produce crops and rearing of animals. According to Sahfi, "Agriculture geography is the study of agricultural activities of people."

Agricultural geography studies the agricultural activities of man and his economic actions for the fulfillment of his needs (B. S. Negi). Agriculture geography is to basically explain how agriculture activity is practiced in different region of the Earth surface, the regional production, types of crops, farming method, rotation of crops, and extensive and intensive agriculture. It also explain the method irrigation, dry farming, application of chemical fertilizers, the nature of agriculture implements, agro-processing industries, etc.

Agriculture is one of the world's oldest industries. It began to develop about 11,000 years ago in the Middle East. At that time, certain Middle Eastern tribes discovered how to grow plants from seeds and how to raise animals in captivity. By about 10,000 years ago, they had mastered these skills and had begun to depend chiefly on farming for food. Before the development of agriculture, people got all their food by gathering wild plants, hunting, and fishing. They had to search for food continually, which left them little time for other activities. But as agriculture developed and farm output increased, fewer people were needed to produce food. The non farmers could then develop the arts, crafts, trades, and other activities of civilized life. Agriculture therefore greatly affected the food supply and made civilization possible.

Agriculture still forms the backbone of Indian economy, inspite concerned efforts towards industrialization in last three decades. Agriculture contributes a high

share of net domestic product by sectors in India. Further, it is not surprising in the Indian economy, with agriculture as the dominant activity, the main source of livelihood is agriculture itself agriculture also has been the source of raw material to India's leading industries. Agriculture geography has thus become a unique branch of Geography in which physical environment and it's response to it have become cardinal points of research and regionalization.

Horticulture is the branch of agriculture which specializes in fruits, vegetables, flowers, and ornamental shrubs and trees. Today , Horticulture contributes over 24.5 percent agriculture GDP over 10 percent of the total agriculture export earnings, and is supporting more than 19 percent of the labour force of the country . India is second largest producer of fruits and vegetables in the world. In India the fruits are grown over an area of 3.73 million hectares contributing to an annual production of 46.6 million tons .Indian basket comprises a wide variety of fruits like mango ,banana, papaya, guava, grapes to apple peach ,almond and walnut among the temperature fruits and anole, bor, pomegranates etc. are the arid zones.

Fruit farming means cultivation of fruit crops in large area in open fields on a commercial scale. Fruit farming is the science and arts of growing fruit plants. This is one of the ways to improve economic condition of farmers. Fruit farming has credibility for improving productivity of land, generating employment, improving status of farmers, enhancing export potential, one-time of capital investment & continuous flow of money and eco-friendly system. In drought-prone areas huge waste land is under cultivation which is improving the rural economic structure. Fruit farming is also very important because the well maintained established orchards give better returns than traditional crops. Traditional fruit crops are normally planted at the farm corners only to fulfill the family needs.

Geographical analysis of food grain to fruit farming in Drought Zone Area of Sangli District is concerned with the physical and socio - economic factors. These factors affect the cropping pattern and selection of crops. Farmers in dry zone area always try to cultivate low water required and high beneficial crops. That's why, the food grain crops to fruit crops transformation is analyzed in this study.

1.2 Selection of the region

India is a predominantly agricultural nation and Maharashtra state in India occupies a very important position which ranks third in area and second in population.

Fruit farming is mainly concentrated in Nasik, Sangli, Amravati, Ahmenagar, Jalgaon, Nagpur and Solapur districts. These districts are leading in respect of area and production under fruit crops. Though the fruit farming is not native to this region, it has emerged as well as established form of land-use with the passage of time and has been done successfully.

Within Maharashtra the Sangli district has significant position as regards to area. There is good scope to increase the area under fruit crops. The geographical setting and ecological factors have given boost to it.

The region under study i.e. Sangli district lies to the southern part of Maharashtra state on the border of Maharashtra and Karnataka State. The district of Sangli lies between $16^0$45' north to $17^0$33' north latitudes and $73^0$42'east to $75^0$40' east longitudes. The average height of Sangli district from mean sea level varies from 500 meters to 1100 meters. The district is bounded by Satara District on the north western side. On the northeastern side it is bounded by Solapur district. On the southern side it is bordered by the Belgaum and Bijapur district of Karnataka state at the centre and east and Kolhapur district is in the west. The Ratanagiri district lies on the west of Sangli district. The total area of Sangli District is about 8601.5 square kilometer.

For Geographical study of food grain to fruit farming in Dry Zone area of Sangli District is selected as a study region. For the purpose of study, the six tahsil (Atpadi, Khanapur, Jat, Tasgaon, Miraj and K.Mahankal) are selected which belong in dry zone area. The region under investigation has been influenced by several considerations.

1. Climatically entire region falls in the rain shadow area. Climate of the region is generally dry except, during south-west monsoon season. There is a spatial as well as temporal variation in the distribution of rainfall. The rainfall variability is more in the study region.
2. The study region has irrigation facilities through wells, tube wells and canals. Irrigation has played an important role in transforming the agricultural landscape and life of the rural people in the study region.
3. Soils of the region are mainly derived from trap rocks. Basaltic rock- structure is the main parent material for the formation of soils. Agriculture is developed in the region of deep and medium black soils, where irrigation facilities are

available. Shallow and medium deep soils of the region are more suitable for fruit crops.

4. Economy of the region has an agrarian base. Out of the total working population nearly 80 percent working population is engaged in primary economic activities, especially in agriculture and allied activities.

5. Out of the total gross cropped area in the study region about 24.76 percent area is under irrigation. Irrigation has played an important role in transforming the agriculture landscape in general and fruit farming in particular, and life of the rural people in the study region.

6. The study region has a fairly good system of road and rail network. This region has accessibility for market through transportation and communication network. Transport plays an important role in the economic development of the region and rural-urban interaction.

7. The physical and socio-economic environment of the region has provided a good potential for the development of the fruit farming.

8. Farmers of this region have given much response to "Phalodyan Vikas Yojana' (1990-91) and innovations in water supply systems, particularly drip irrigation system.

9. The researcher, who is born and brought up in the study region i.e. Sangli district, is quite aware and well-acquainted with the geographical environment of the area. So, it is helpful in carrying out the field work and required data for the purpose of study.

10. The work on the "Grain Farming to Fruit Farming: A Geographical study in Dry Zone of Sangli District" has not yet been attempted by any other geographer and such type of work can be useful for preparing and implementing developmental schemes regarding fruit cultivation. So the researcher has selected this region and topic for the purpose of geographical investigation.

1.3 Selection of Crop

The fruit farming is very important for developing countries like India in order to meet increasing demand of food, to make a balanced diet, to improve the rural economy, to solve the problem of unemployment, to bring the huge waste land under cultivation, to improving the economic condition of farmers in drought-prone area to develop agro-based industries in rural area. It is also important because it plays an

important role in generating employment potential in farm and non farm sector. They are best situated for agro-forestry, social forestry and water-shade development programmerse.

The economic aspect of fruit farming i.e. well maintained and established orchards, give better returns than the traditional crops. The importance lies in per unit area yield, high net profit, source of raw material, efficient utilization of resources, and utilization of waste and barren land, ability of earning for high exchange, one-time capital investment and continuous flow of money. Moreover, fruit farming is one of the important branches which diversified farming in the study region. It also promises the development of several ancillary industries like preservation, dehydration, essence oils, packages, transport and refrigeration etc.

The accumulative effect of these many-sided efforts is farmers in Sangli district are shifting over to the cultivation of Fruits. Therefore, the researcher has selected the food grain to fruit crops for the present investigation based on following considerations.

- Today, fruit cultivation is an option of food grain crops of the region.
- Fruit crops are required low water compare to food grain crops.
- Drip irrigation system are used for fruit crops which is water saving technology, however it is not easy to use for food grain crops that's why flood irrigation system used which waste amount of water.
- Among the fruit crops, the inter crop are cultivated which support farmers at the time of crop failure, but in food grain inter crops are not cultivated.
- State and central Govt. has give more subsidies for fruit crops for plantation, tree crops, irrigation, etc. which are not available for food grain crops.
- Shallow soil is best useful for fruit crops which 60 percent to total soil in DZSD while it need more water for food grain cultivation.
- National and international markets are available for fruit crops while food grain crops are sold in only local and domestic markets.
- Agro-processing industries for fruit crops in region or state while no agro-processing industries for food grain crops in the region and very few in the state.
- New agriculture technology used for fruit crops cultivation like tractor, chemical weed control, chemical fertilizers in drip, etc. and other hand food grain crops are cultivated in proper old method that's why production cost of food grain increased compare to fruit crops.

- The environmental parameter affects growth, quality, size, distribution, concentration and production of fruit crops.
- Fruit cultivation has influenced the farmer's economy to a considerable extent due to high per hectare return compared to food grain crops in the drought prone area.

So it has been decided to study food grain to fruit crops in dry zone area of Sangli district. Because out of these considerations the fruit crops has been selected for the study.

1.4 Selection of Period

For the present study, the selected period is twenty year and this is 1989 to 2009. The main reasons of this period selection are followings.

1. The population pressures on agriculture land use tremendously increase after 1990 as well as literacy of population increased. Increasing unemployed population turned to agriculture and cultivated crops in scientific matter.
2. The Government gives more subsides on fruit farming.
3. The fallow land and shallow soil share in total geographical area is huge which is favorable for fruit cultivation. Literate and young farmers want to cultivate fruit farming for maximum profit.
4. The new ideas of fruit farming in dry region are provided by Govt., Agencies and NJO. For exam- Drip irrigation system and farm storage tanks etc.
5. Agro processing industries developed, however the demand of fruit crop increased and cost also increased.
6. The transport and communication are developed; therefore farmers sold their fruits on big city easily. The communication like mobile, television, farmer conferences, agriculture exhibition, agro won news paper are well developed which gives new ideas and suggestion for best fruit farming.

1. 5 : Objectives

Following are the main objectives of the study:

1. To identify the dry zone area of Sangli District.
2. To study the physical setting of the region as a basis for food grain and fruit crops.
3. To study the socio-economic setting of the region as a basis for food grain and fruit crops.

4. To analyse the spatio-temporal changes in food grain crops and fruit crops in the study region.
5. To measure and examine the food grain to fruit crop transformation.
6. To assess the causes of agriculture transformation in study region.

1.6 Data Base

Data has been collected through primary and secondary sources. Primary data has been collected through field visits to the farmers with interview schedule for which special interview schedule was prepared by considering objectives of the study. Data regarding the farmers was collected by observation of the farms and personal talk with the farmers. Secondary data has been obtained from socio-economic reviews of the district, district census handbooks, gazetteers, agricultural epitomes, bulletins, periodicals, seasons and crop reports, etc. The data thus collected through primary and secondary sources has been classified, tabulated and analyzed by using various statistical techniques and presented by using various cartographic methods by using GIS.

In the present work Dry Zone Area of Sangli District (DZSD) is selected as a study region in general and each tahsil of the district as a component areal unit. Period of investigation is of twenty years (1989 to 2009). For the micro study 45 villages from DZSD have been selected. Among the 45 villages 4 farmers are selected in each village. Micro study focuses on farmer's socio-economic status, physical situation of farms, food grain crops, fruit crops area and changes in during the investigation period.

1.7 Methodology

This research work is based on secondary and primary data. Secondary data have been processed and represented by many cartographic techniques and different statistical methods. The data have been analysed and shown by many cartographical and statistical methods.

In the present work Dry Zone Area of Sangli District is selected as a study region in general and each tahsil of the district as a component areal unit. Period of investigation is of twenty years (1989 to 2009). The spatio-temporal changes in

general landuse, agriculture landuse are analysed during investigation period in study area. The annual variation, index number and agriculture transformation of food grain and fruit crops are calculated in this study.

For micro level study area consist six tahsils of Sangli District which located in Drought prone area. Then all villages arranged alphabetically in each tahsil of study area. Then the 10 percent villages are selected as a sample in each tahsil of study area. In this way, the total 45 villages are selected form total villages (449) of study area. After that the four farmers are selected purposive sampling in each selected village and the total 180 farmers are selected to study food grain to fruit crops transformation.

Sum of the methods used in the analysis of the present study are given below.

1. Irrigation Intensity:-

$$\text{Intensity of Irrigation} = \frac{\text{Net Irrigated area}}{\text{Gross cropped area}} \times 100$$

2. Population Growth Rate :-

$$PGR = \frac{P2 - P1}{P1} \times 100$$

Where_

PGR = Population Growth Rate

P2 = Population of Current Year

P1 = Population of Previous Year

3. Population pressure on Agriculture land:

$$\text{Relative coefficient of over population} = \frac{\text{Per Capita Land (Hect.)}}{0.4047 \text{ hect.}}$$

Where –

0.4047 - Standard hectarage 0.4047 hect. suggested by Swamithan (1974)

4. Agriculture Density :

$$\text{Agriculture Density} = \frac{\text{Cultivators + Farm Workers}}{\text{Agriculture Area}}$$

5. Index number of crops

$$\text{Area Index} = \frac{P_1}{P_o} \times 100$$

Where_

P_1 = Area crop in current year

P_o = Area of crop in base year

6. Analysis of correlation

$$r = \frac{\sum dxdy\,(n) - (\sum dx)\,(\sum dy)}{\sqrt{\sum dx^2(n) - (\sum dx)}\ \sqrt{\sum dy^2(n) - (\sum dy)}}$$

1.8 Review of Literature

The knowledge of research work done in the past relating to the research problem is necessary & helpful to proceed in the right direction. Researcher would be able to make an improvement over the existing studies & also expand horizon of investigation. The review could also help refuting the concepts & statements made in earlier studies as well as supporting the findings of present study following foreign as well as Indian, scholars who have contributed and carried out the study related to fruit farming in India.

Majid. **Husain (2004):**

He has made important contribution in his book entitled "Agricultural Geography" that fruit farms are small and are located where communication links with the consumption centers are appreciably good. Soil fertility is maintained by the heavy application of manures and fertilizers.

Kolhe. **Committee Report (1991):**

This is committee formed by government of Maharashtra for the development of fruit growth potential in drought prone area of Maharashtra, In his report committee has rightly pointed out the significance of horticultural crops for the

development of the state economy. This committee has acquired importance all over the world because of horticultural crops play an important role in human nutrition, help to improve the economic status of the farmers, generate employment potential on farm and non-farm sectors in rural area and help in conserving soil and environment.

Pujari. **A. G. (1993):**

In his Ph.D thesis entitled "The Progress and Prospects for Development of Pomegranate and Ber Fruits in Solapur District" he stated that about the cost of establishment, cost of cultivation and cost – benefit ratio of ber and pomegranate orchards.

Pawar. **C.T. and Phule**. **B.R. (2000):**

In their article 'Fruit Farming in Drought Prone Area of Maharashtra - A Micro Level Analysis of Pomegranate Farming", they highlight the various aspects of fruit farming with special reference to pomegranate in drought-prone area of Maharashtra.

Bal. **J. S. (2003):**

In his Book "Fruit Growing" he tried to give scope of fruit farming in India. He stated that the living standard of the people can be judged by production and consumption of fruits per capita. He has also pointed out that India is climatically favorable for the production of a variety fruits.

Hajare. **R.V. (2007):**

He recorded in his Ph.D. thesis entitled "A study of Fruit Farming in Maharashtra Plateau" that though the fruit farming is not native to this region it has emerged as well as established form of land-use with passage of time and has been done successfully. This region has developed various fruit pockets. The geographical setting and ecological factors have given boost to fruit farming.

Todkari. **G.U. (2009):**

In his Ph.D thesis entitled "Impact of environmental factors on crop land use in Solapur district with Special reference to grapevine cultivation" he analysed the Spatio-temporal variation in grape fruit farming, economy, and marketing of graps in Solapur district.

Prasad. **S. and Kumar**. **U. (2010):**

In his book "A Handbook of Fruit Production" stated that the nature is given to diverse geographical soil and agro-climatic condition in varies region. Hence it is possible to grow various kinds of fruits in the different stats of India. The

classification of fruit reflects the fundamental structure of the flowers from which the fruits are derived. The fruit is as the product of the entire gynoecium and the floral parts that may be associated with the gynoecium at the fruit age.

Prasad C.S.(Edited 2006)

He has examined the sixty years of Indian agriculture 1947 to 2007. He has worked as senior research officer in the planning commission of the Govt. of India, New Delhi from 1975 to 1981. He has explained Indian Agriculture past and present. This work is divided into six parts. Part I covers fourteen chapters, Part II covers with the first to the tenth five year plans part III covers the year wise review of agricultural development in India, 1947-2006. Part IV is related with time series data (1950-51 to 2004-05) on Indian agriculture. The whole scene of the Indian agriculture has been explained by Dr. Prasad.

Shashi Bala Singh (2008)

He has analyzed the changing pattern of land use, land use efficiency and cropping intensity in Sant Ravidas Nagar, Uttar Pradesh. He has also explained the changes in land use efficiency and intensity of cropping in Sant Ravidas Nagar district of Uttar Pradesh. Gyanpur block has highest increase of 160.69% to 133% in 1981. Aurain had the second highest cropping intensity (155.41%) while Suryawan had the third rank (147.71%) during 2001.

M.V.Reddy and N.B.K Reddy (1992)

He have discussed the changing pattern of irrigation in Andhra Pradesh. They have also explained irrigation as a decisive factor in Indian agriculture due to high variability and inadequacy of rainfall. Irrigation is imperative for successful agricultural particularly the arid, semi-arid and sub-humid areas which are prone to drought and famine conditions due to partial failure and delayed Arial or early with drawls of the monsoons. The study area Andhra Pradesh has substantial area under semi-arid climate; agriculture is a gamble with monsoon.

Awate S.J. (2013):

He studied the fruit farming in Solapur district which is located in drought prone area of Maharashtra state. He explains very clearly and simply the benefit of fruit cultivation in drought prone area. He measured the spatio-temporal growth of fruit farming in study region. The problem of fruit farmers consisted in his study and suggests best solution.

More K.S.(1980):

The landuse pattern in Kohapur district is studied by More K.S. According to him, the technological determents largely affect on cropping pattern. He calculated the spatial organization of agriculture in Kolhapur district on the base of six villages in Kolhapur district. He measured the agriculture development in Kolhapur district in his study.

1.9 Organization Of The Work

The present study entitled *"Grain Farming to Fruit Farming A Geographical Study In Dry Zone of Sangli District (1989 - 2009)"* is based on the above objectives and methodology. The thesis includes seven chapters. The contents of each chapter have been presented below.

Chapter I:- 'Introduction'

This chapter under the title '**Introduction**' explains the significance of the theme select, the objectives, data base, methodology, and choice of study region, choice of crop and brief review of relevant literature as well.

Chapter II:- 'Identification of Dry Zone OF Sangli District'

Under the title '**Identification of Dry Zone OF Sangli District'** the term 'drought' and identify the dry zone area of district. In this chapter a detailed explain the 'drought' term, types of drought and account of the study area, its location and extent history, administrative setup, of the district. The dry zone area of Sangli District is indentified in this chapter by using quantitative techniques.

Chapter III:- 'Physical and Socio-economic Setting of the Dry Zone Of Sangli District'

In this chapter under the title **'Physical and Socio-economic setting of the Dry Zone of Sangli District'** an attempt has been made to study the physical and socio-economic factors which influence on agriculture. In this chapter the relief, geology, drainage, soil, climate, population growth, population density, population literacy, agriculture density, population pressure on agriculture, agricultural implements, and sources of irrigation and transport network are discussed.

Chapter IV:- 'Land-use'

Under the title **'Land-use'** the chapter is devoted to the analysis of general land-use pattern and agriculture land-use pattern and changes therein. In this chapter,

the general land-use is divided into major five major categories and temporal changes therein are observed. For the analysis of agriculture land-use, food grain and non food grain crops analysed in the from of spatio- temporal variation.

Chapter V:- 'Grain Farming to Fruit Farming Transformation'

Under the title **'Grain Farming to Fruit Farming Transformation'** it deals with food grain and fruit crops. The measurement of the annual variation, index number of crops and spatio-temporal variation of food grain and fruit crops are discussed here. The agriculture transformation especially food grain to fruit crop are calculated in this chapter.

Chapter VI:- 'Analysis of survey work'

Sixth chapter deals with Analysis of survey work. This chapter is completely based on the field survey data. It includes method of sample selection, physio-cultural status of sample farmers, general landuse of sample farmers, agriculture transformation in sample farmers, causes of food grain to fruit crops transformation and problem of agriculture transformation are discussed in this chapter.

Chapter VII: Conclusions and Suggestions

The last chapter deals with conclusions and suggestions. In this chapter results emerged from the analysis of the data in the preceding chapters are stated in form of conclusions. The problems related with fruit cultivation discussed in detail. The important suggestions are also given in this chapter to improve the overall condition of the fruit cultivation in the study area.

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CHAPTER – 2

INDETIFICATION OF DRY ZONE OF SANGLI DISTRICT

2.1 . Introduction

Sangli District is one of the drought-hit districts of Maharashtra. Drought is a natural hazard that differs from other hazards since it has a slow onset, evolves over months or even years, affects a large spatial extent, and cause little structural damage. Its onset and end and severity are often difficult to determine. Like other hazards, the impacts of drought span economic, environmental and social sectors and can be reduced through mitigation and preparedness. Because droughts are a normal part of climate variability for virtually all regions, it is important to develop plans to deal with these extended periods of water shortage in a timely, systematic manner as they evolve. Experience has shown that the democratic from of governance has handled droughts more efficiently than others, as demonstrated by the situation in India before and after independence. In order to solve the problems along with other problems of drought prone areas, it is very important to identify such area in Sangli District. In this chapter it has been attempted to identify Drought (Dry) prone area of Sangli District.

2.2. Drought

The term 'Drought' is of meteorological origin. The term drought is used differently by different persons depending upon the context and purpose. To the agronomist it is a shortage of moisture for the crop. The hydrologist defines it as when surface and underground water level are depressed and there is diminution of stream flows. According to economist drought means a situation where water shortage ultimately affects the established economy of the region. To the meteorologist drought represents the absence of rainfall. Thus, drought is not understood as any absolute condition but as relative terms. It representation depends upon the context in which the term is used.

2.2.A. Definition

The meaning of drought is a complex phenomenon, and the formation and development of its strength go through a process in gradual accumulation, which is so slow that it is difficult to detect during initial period. Drought can be understood as shortage of water supply or imbalance between the demand and supply of water.

1. Drought as a week with actual rainfall equal to half the normal rainfall or less. **- Ramdas and Mallik.**

2. Drought as prolonged period of abnormal moisture deficiency and drought severity as a function of moisture demand as well as moisture supply.- **Palmer**

3. Drought as a situation when annual rainfall over the area or place is less than 75 percent of the normal. - **Indian Metrological Department.**

4. Drought is a period of abnormally dry weather sufficiently for the lack of precipitation to cause a hydrological imbalance and carries connotations of a moisture deficiency with respect to mains usage of waters- **M.Mohan and Diaz Arena (1982)**

5. Drought is considered by many to the most complex but least understood of all natural hazards affecting more people than any other hazards. – **Hangman (1984)**

In short drought is a condition of moisture deficit sufficient to have an adverse effect on vegetation, animals, and man over a sizeable area. However, from practical standpoint, drought may be regarded as a period of abnormal dry weather sufficiently prolonged for lack of water to cause serious hydrological imbalance in the affected area. In India not only the tropical situation but also its entire dependence on the monsoon rainfall aggravates the situation of drought even more. Drought prone areas in India are generally associated with low level of development, and when drought strikes, the condition of toiling people becomes miserable. Drought affected people have to lead the life of destitute. Moreover, the scope of agricultural growth in these areas is limited by low and uncertain moisture conditions.

2.2.B. Types of Drought

A general survey of definitions of drought indicates that drought can be classified in four types according to the criteria in use either alone or in combination of rainfall, temperature, humidity, evaporation from free water, transformation from plants, soil moisture, wind, stream flow and plant condition. These types are follows-

a) Meteorological drought

The meteorological droughts are defined mainly on the basis of the amount of rainfall and the period of the lack of rain. According to Huschke, R.E., "A period of abnormally dry weather sufficiently prolonged for the lack of water to cause serious hydrologic imbalance in the affected area." Meteorological drought is simple absence/deficit of rainfall from the normal. It is the least severe form of drought and is often identified by sunny days and hot weather. According to Blumen stock, “Drought

is a period of 48 hours during which precipitation is less than 0.10 inch. Indian Meteorological Department has classified below normal rainfall as slight, moderate and severe droughts in intensity when the deficiency of rainfall is -11 to -25percent, -25 to-50 percent and below -50 percent respectively.

b) Hydrological drought

Hydrological drought often leads to reduction of natural stream flows or groundwater levels, plus stored water supplies. Main impact is on water resource systems. According to Yevjevich Vujica, "A period of below average water content in streams, reservoirs, Groundwater aquifers, lakes and soils." Hydrological drought is a situation in which insufficient water availability affects human beings either directly or indirectly in all disciplines.

c) Agricultural drought

According to Thornwait, “Drought does not begin when the rain causes but only when plant roots can no longer obtain soil moisture.” Rosenberg, N.J. defined drought as “A climatic excursion involving a shortage of precipitation sufficient to adversely affect crop production or range production." This form of drought occurs when moisture level in soils is insufficient to maintain average crop yields. Initial consequences are in the reduced seasonal output of crops & other related production. An extreme agricultural drought can lead to a famine, which is a prolonged shortage of food in a restricted region causing widespread disease and death from starvation.

d) Socio-economic drought

Socio-economic drought correlates the supply and demand of goods and services with the three above-mentioned types of drought. When the supply of some goods or services such as water and electricity are weather dependant then drought may cause shortages in supply of these economic goods.

2.3. Sangli District

Sangli district is almost an epitome of the whole Maharashtra, except for seashore. It also represents almost every aspect of Maharashtra’s geographical, historical, industrial and cultural status.

2.3.A. Historical background

Sangli District derives its name from it’s headquarter ‘Sangli’ town which was erstwhile princely state and now forms a part of the district. District forms a part of Deccan plateau. Its history is essentially linked with the southern Maratha territories also referred to as the Kuntala during the ancient period. After the death of Emperor

Ashoka in 236 B.C. this region witnessed the rise and fall of the dynasties of Satavahanas, Vakatakas, Rashtrakutas, Chalukyas and Bahamani Kings. After the invasion of Devagiri by Al-ud-din Khilaji, the Deccan passed under the overlordship of Delhi emperors. The first Moghal invasion in Deccan began in 1593 during the region of Akbar. The successive history of the region is marked by prolonged struggle for domination among the forces of Moghal, Adilsahi's Kingdom and the Marathas. Marahta chieftains belonging to Patawardan Family are said to have been the rules of small principalities such as Sangli, Miraj and Tasgaon which came under the domination of British in 1818-19 and finally these were merged with the state of Bombay during the post independence period in 1948. In this way Sangli District was formed in 1949.

2.3.B. Location and Geographical Area

Sangli District is one of the southern most districts of Maharashtra state. It is situated between the latitudes of 16° 45' N to 17° 33' N and the longitudes of 73° 42' E to 75° 40' E. The average height of Sangli district from mean sea level varies from 500 meters to 1100 meters. The district is bounded by Satara District on the north western side. On the northeastern side it is bounded by Solapur district. On the southern side it is bordered by the Belgaum and Bijapur district of Karnataka state at the centre and east and Kolhapur district is in the west. The Ratanagiri district lies on the west of Sangli district. The total area of Sangli District is about 8601.5 square kilometer.

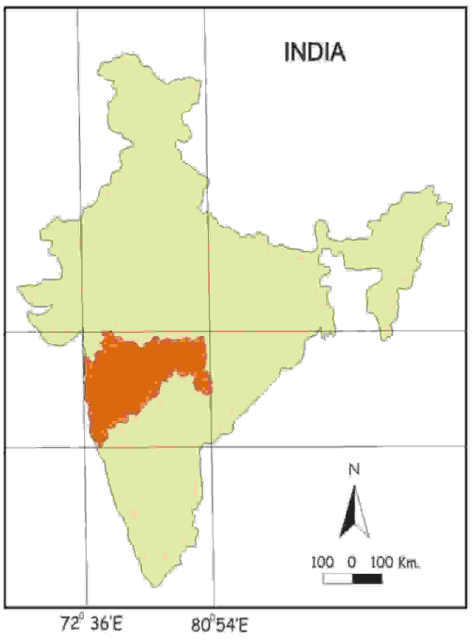
Table 2.1
Sangli District : Geographical Area

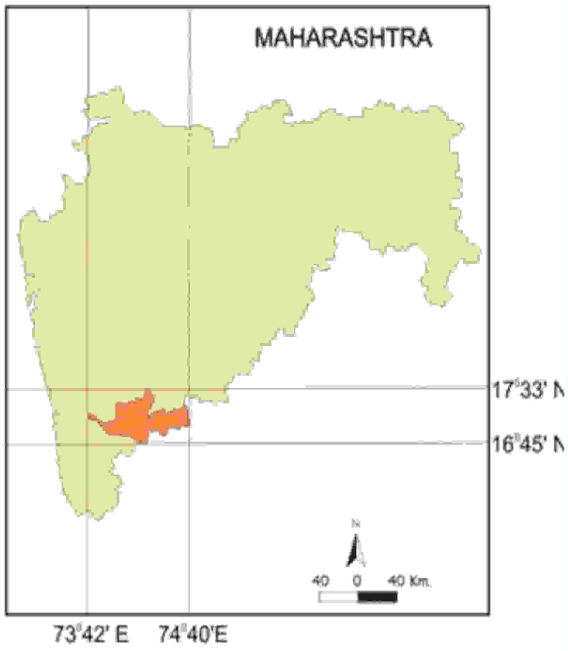
Sr. No.	Tahsils	Area in Hect.	Percentage to total
1	Shirala	63417	7.36
2	Walwa	78781	9.14
3	Palus	NA	NA
4	Khanapur	132602	15.39
5	Atpadi	87171	10.12
6	Tasgaon	111259	12.92
7	Miraj	92624	10.76
8	Ka.Mahakal	70673	8.20
9	Jath	224538	26.07
10	Kadegaon	NA	NA
	Sangli District	861065	100

Source:- Sangli District socio-economic abstract in 2010/11.

Location

Sangli District





Sangli District

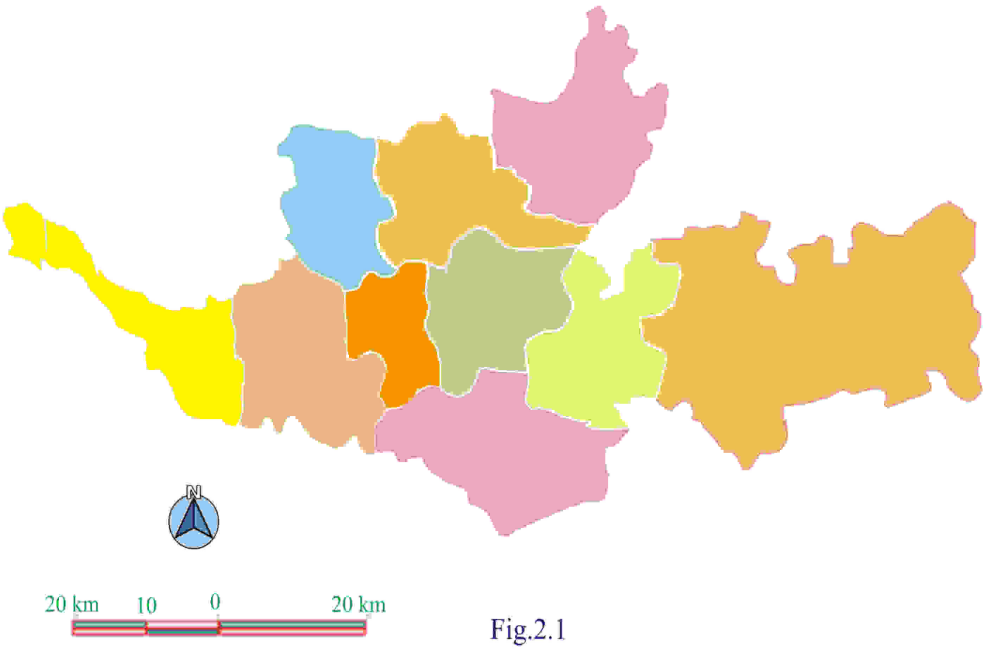


Fig.2.1

The Sangli district has an irregular shape. The average length of the Sangli district is 126 k.m. and it spread into East Jath taluka to west Shirala taluka and roughly, squarish width 122 K.m. is spread between Miraj taluka in the South to Atpadi taluka in the North. The total geographical area of Sangli District is 861065 hectors.

According to geographical area, Sangli district is the 17th number district in Maharashtra State .This area is divided into urban area and rural area. According to area Jath taluka is the largest taluka (26.07 percent) and Shirala taluka is the smallest tahsil (7.36 percent) in Sangli district.

2.3. C. Administrative Evolution

The present areas of Sangli district were up to 1948 partly included in old Satara district and partly in the former States of Aundh, Jath, Sangli, Kurundwad (senior), Miraj (senior), Miraj (Junior) and Wadi Estates. In 1949, the district was named as South Satara district which included four talukas of Tasgaon, Khanapur, Walwa and Shirala transferred from old Satara district and two new talukas of Miraj and Jath formed out of the erstwhile Princely States. In 1960, the name of South Satara district was changed to Sangli district with its headquarters at Sangli in Miraj taluka. On 1st August 1964 Khanapur and Miraj talukas were reconstituted into Khanapur taluka & Atpadi taluka and Miraj taluka & Kavathe Mahankal Mahal, respectively. Palus taluka came into existence 26 Jun 1999. Kadegaon is last taluka declared by Govt. of Maharashtra on 6th April 2003.

Presently, the land of the district is distributed in 10 talukas and 5 towns. Among these, Jath lies isolated in the east, Shirala is west, Atpadi, Khanapur and Kadegaon in the Middle North, Miraj in the middle south, and Palus, Tasgaon, K.Mahankal in the Center.

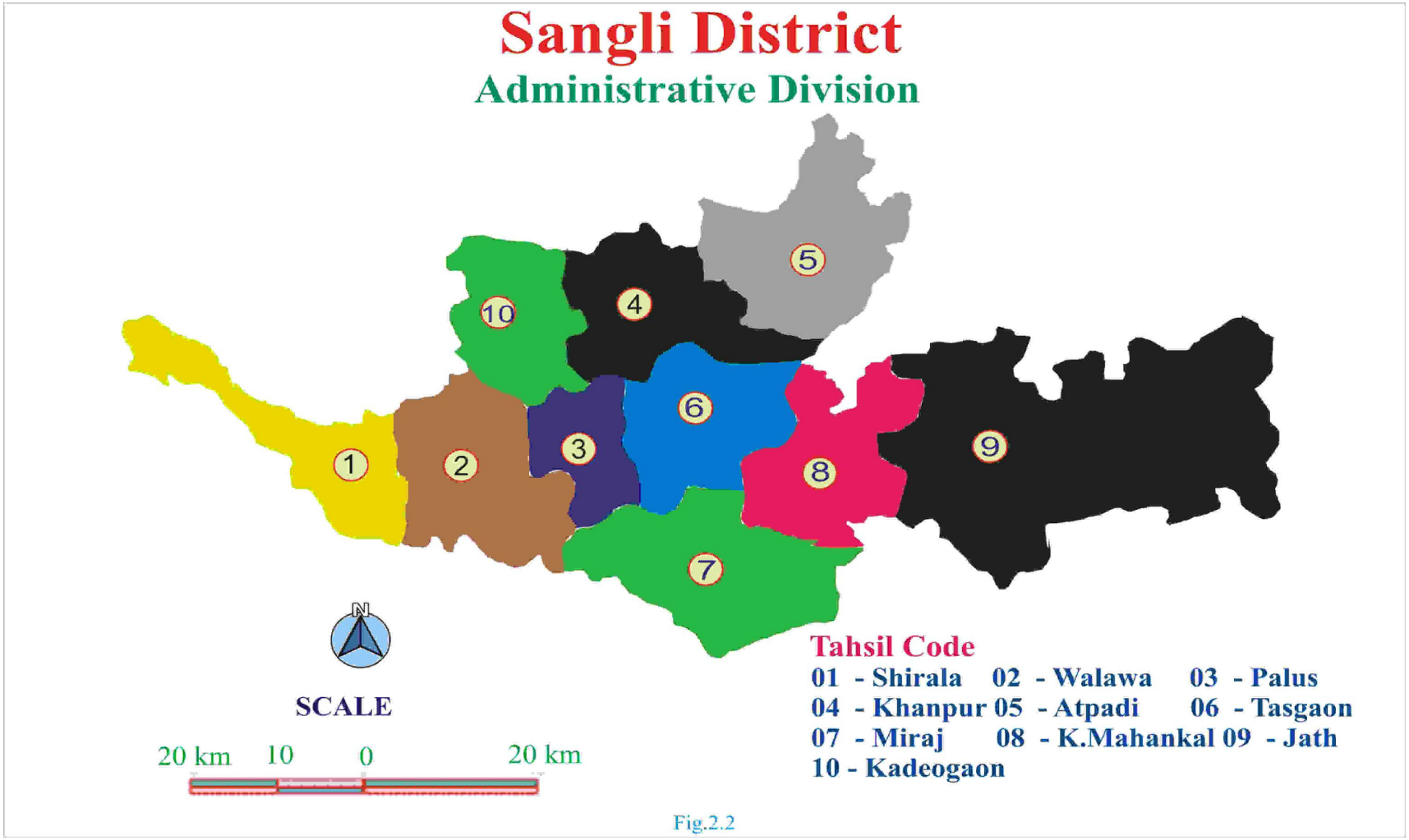

Sangli District
Administrative Division
1
2
3
4
5
6
7
8
9
10
N
SCALE
20 km 10 0 20 km
Tahsil Code
01 - Shirala 02 - Walawa 03 - Palus
04 - Khanpur 05 - Atpadi 06 - Tasgaon
07 - Miraj 08 - K.Mahankal 09 - Jath
10 - Kadeogaon

Fig.2.2

2.4 Method of Delimitation of Dry Zone Area

There have been many methods developed of delimitation of drought prone areas. Ravindranath (1978) has given an account of various methods of drought studies. The methods used by geographers and various committees are also many, and these methods are follows.

1. Rainfall and irrigation based
2. Rainfall and potential evapotranspiration based.
3. Water balance analysis based
4. Physical factors based

These methods are used for delimitation of drought prone area. Each of these methods has some limitations, demerits and merits. However, the nature and purpose of study, the rainfall and irrigation based method is selected for delimitation of drought prone area.

Rainfall and Irrigation based method

Drought is no longer mere scarcity or the absence of rainfall, but related to inefficient water resource management. Requirement of over 80-90 percent of the drinking water and over 50 percent for irrigation is met from groundwater. Maharashtra Government has appointed several committees for the drought from time to time. The fact finding committee for the survey of scarcity survey areas in Maharashtra has considered weekly rainfall as a major criterion for identification of drought areas in Maharashtra. Beside, taking into account a 25percent annual rainfall deficiency and the data furnished by other reports, the committee has used deficient rainfall weeks as the main agro-climatic parameter to determine drought prone areas. A week is defined as a deficient week when the rainfall was 50 percent less than the average rainfall for the week. The committee has considered weeks of S.W. monsoon season. If 50percent of these weeks were deficient, the year was considered as a drought hit year. The weekly rainfall data 15 years is considered for all stations. According to Dikshit the agro-climatic significance of deficient week is limited.

The second Irrigation Commission (1972) has used the criteria suggested by Indian Metrological Department i.e. if in any area the rainfall of a year is 75 percent

or less than the normal annual rainfall, then the area is considered as drought prone in that particular year. If in such area, such damage is 20 percent or more than the total 60 years for the study, then the area is called as drought area.

Swaminathan Committee appointed by the Government of India, has used two criteria namely, annual rainfall and irrigation facilities for drought studies. According to Sahtri have used annual rainfall anomaly to study and a year receiving a rainfall of 50 percent or less than that of annual normal is the in the drought year.

2.4.A. Rainfall

Rainfall, as a primary ecological parameter, has created a variety of farming enterprises, types or systems of agriculture. It is the dominant single weather element influencing the intensity and location of farming system and the farmers' choice of enterprises. It also becomes a climatic hazard to farming when it is characterized with scantiness, concentration, intensity, variability and unreliability.

Table 2.2
Sangli District: Average Annual Rainfall (1989-2009)

Sr. No.	Tahsils	Rainfall in mm.	Sr.No.	Tahsils	Rainfall in mm.
1	Shirala	1005	7	Miraj	629
2	Walwa	680	8	Ka.Mahakal	549
3	Palus	597	9	Jath	558
4	Khanapur	581	10	Kadegaon	459
5	Atpadi	565	Sangli District		620
6	Tasgaon	597	Maharashtra State		

Source : Socio-economic Abstract of Sangli District, 1989 and 2009

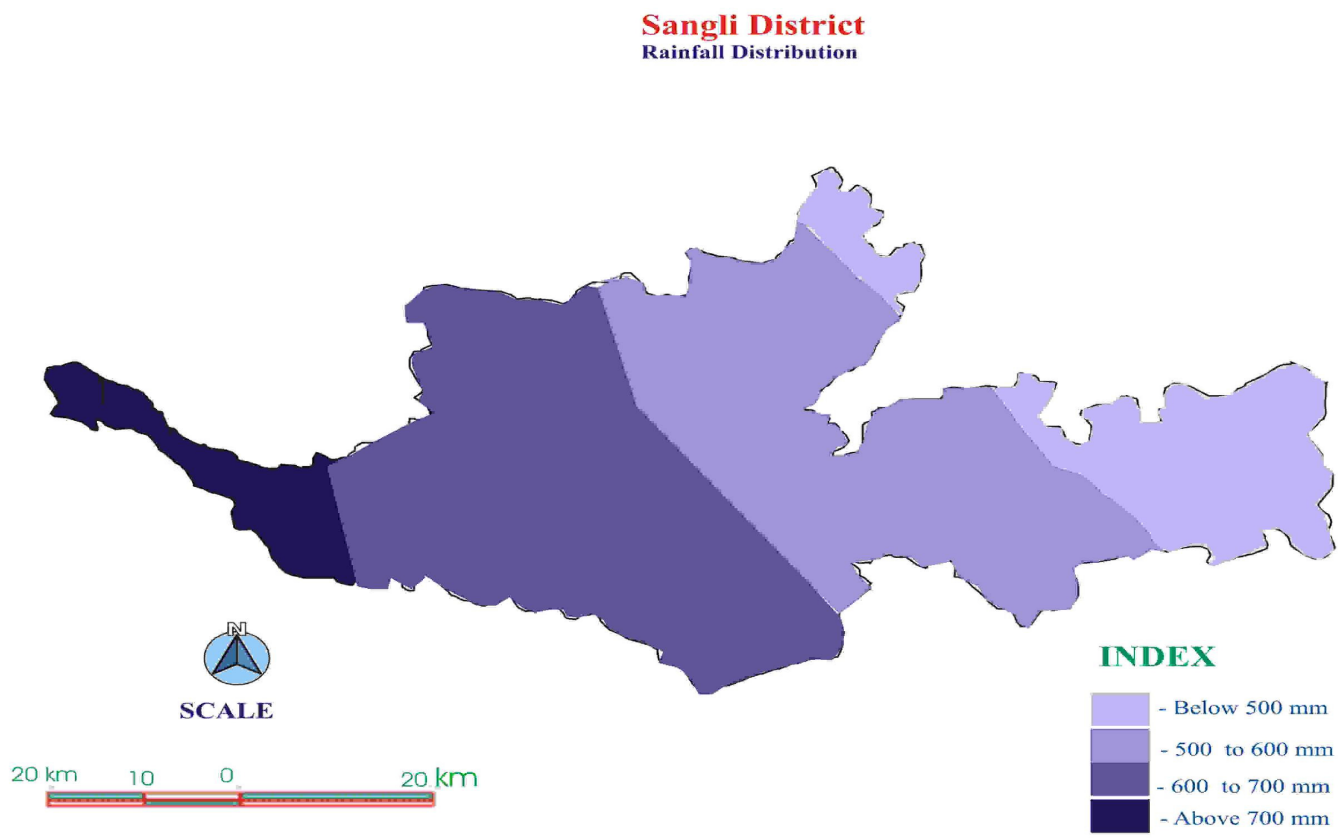

Sangli District
Rainfall Distribution
N
SCALE
20 km 10 0 20 km
INDEX
- Below 500 mm
- 500 to 600 mm
- 600 to 700 mm
- Above 700 mm

Fig.2.3

Sangli District roughly 80 percent rainfalls is received from the south west monsoon. Rainfall starts sometime in the last week of June and lasts till end of September because Sangli District is located in rain shadow area of Western Ghats. This scanty and uneven rainfall are drastically affecting on agriculture of the region. But Shirala tahsil records heavy amount of rainfall with average of 1005 mm. This perhaps, is due to close vicinity of this tahsil with Western Ghats. From Shirala tahsil eastwards rainfall decreases which is evident form the table 2.1. Expecting Shirala (1005mm) and Walwa tahsils (680mm) the rainfall range of 450 to 620 mm are observed in Palus, Khanapur, Atpadi, Tasgaon, Miraj, Kadegao, Jath and K. Mahakal tahasils of Sangli district.

2.4.B. Irrigation

Irrigation is considered one of the most important and basic factors in process of transformation of agriculture, where rainfall is inadequate, and irrigation played an important role in transforming the rural landscape of the study region. The canal, tube-well, well and tanks are major source of irrigation used in India, which can change landuse pattern dominantly. However, the intensity of irrigation is useful to delimitation of dry zone area. For the measurement of irrigation intensity the following formula are used.

$$\text{Intensity of Irrigation} = \frac{\text{Net Irrigated area}}{\text{Gross cropped area}} \times 100$$

The intensity of irrigation is the proportion of net irrigated area to net shown area of the aerial unit. The spatial pattern is revealed by Fig 2.4. High proportion of the intensity of irrigation is observed in Walwa taluka (37.30), where canal and well irrigation has been developed during the last two decades. This has been followed by Shirala (29.62) and Miraj taluka (28.51percent). These tahsils have also availability of water from either canals or wells for irrigation purpose.

Table No 2.3
Sangli District: Irrigation Intensity (2009-10)

Sr. No.	Tahsils	Gross cropped area	Net irrigated area	Irrigation intensity
1	Shirala	45036	13440	29.62
2	Walwa	95054	35456	37.30
3	Palus	NA	NA	NA
4	Khanapur	115370	21664	18.77
5	Atpadi	48972	12152	24.81
6	Tasgaon	92667	20527	22.15
7	Miraj	108013	30798	28.51
8	K.Mahankal	50594	11425	22.58
9	Jath	154886	31038	20.03
10	Kadegao	NA	NA	NA
District		712592	176500	24.76

Source : Socio-economic Abstract of Sangli District, 2009-10

(NA- Data is Not Available**)**

Expecting these (Walwa, Shirala, Miraj) tahasils, remaining all tahasils of district have recorded low intensity (below 25) of irrigation giving a way to rain fed agriculture. The intensity of irrigation is very low in Khanapur (18.77) and Jath (20.03).

The average irrigation intensity district is 24.76. That is low compare to other neighboring district like Kohlapur, Pune and Satara district. The Palus and Kadegao tahasils irrigation data are not available but Sukthankar committee identified drought prone areas these tahasils excludes.

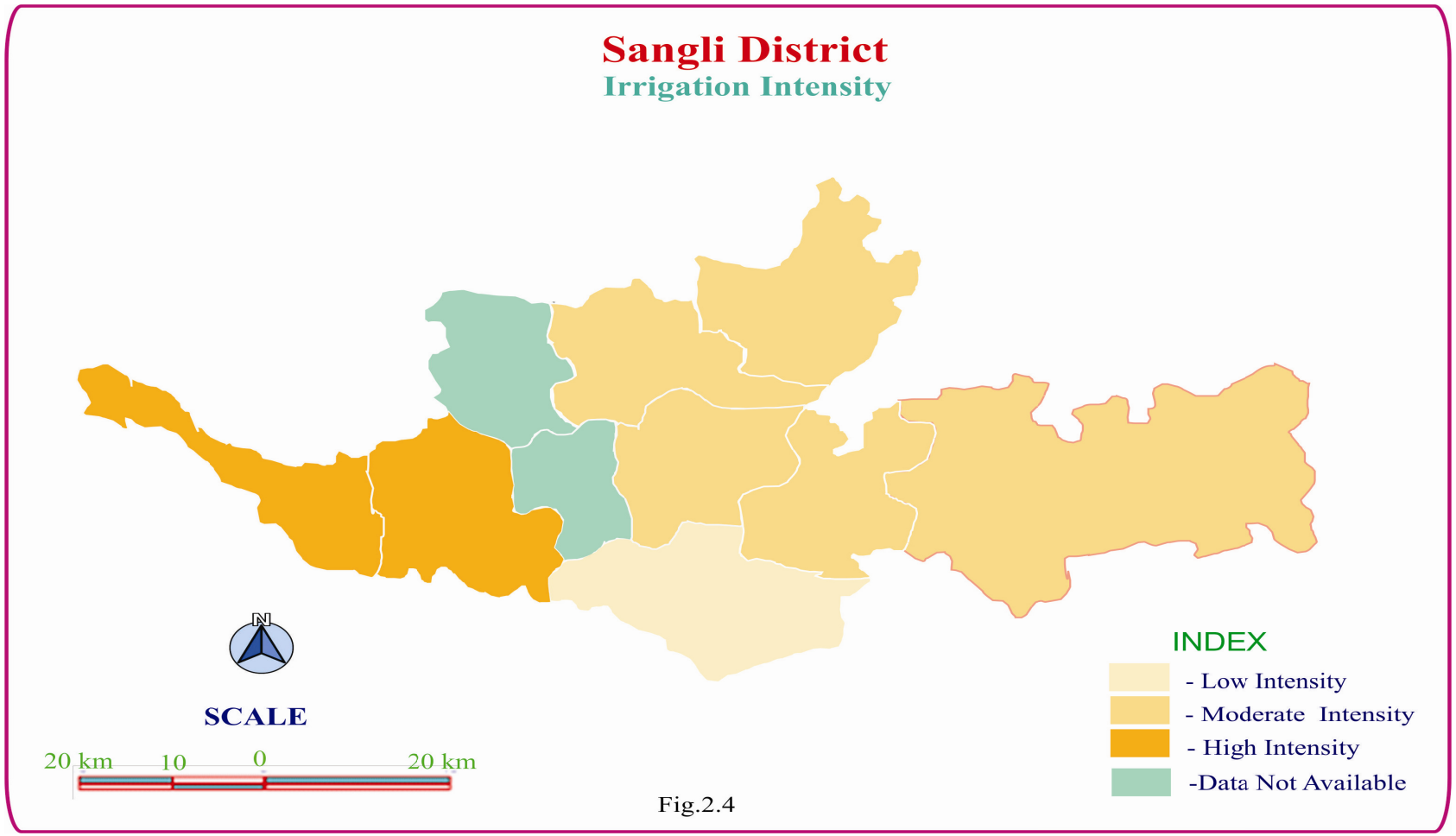

Sangli District
Irrigation Intensity
N
SCALE
20 km 10 0 20 km
INDEX
- Low Intensity
- Moderate Intensity
- High Intensity
-Data Not Available

Fig.2.4

2.5. Identification of Dry Zone Area of Sangli District (DZSD)

The study based on rainfall and irrigation based methods indicates that Shirala, Walawa, Kadegao and Palus all other six tahasils are included in drought prone area. The result of above discussed methods are related to rain gauge station and intensity of irrigation but for want of data related to tahsil boundary has to be accepted as a separating line between drought prone area and non drought prone area. The problem of western boundary may be raised. This problem does not raise in case of boundary line on northern, southern and eastern sides of area because stations on these sides are located in well-defined drought prone areas.

The rainfall and irrigation based method is used to identify the drought prone area of Sangli District. These identify same six tahasils of Sangli District in drought prone area of district and with help of choropleth method, the western boundary of drought area of Sangli District is demarcated. Rainfall of Palus and kadegao Tahsil is low and moderate, but they are not included in drought prone region. The Palus and Kadegao tahasils irrigation data are not available but Sukthankar committee identified drought prone areas these tahasils are excludes.

Thus the six tahasils namely Jath, Atpadi, Tasgao, Khanapur, K. Mahankal and Miraj tahsils. (Fig. 2.5). The 445 villages and seven towns are included in DZSD. The total area of these six tahsils is 718867 hect. which is about 83 % of total area of Sangli District.

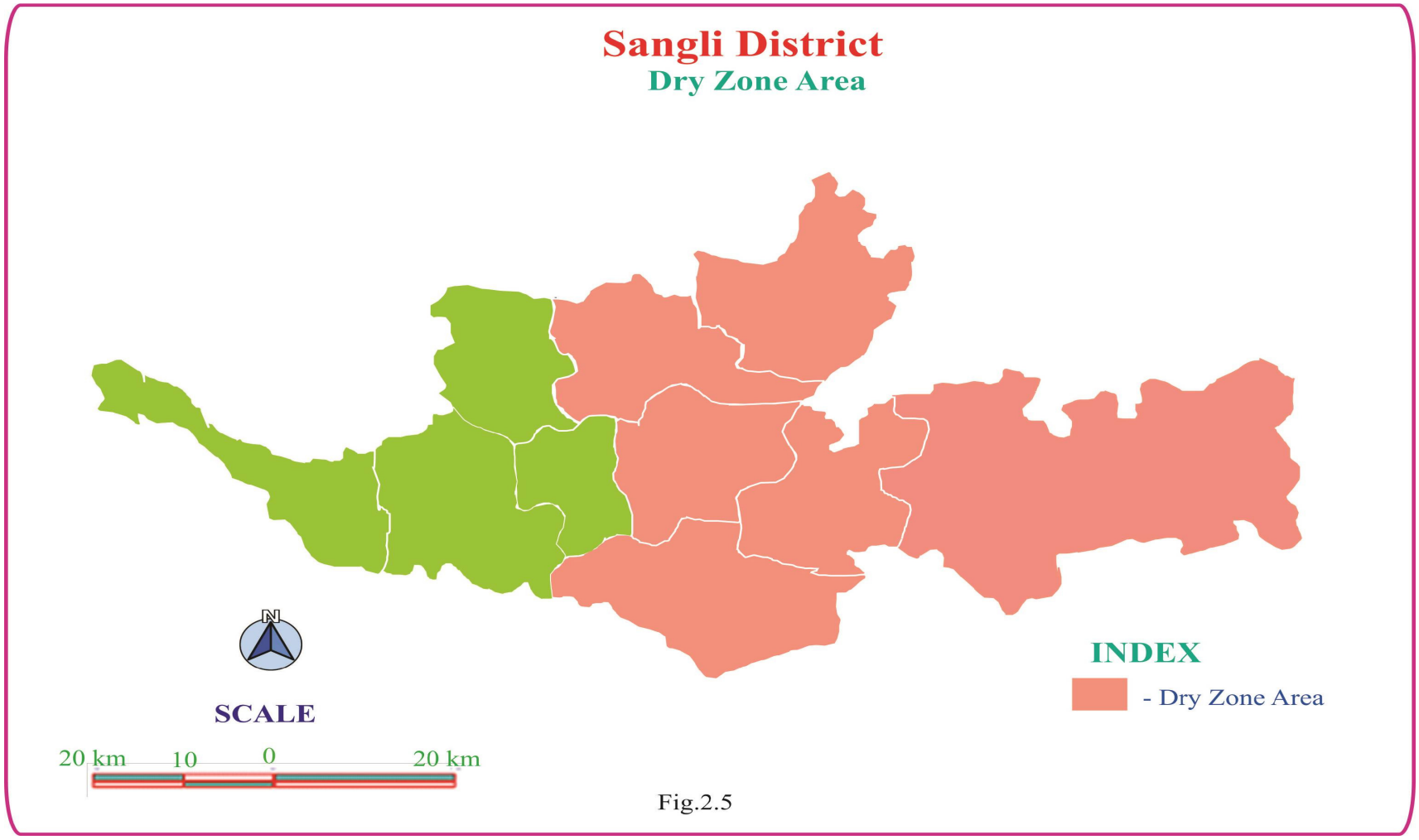

Sangli District
Dry Zone Area
N
SCALE
20 km 10 0 20 km
INDEX
- Dry Zone Area

Fig.2.5

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CHAPTER - III

PHYSICAL AND SOCIO-ECONOMIC SETTING OF THE DRY ZONE AREA OF SANGLI DISTRICT

3.1 Introduction

The profile of the region such as Physical, Historical, Social, Economic and Political create an influence on the scenario of the region concerned. Man can change and modify the physical landscape into cultural with his expertise as he desires for his comfort. From the historical events, man can learn a lot and may implement his past experience for future oriented plans for development. To a certain extent, political factors also play a very important role in changing the face of the region. Man can implement various policies and programs by establishing different projects for improvement of socio-economic conditions of the region. In this way, the physical landscape may be changed into social and economic landscape such as converting forest area into agricultural land, river water into artificial reservoirs, which brings a tremendous change in the region.

3.2 Physiographic Profile of the Region

The physiographic profile of the DZSD may include relief, geology, drainage pattern, soil, climate etc. Here, these aspects are given for represent of physiography of DZSD.

3.2.A. Relief

Relief affects agriculture operation in many ways. Relief directly affects land use and growth and distribution of crops. Relief influences land cultivation and farming in a region by affecting the cause of altitution. DZSD is a part of the larger Deccan Peninsula of India. The average height of the area is about 600 meters. The maximum height is 918 meters which is observed in north eastern part of the DZSD. The lowest point is in the extreme east part where the height 480 meters above sea level. On the basis of altitudes DZSD divided in to three division i.e.

i. Height below 600 meters
ii. Height between 600 to 700 meters
iii. Height above 700 meters

i. The Plains (Height below 600 meters)

The zone of 500 to 600 meters include eastern and northeastern parts of Jat tahasils, the eastern part of Atpadi tahsil, the southern part of Khanapur tahsil, the western part of Tasgaon tahsil and the southern part of K.Mahankal tahsil. The north eastern part of Jat tahsil is less than 500 meters. The Agarani river plain area located in the southern part of K.Mahankal tahsil, Man river plain of north eastern part of Atpadi tahsil and the Bori river plain located in the eastern part of Jat tahsil.

ii. The Plateau (Height between 600 to 700 meters)

The altitude zone of 600 to 700 meters include the northern part of Miraj tahsil, the central part of Khanapur tahsil, the east central part of Jat tahsil, the southern part of K.Mahankal. The height of Khanapur plateau varies from 700 to 900 meters, some peaks having the height of more than 900 meters are found along the north eastern fringe of plateau. The height of Jat plateau varies from 600 to 700 meters and maximum height is 758 meters. The Khanapur Plateau is comparatively less undulating than the Jat Plateau.

iii. The Foot Hill (Height above 700 meters)

The south central part of Jat tahsil, the extreme western part of Atpadi Tahsil, the north eastern part of Miraj tahsil, the western part of K.Mahankal tahsil and the eastern part of Tasgaon tahsil are included in the altitude zone of above 700 meters. This zone can be divided in to three subdivisions 1) Foot hill areas lying to the west of Khanapur-Jat Plateau. 2) The foot hill areas lying to the east of plateaus. 3) The hilly and foothill area lying to the west of the Yerala River plain. The average slope of this area is comparatively more than the other areas and the slope is very steep along the border of the plateaus.

3.2. B. Geology

The geological formation of Dry Prone Area of Sangli district is the Deccan traps. The Deccan lava flows are found usually in the form of horizontally bedded sheets. Vertical or inclined jointing at right-angles to the bedding planes of the trap are marked at places. The flows usually form flat-topped hills so characteristic of the trappean country. The traps belong to the type called 'plateau basalt'. They are more or less uniform in composition corresponding to dolerite or basalt. These are dark grey or greenish grey in colour. These traps are distinguished into vesicular and non-vesicular varieties. The non-vesicular types are hard, tough, compact and medium to

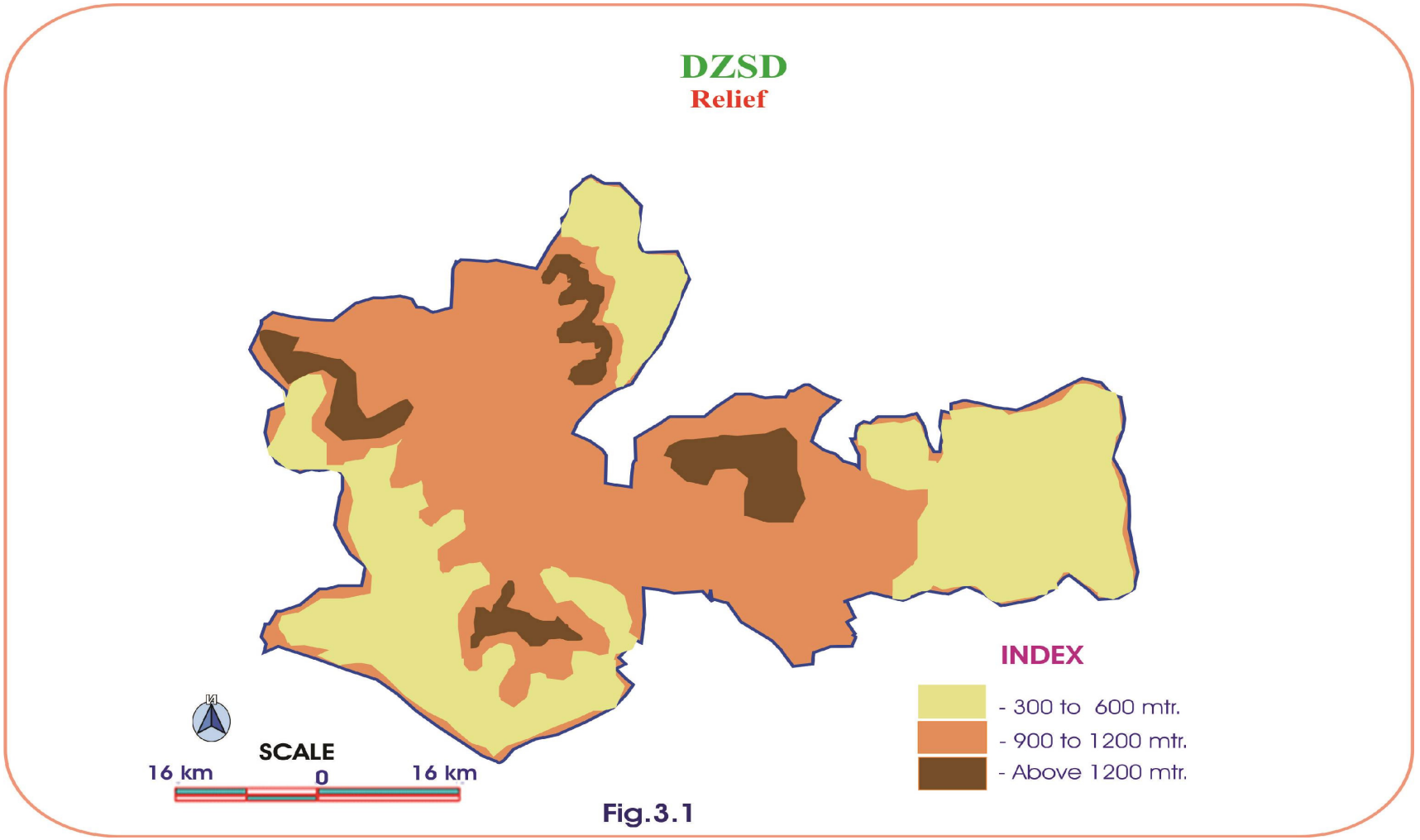

DZSD
Relief
INDEX
- 300 to 600 mtr.
- 900 to 1200 mtr.
- Above 1200 mtr.
SCALE
16 km
0
16 km

Fig.3.1

fine-grained, and break with a conchoidal fracture. The vesicular types are comparatively soft and friable and break more easily. The amygdaloidal types are characterized by vesicles filled with quartz, chalcedony, calcite and zeolite. The river valley areas, are occupied by the typical black soil derived from the Deccan traps. All the types, though varying in quality, are fertile on the whole. The black soil contains high alumina and carbonates of calcium and magnesium with variable amount of potash, low nitrogen and phosphorus. The soil is generally porous and swells considerably on addition of water, and dries up with cracks on losing moisture. The black soil is very fertile and does not require manuring for long periods. The soil of reddish brown colour is found on the hills. This type of soil becomes fertile on proper minoring and irrigation.

The inter-trappean beds generally form aquifers. In the area of Tasgaon, which is composed of Deccan trap flows, the main aquifers are either the inter-trappean beds or the decomposed zones in the traps. The depth of the water-table is variable, generally being more than 6 meters. In general the Deccan traps are unreliable sources of ground-water because of the sporadic distribution of their inter-trappean beds. Supplies are often exhausted owing to the limited storage areas and by leakage through natural springs. Shallow wells located on the banks of streams usually give fair supplies for household purposes. The quality of ground-water is good for all purposes, excepting where contamination results through the introduction of foul matter or by infiltration. Contamination is very common in the area and as such the water is hard, especially if drawn from the decomposed, amygdaloidal varieties of the traps, and is often brackish owing to the presence of sodium chloride and the sulphates of calcium and magnesium.

3.2.C. Drainage

The rivers like Krishna, Yerala, Man, Agrani, Bore River and many other smaller tributaries drain in the DPAS. Among them Krishna and Man are important rivers in this area. (Fig No 3.2)

i. The River Krishna :

The river Krishna is one of the dominant rivers in Sangli District. Within the DPAS it flows for a distance of about 28 kilometers approximately western part of Miraj Tahsil and is joined by the Varna; and the Yerala, while the Agarani river, with a greater part of its course within the district, joins it just outside. The Krishna is unfit

for navigation. The channel bed is only about 40 to 45 meters across and outside the monsoon season the river is so shallow that it is possible to drive even bullock-carts across the bed in about knee-deep water.

ii. The River Yerala:

The Yerala River is the left bank tributary of Krishna River. It collects water from the western and central part of Khanapur and Tasgaon tahsil. It flows north to south in a valley flanked by the Vardhangad-Machchhindragad range on the right and by Mahimangad-Panahala range on the left. The most west bank tributary of Yerala, the Nani Nadi, has a course some what parallel to the Vardhangad-Machchhindragad range draining the western parts. Sonhira stream is another west bank tributary of the Yerala Following eastwards.

iii. The River Agarani:

The river Agarani rises above Balvadi in Khanapur plateau and flows 3.29 kms. east of Khanapur, deeply incised in the plateau. The narrow valley bottoms of this river and its incised tributaries are the only areas of fertile soils with facilities for well irrigation in the other side barren plateau areas. The east bank tributaries of Agarani river have cut down relatively broader valleys and hence, there is a greater intensity of agriculture and the valley are consequently larger and more frequent to the east of the river than to the west.

iv. The River Man:

The river Man has only about 18 kms. of its course within and on the border of the Sangli District. But along with its tributaries, it is responsible for draining the north eastern parts of Khanapur and Miraj talukas and the northern part of Jath taluka into Bhima River. The Mhaswad canal created on Man just before its entry into the district provides irrigation facilities to the east of the river in Khanapur taluka. To the west of the river are a number of tributaries draining the slopes of Khanapur plateau eastwards.

v. The River Bor :

The Bor River is principally drained in the eastern part of Jath taluka with its tributaries of Dodda and Darai. These tributaries turn northwards towards Bhima River. The river Bor rises on the northern slopes of the water divide about 4.8 kms. to the northeast of Jath where it is known as ‘Don’.

DZSD

Drainage Pattern

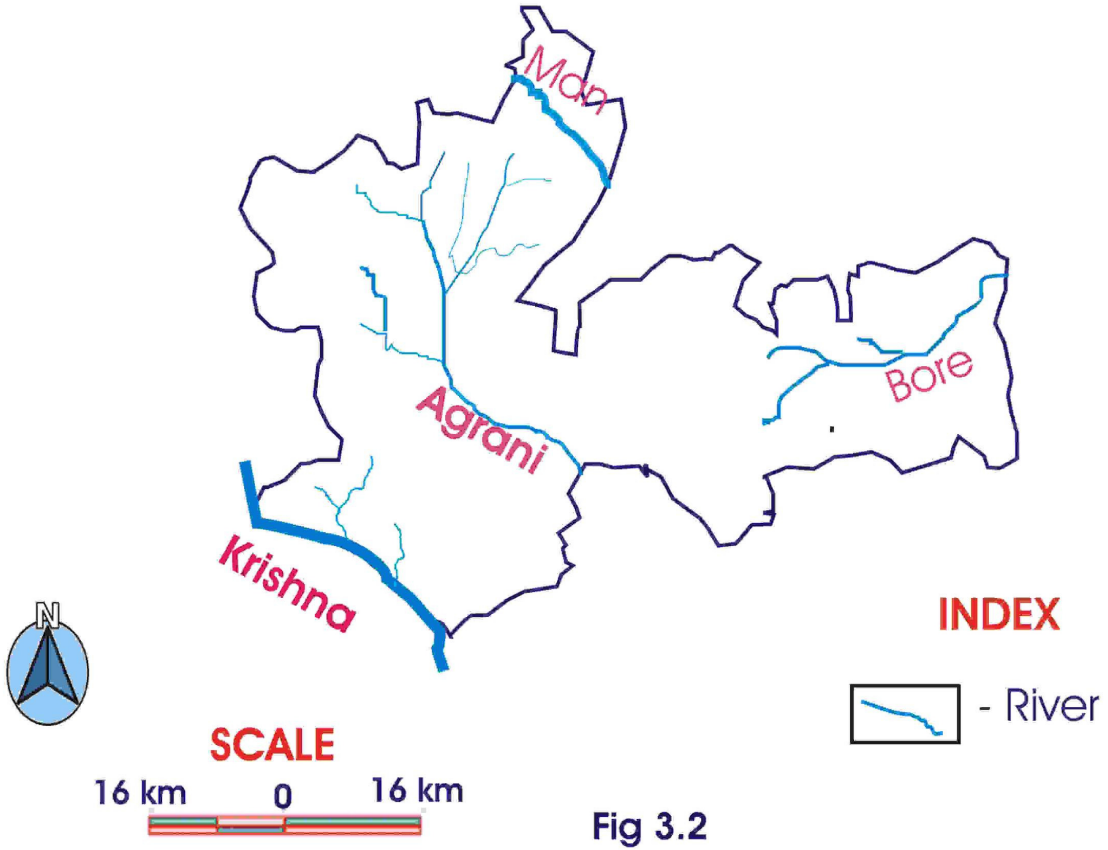


Fig 3.2

3.2. D. Soil

Agriculture depends on soil to a great extent. The size of soil in particular determines the soil texture and arrangement of soil particles refers to the structure of soil. The land suitability of crops depends largely on these physical characteristics of soil .The availability of moisture in the land or the immediate absorption of water, the wide extension of roots and aeration and maintenance of naturisms of plants are the charactertics of soil. The physical characteristics are related to the structure, texture, colors of the soil and temperature of the soil .The chemical characteristics are also of great importance and the fertility of the soil to a large extent depends on its chemical structure.

Soil formations in DZSD have been predominantly influenced by the climate. The transition zone of Krishna valley has deep black soils of alluvial origin. The eastern drier zone, which consists largely of granular black soils and poor shallow soils. Saline-alkaline soils are met with in the low-lying patches in the areas of low rainfall. Therefore, soil of DZSD can be classified as following.

i. Shallow Soil

The area of shallow soil is about 60 percent of the total area of DZSD, however there is tahsilwise variation in distribution of shallow soils. These soils are redish brown colour and are found in the central, southern parts of Khanapur tahsil and west central part of Jath tahsil. These soils are poor in structure and texture. It is known as 'Murum soil'. The lime content in these soils is comparatively more than the black soil.

ii. Medium Deep Soil

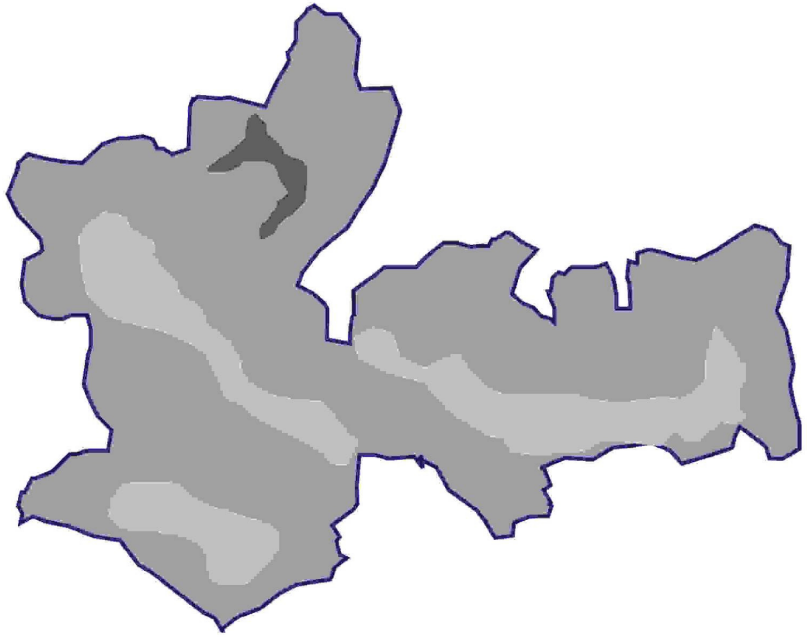
This soil has black to dark brown colour. The medium soils of dark brown colour are found in the eastern part of Miraj tahsil, the western and northern part of Kavathemahankal tahsil, the western and the central part of Jath tahsil, the eastern part of Khanapur tahsil, the western and north eastern part of Atpadi tahsil. The medium soil of black colour is found in the southern and central part of Atpadi tahsil, the central part of K.Mahankal tahsil and eastern part of Jath tahsil.

iii. **Deep Soil**

The deep soils are of black to dark brown colour and these are found along the major rivers and *nalas*. The adjoining areas of the rivers Yerala, Agarani, Man and

Dry Zone Area of Sangli District

Soil





SCALE

16 km 0 16 km



INDEX

- Shallow Soil
- Medium Soil
- Deep Soil

Fig. 3.3

Bor are occupied by these soils. The advantages of these black and medium soils contain high alumina and carbonates of calcium and magnesium with variable amount of potash and low nitrogen and phosphorus. The soil is generally porous and swells considerably on addition of water and dries with cracks on losing moisture, the soil close to the rivers and *nalas* are very fertile due to high humus content.

3.2. E. Climate

Among physical factors, climate is a quite significant determinant for the agriculture land use and agriculture pattern of the region. Climate consists of temperature, rainfall, humidity, sunshine, fog, mist, snow, hailstorm, winds and air pressure. These always exists a significant relationship between climate and crops because of limits imposed on crop growth by existing board natural climate conditions which determine the pattern of farm activity and crop production.

The climate of the DZSD is on the whole agreeable and is characterized by general dryness except during monsoon season .The year climate is mainly divided into four seasons. The cold season from December to middle of February, followed by the summer season lasting up to the end of May, the South West monsoon season from June to September and the post –monsoon seasonS or retreating monsoon season in October and November.

3.2. E. i. Temperature

For the growth of crops there is a limit in temperature and if any crop crosses that limit, it can not be grown in that region. Each crop plant needs a certain number of effective heat units for germinating, thriving, stalking, maturing and ripening. This is called the thermal constant and it varies from crop to crop.

Temperature is a very important factor of climate. Sangli district is located in drought prone area and hot tropical region. So the temperature of the district is hot and high. The cold weather commences towards the end of November when temperature begins to decrease rapidly. December is the coldest month with daily maximum temperature about 28ºc and the mean daily minimum temperature at about 12.8ºc.

The heat during summer [April to May] is intense and maximum temperature sometimes goes up to about 38ºc. Afternoon thunder shower which occurs some days during brings welcome relief through temperately with onset of the South East

monsoon in the district early in June. There is an approachable drop in temperature with the early withdrawal of the monsoon.

In rainy season monthly maximum temperature for Jun is 34.4ºc. Towards the end of September, temperature again increases slightly. In October high increase in the temperature occurs, which is called as "October heat", but temperature of night steadily decreases.

Table 3.1

Mean Monthly Minimum and Maximum Temperature [2009-10]

Sr. No.	Month	Maximum temperature in ºc	Minimum temperature in º c
1	January	**29.1**	**14.1**
2	February	**32.4**	**18.6**
3	March	**36.5**	**19.4**
4	April	**38.5**	**22.4**
5	May	**36.3**	**22.7**
6	Jun	**34.4**	**23.5**
7	July	**29.0**	**22.4**
8	August	**30.5**	**21.9**
9	September	**29.0**	**20.6**
10	October	**31.3**	**20.8**
11	November	**30.3**	**16.2**
12	December	**28.0**	**12.8**
	Average	**32.4**	**20.6**

Source:- Socio-Economic Abstract of Sangli District [2010]

In cold season maximum temperature ranges from 28ºc to 30ºc. December and January are coldest month of the year with minimum temperature of 12.8 ºc and 16.2 ºc.

The percentage of humidity at 8.30 hrs. varies from 44 percent in March to 78 percent in August. Similarly, the percentage of humidity at 17.30 hrs. varies from 18 percent in April to 89 percent in July.

DZSD

Mean Monthly Minimum and Maximum Temperature (2009-10)

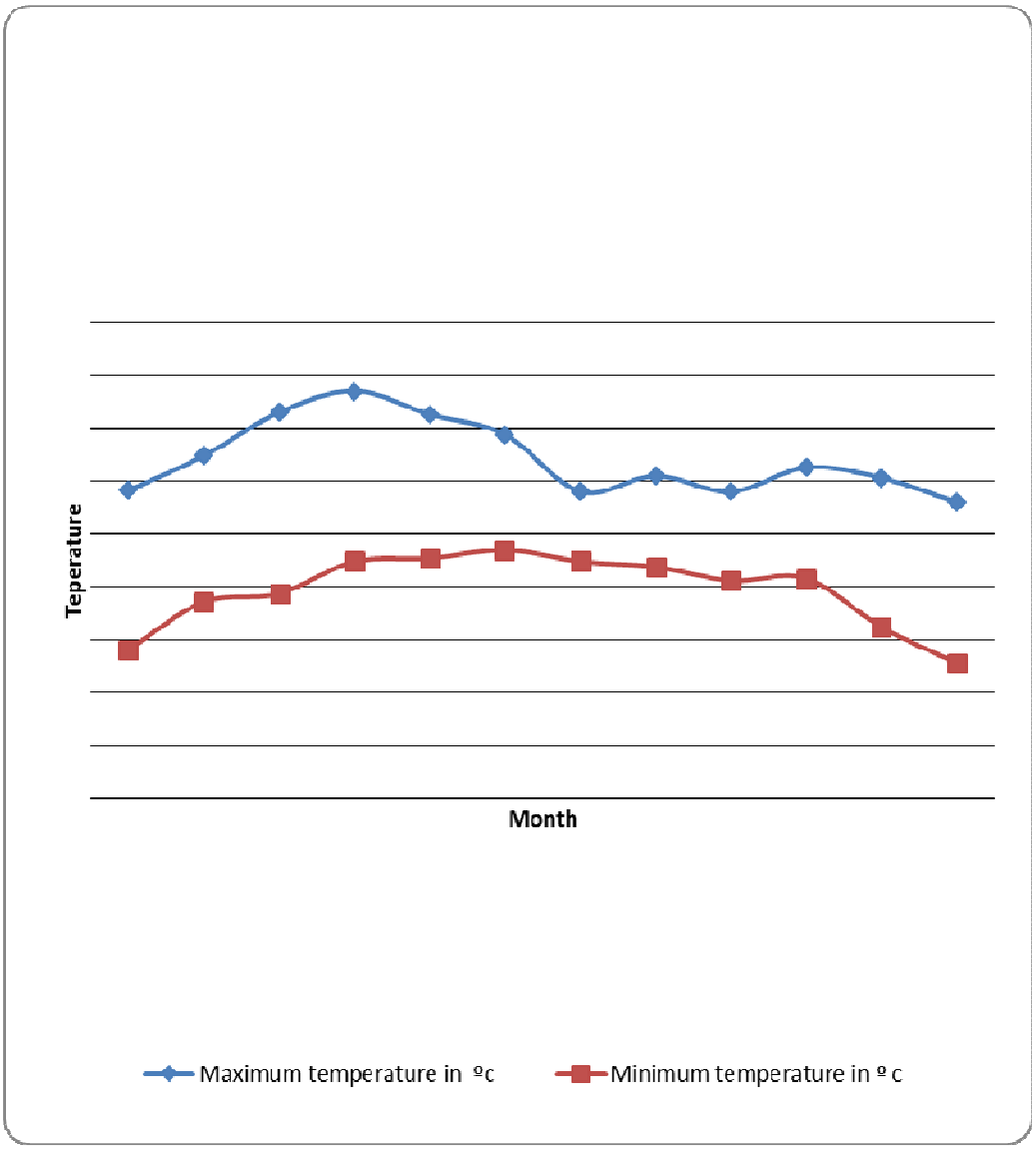


Fig. 3.4

3.2. E.II. Rainfall

Rainfall as the primary ecological parameter has created a variety of farming enterprises types or systems of agriculture. It is the dominant single weather element influencing the intensity and location of farming system and the farmer's choice of enterprises. The amount of rainfall is determined the necessity of irrigation. Rainfall is a basic factor in all crop producing areas, normal rainfall is generally necessary for successful crop production

a. Spatial Distribution of Rainfall

It may be said that rainfall is the most important climatic factor, as it determines the potential of any region in terms of crops to be raised. The necessity and feasibility of irrigation are determined by the degree of evapo-transpiration and the characteristics of rainfall. Where rainfall is confined to a particular period or when a short rainy season is succeeded by along dry season, soil moisture gets rapidly depleted by high rates of evaporation.

Table 3.2
DZSD: Distribution of Annual Rainfall and Rainy day

Sr. No.	Tahsil	Rainfall mm	Rainy days	Intensity of Rainfall	Co-efficient of variation
1	Khanapur	581.70	29	20.06	100.24
2	Atpadi	565.70	24	23.57	97.48
3	Tasgaon	597.40	27	22.13	102.94
4	Miraj	629.20	28	22.47	108.42
5	K. Mahankal	549.70	30	18.32	94.72
6	Jath	558.30	30	18.61	96.20
	Total DZSD	580.33	28	20.72	-

Source: Socio-economic Abstract of Sangli District. [2010]

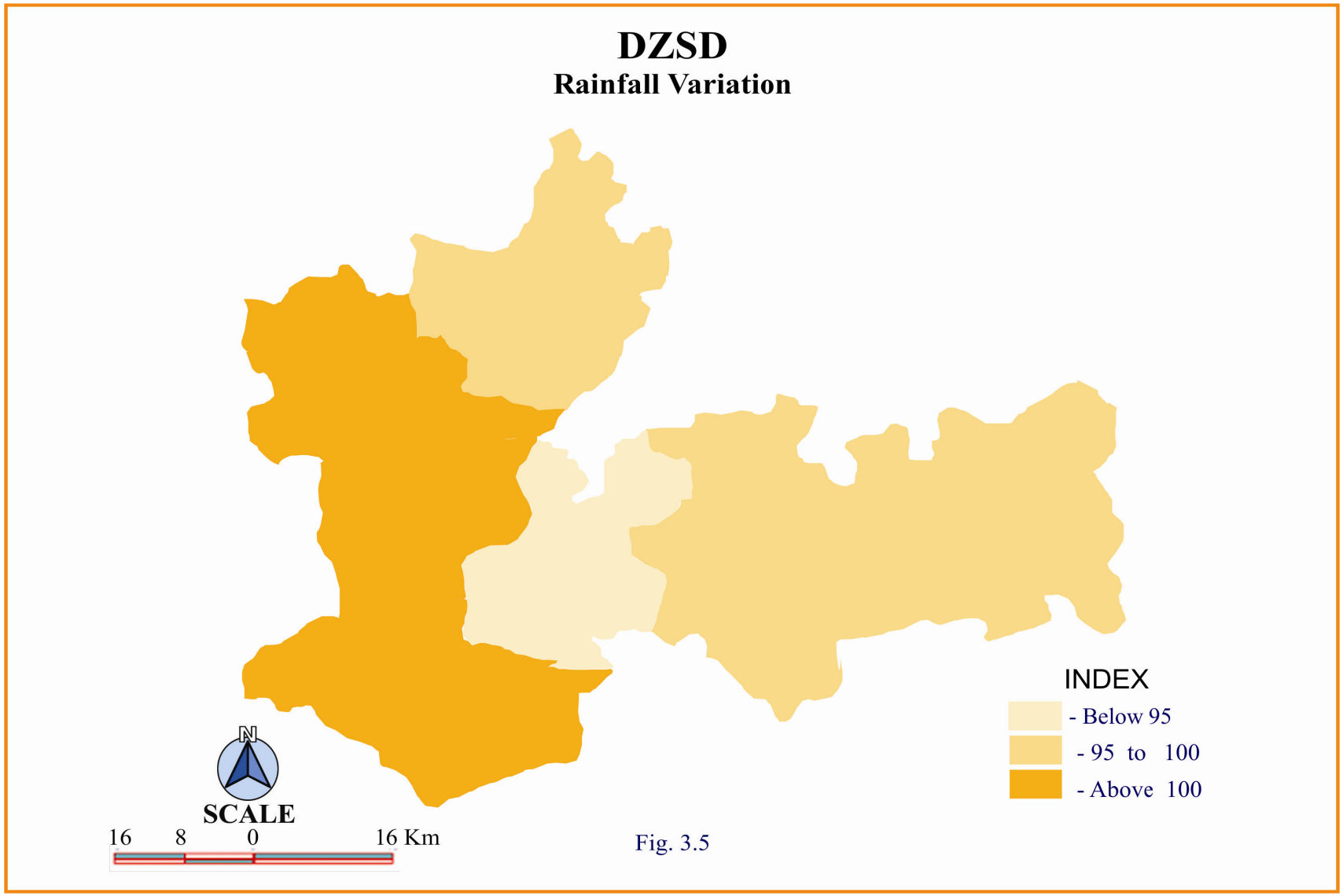

DZSD
Rainfall Variation
INDEX
- Below 95
- 95 to 100
- Above 100
N
SCALE
16 8 0 16 Km

Fig. 3.5

The average annual rainfall in the DZSD is 580.33 mm. Highest number of rainy days are recorded at K.Mahankal and Jath tahsils in 2010 and against low rainy days are found is Tasgaon and Atpadi tahsils in same period (Fig 3.5).An increase or decrease in the number of rainy days in an area depends on forest and coverage by crops. The spatial rainfall distribution is represented with help of intensity of rainfall and the variation of rainfall.

Rainfall intensity:

The term intensity is used in the context of rainfall received during 24 hours period. It is important as it determines the intensity of soil erosion. Moreover, the intensity of rainfall determines the water regime and thereby irrigation potentials of the region. It is calculated by using following formula.

$$\text{Intensity of rainfall} = \frac{\text{Rainfall in mm}}{\text{Rainy Days}}$$

The average intensity of rainfall is 20.72 in DZSD that is very low compare to the other tahsils of Maharashtra state. Intensity of rainfall is very high which is found in Atpadi tahsils that is 23.57 and very low intensity is in the K.Mahankal tahsils that is 18.32.

Rainfall Variation

The coefficient of variation is very useful to measure dispersion. The variation in rainfall characteristic affects agriculture as a whole; therefore, there is need to investigate. Hence, with this technique the tahsil wise comparison in respect of annual rainfall is attempted here. For the measurement of rainfall variation the following statistical equation is used.

$$\text{Rainfall variation} = \frac{\text{Average annual rainfall in 'a' particular unit}}{\text{Average annual rainfall in whole region}} \times 100$$

Table 3.2 shows the spatial variation is rainfall in the study area, which is very remarkable. It has been observed that rainfall has gradually irregular and uneven in DZSD. The highest (above 100) coefficient of rainfall variation is observed in western part and lowest (below 100) in eastern part of DZSD.

b) Seasonal Distribution of Rainfall

The necessity of rainfall arises when the distribution of rainfall is unequal in time and space though for the better growth of crop timely and adequate water supply

is significant. Table 3.2 shows the temporal variation is rainfall in the study area, which is very remarkable. In view of the fluctuations accruing in rainfall, the year can conveniently be divided into seasons.

i. Monsoon Period: (June to September)

The period of this season is from June to September. During this season study region as whole receives about 80.93 percent of the annual total rainfall. The rainfall is heavy, mostly assured and very much useful for Kharif crops. Successful cultivation of about ¾ of the cultivated land depends on the adequacy of these rains. The intensity of rainfall during

the season is important in the context of water availability for irrigation in

the following seasons.

ii. Post-Monsoon Season (October to November):

This period is climatically transitional during this season district as whole received about 9.96 percent of the annual total rainfall.

3.3. Demographic profile of the region

Man is most active element in the process of agricultural development, particularly in technological field i.e. irrigation, HYV seed etc. Natural resources like soil, water etc. cannot develop by themselves. Natural resources get modified based on the need of the population. Population growth and literacy are responsible for bringing changes in agriculture. These exist best in each other company, hunger make men willing to work and new ideas give them incentive for action. The physical attributes of an area become resources, only when its people are able to use them. Whether to accept and apply irrigation methods to develop agriculture is decision making factor of the man, who practices agriculture. There is close relationship between population and landuse. The huge concentration of population in rural area as like in India, confirms deep rooted relationship between people and natural resources. Overall, irrigation development depend both physical and demographic factors of the region. Because agriculture is affected by climate, but 55 ultimately it is outcome of human effects; though man's role is irrigation is great importance.

3.3. A. Population Growth

The population growth is instrumental in bringing about agricultural change in an agrarian society. The trend of growth of population indicates gradual increase in total population, while decadal growth rate gives a different picture. The growth of

population in an area is determined by three basic factors namely births, deaths and migration (in migration or out migration). The difference between births and deaths is called natural increase in population. For this purpose of analysis total population growth is considered:

$$PGR = \frac{P2 - P1}{P1} \times 100$$

Where_

PGR = Population Growth Rate

P2 = Population of Current Year

P1 = Population of Previous Year

Table 3.3
DZSD: Population Growth Rate

Sr	Tahsil	Year 1981	percent	Year 2001	percent	Change	percent
1	Khanapur	271958	18.7	298317	13.9	+26389	+9.69
2	Atpadi	84016	5.80	125265	5.8	+41249	+49.1
3	Tasgaon	300597	20.7	533608	24.9	+233011	+77.5
4	Miraj	506320	34.8	756048	35.3	+249728	+49.3
5	K. Mahankal	97274	6.7	144596	6.80	+47322	+48.6
6	Jath	193096	13.3	283950	13.3	+90854	+47.1
	Total DPAS	1453261	100	2141782	100	+688521	+47.4

Source : Socio-economic abstract of Sangli District 1989, 2009.

The table no 3.3 gives the population of DZSD and it's variation in each tahsil. The population of DZSD is 688521 persons according to 2001 census. The spatial distribution of study area is uneven. The highest population is observed in Miraj (35.3percent) and followed by Tasgaon tahsil (24.9percent). The lowest population is located in Miraj tahsil (5.8percent). The population of DZSD increased from 1453261 in 1981 to 2141782 in 2001 giving growth of 47.4 percent during investigation period. Regarding the growth of talukas, there are also significant differences in the rates of growth of population in various talukas. Highest growth rate (77.5percent) is observed in Tasgaon tahsil due to the agriculture development and lowest growth rate

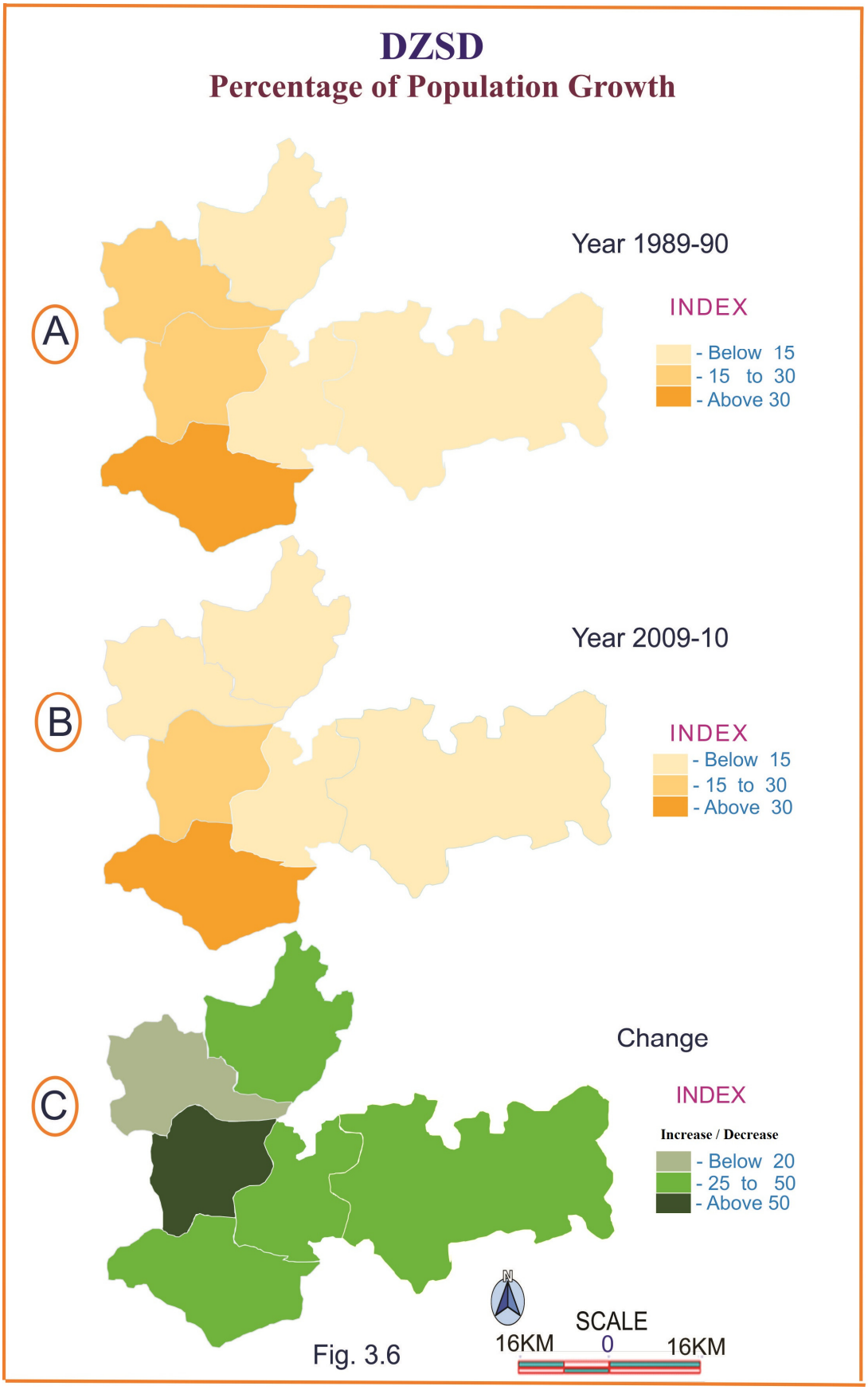

DZSD
Percentage of Population Growth
A
Year 1989-90
INDEX
- Below 15
- 15 to 30
- Above 30
B
Year 2009-10
INDEX
- Below 15
- 15 to 30
- Above 30
C
Change
INDEX
Increase / Decrease
- Below 20
- 25 to 50
- Above 50
N
SCALE
16KM 0 16KM

Fig. 3.6

(9.69 percent) due to the drought and the huge migration towards the town for employment.

B. Literacy

The term literacy is one of the very significant qualitative indictors of social development associated to the economic development. Even today education is the most intrisinsic instrument for changing the socio-economic status of an individual and society as a whole. According to the Indian census, "A person who can both read and write with understanding in any language has been taken as a literate". Literacy is necessary for all those who wish to practice the agricultural occupation on modern lines. Literacy is the main factors to develop the agriculture. Literacy and population growth are the two factors which bring about a change in agricultural. Without literacy we can't imagine the agriculture development.

Table 3.4
DZSD: Rural and Urban literacy

Sr. No.	Tahsil	Percentage of Literacy		
		Total	Urban	Rural
1	Khanapur	65.93	72.07	63.81
2	Atpadi	66.40	-	66.40
3	Tasgaon	67.67	83.80	66.80
4	Miraj	82.10	84.80	77.70
5	K. Mahankal	73.00	-	73.00
6	Jath	63.00	-	63.00
	Total DZSD	69.68	80.22	68.45

Source : Socio-economic abstract of Sangli District 2009.

It is noticed from the Table 3.4 and Fig 3.7 that the study region is 69.68 percent as a whole, the literacy rate for urban (80.22 percent) is substantially higher compared to rural area (69.68 percent). The tahsilwise breakup shows that Miraj tahsil with 82.10 percent literacy top the list, while Jath tahsil with 63.00 percent stands at the bottom. Urban literacy rates are low (80.22 percent) in only Khanapur tahsil compare to the region's average. Rural literacy rates are also low in four of six tahsils.

DZSD

Population Literacy (2009-10)

(In Percent)

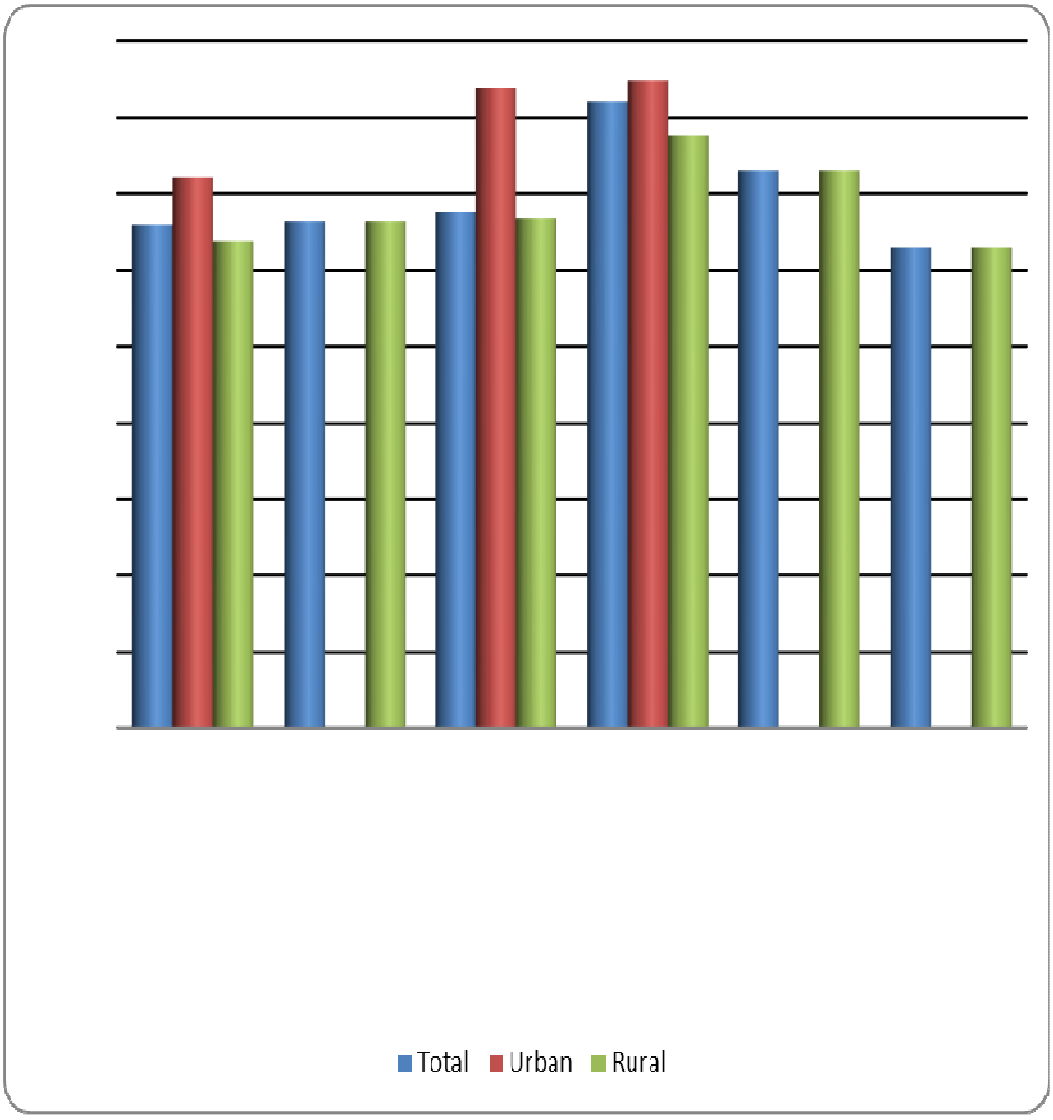


Fig. – 3.7

C. Population Density

Population density has been studied in order to understand the regional variations in the population density and its influence on agricultural landuse. The population density values were calculated as ratio of total population to total area. The average density of population is expressed as a number of people per sq.km. The distribution of population is uneven and mostly influenced by the Physiography and agricultural pattern of the area.

Table - 3.5
DZSD: Population Density

Sr.	Tahsil	Area in sq.km	Population	Population Density (per sq. km)
1	Khanapur	744.32	162963	219
2	Atpadi	830.26	125265	151
3	Tasgaon	958.80	533608	557
4	Miraj	926.10	756048	816
5	K. Mahankal	934.06	144596	155
6	Jath	2196.05	283950	129
	Total DZSD	6589.59	2141782	325

Source : Socio-economic abstract of Sangli District 2009.

According to 2001 census the DZSD has the total population is 2141782 persons and average population density is 325 persons per sq. km. The highest (816 person) population density is observed in Miraj taluka. The main reason of high density in this tahsil because of Sangli, Miraj and Kupwad cities are located. The moderate density (557 person) observed in Tasgaon tahsil. This tahsil agriculture is well developed due to the available of irrigation facilities. The lowest (129 person) population density is observeded in Jath Tahsil. Remaining tahsil of DZSD has observed low (below 300 person) population density. The main cause of low density is this region is drought prone, no irrigation facilities available, no agro-based industries, however the migration trends toward the cities is large.

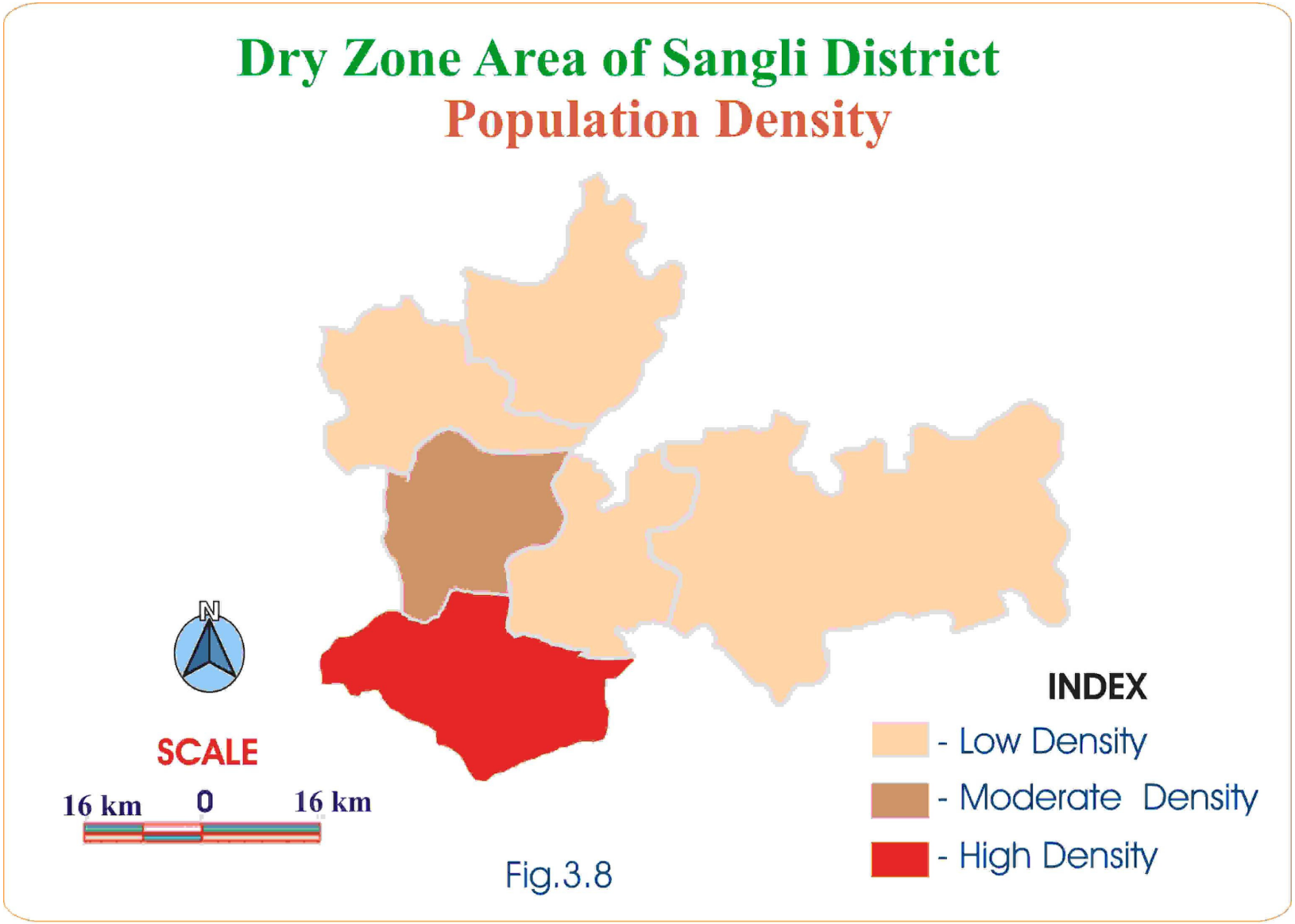

Dry Zone Area of Sangli District
Population Density
N
SCALE
16 km 0 16 km
INDEX
- Low Density
- Moderate Density
- High Density

Fig.3.8

A. Agriculture Density

Another interesting ratio between man and land, which gives clearer picture regarding pressure of population on land, is agricultural density. The sum of cultivators and farm workers are taken as an agricultural population of the region. The ratio of agricultural population and area under agriculture is called as agricultural density. This gives a clearer and relative realistic picture of the pressure of population on land. The study of Agricultural density is necessary for agricultural development. The study of agricultural density pattern is necessary. That is measured by using the following statistical equation.

$$\text{Agriculture Density} = \frac{\text{Cultivators + Farm Workers}}{\text{Agriculture Area}}$$

Table -3.6
DZSD: Agriculture Density

Sr. No.	Tahsil	Area in sq.km	Cultivators	Agri. Labours	Agriculture Density per Sq.km.
1	Khanapur	744.32	36797	13384	69
2	Atpadi	830.26	25841	8781	42
3	Tasgaon	958.80	54532	21539	79
4	Miraj	926.10	51677	36028	95
5	K. Mahankal	934.06	33584	10381	47
6	Jath	2196.05	70298	21473	42
	Total DZSD	6589.59	272729	111586	58

Source : Socio-economic abstract of Sangli District 2009.

Table 3.6 shows that the high cultivators are observed in Jath tahsil and lowest in Atpadi Tahsil. But the high agricultural labour is consisted in Miraj tahsil and lowest in Atpadi tahsil. In the region under study, the population is largely depend on agriculture.

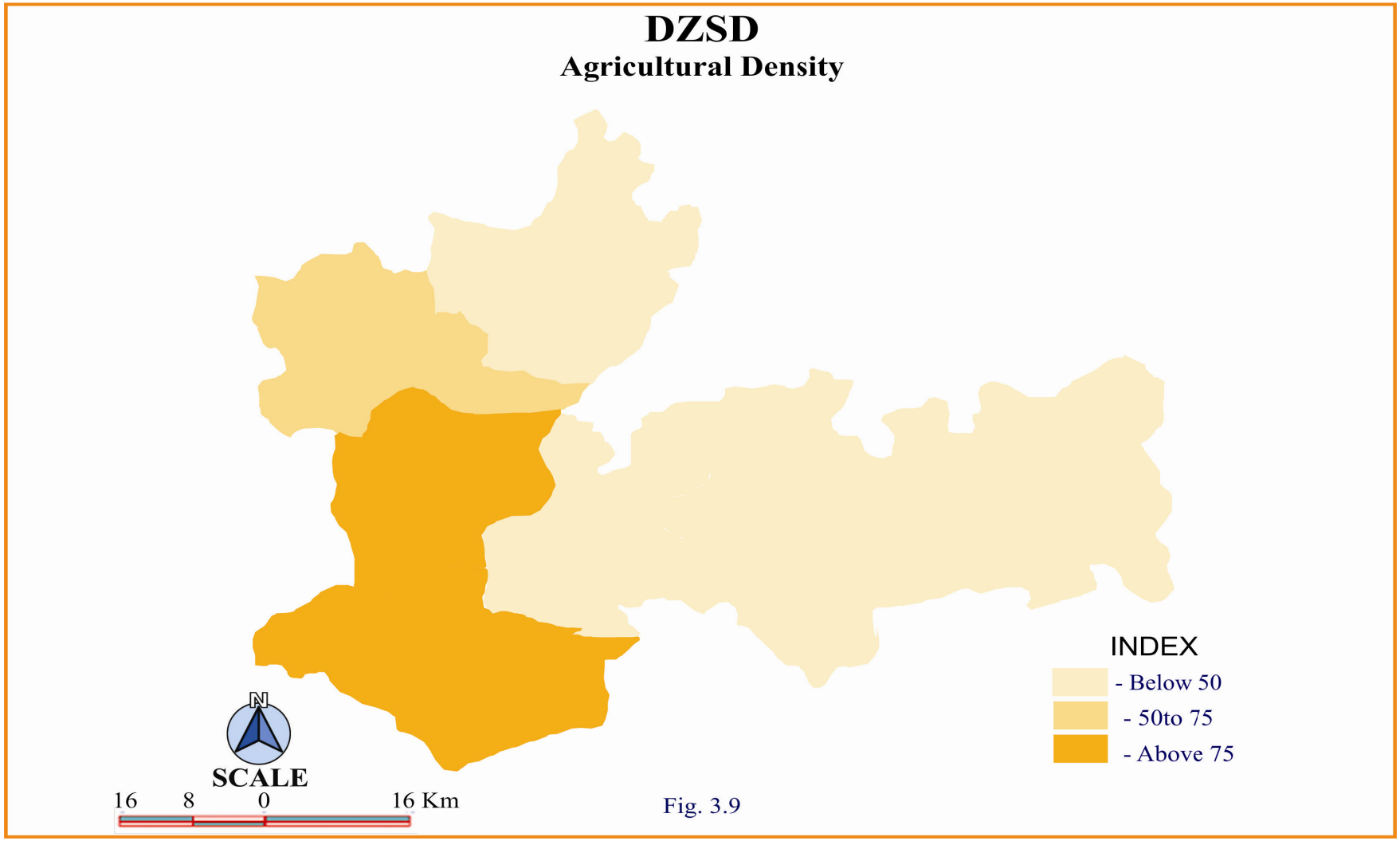

DZSD
Agricultural Density
INDEX
- Below 50
- 50to 75
- Above 75
N
SCALE
16 8 0 16 Km

Fig. 3.9

For the year 2001, the average agricultural density in the region is 58 persons per sq. km. The Miraj tahsil represents the highest value of agricultural density due to relatively high percentage of people engaged in the cultivation. The regions which show higher agricultural density than the region average are Tasgaon and Khanapur tahsils. This clearly shows that in such tahsils, the ratio between man and land is higher due to enough availability of land for agriculture. Besides, the region showing lower agricultural density than the region average, where the proportion of the agricultural land due to physical constraint is relatively low, such tahsils are namely Atpadi, Jath and K.Mahankal tahsil. In such regions, the proportion of waste land and in other category of land is higher which is not suitable for cultivation. Hence, the ratio of agricultural land is lower than the district average.

E. Population pressure on Agriculture land

The agriculture landuse is largely connected with rural population whose livelihood is depending on agriculture. It constitutes a much larger proportion of the total population. As such it is now proposed to examine the pressure of population on agriculture land. For it is felt that the only way to meet the increasing burden of population seems to be the adjustment and readjustment of land.

For measuring the actual pressure of population on agricultural land the relative co-efficient of over population is computed by taking in to consideration the standard hectare i.e. namely 0.4047 hectare suggested by author of Swaminathan and quoted by "Limits of Growth" (1974). Using these criteria the unit 0.4047 of hectare is divided by per hectare land. The use of quotient obtained gives the relative co-efficient of over population. Thus, the greater the co-efficient value, the higher pressure of population on agriculture land.

Table- 3.7
DZSD: Population Pressure on Agriculture Land

Sr . No.	Tahsil	Agriculture land(Hect.)	Rural Population	Per capita land (Hect)	Relative coefficient of over population
1	Khanapur	87342	121139	0.72	1.80
2	Atpadi	61274	125263	0.49	1.23
3	Tasgaon	79786	199101	0.40	1.00
4	Miraj	73737	293546	0.25	0.63
5	K. Mahankal	51422	144596	0.35	0.87
6	Jath	188180	283950	0.66	1.65
	Total DZSD	540741	1167595	0.46	1.15

Source : Socio-economic abstract of Sangli District 2009.

The agriculture landuse data and census population of the year 2001 gave the per capita agriculture land in the region. The regions per capita land divided by standard hectares (0.4047 hectare). Therefore, the relative co-efficient of over population is 1.15 in the study region.

The relative co-efficient of over population of talukas is calculated and the region average is 1.15 which is taken as more or less marginal. Table 3.7 shows the relative co-efficient of over population of the talukas in the DZSD. With help of these data, the region can be grouped into three categories viz; high (above 1.5), medium (1- 1.5) and low (below 1) over population. The high over population is observed in Khanapur and Jath tahsil. Followed by Atpadi and Tasgaon tahsil in moderate over population and low over population is in Miraj and K.Mahankal tahsil.

3.3 Socio-economic profile of the Region

A. Irrigation

Irrigation is essential for cultivation and better yield. Especially in drought prone area or in areas where rainfall is uncertain. Farming without irrigation is very limited and if the rainfall decreases to less than 20 c.m., agriculture is impossible without irrigation. (King 1953) Irrigation is practiced from well, rivers, tank etc. Since long time, the type of irrigation is determined by physical features viz. topography, geology and ground water etc. which varies from different parts.

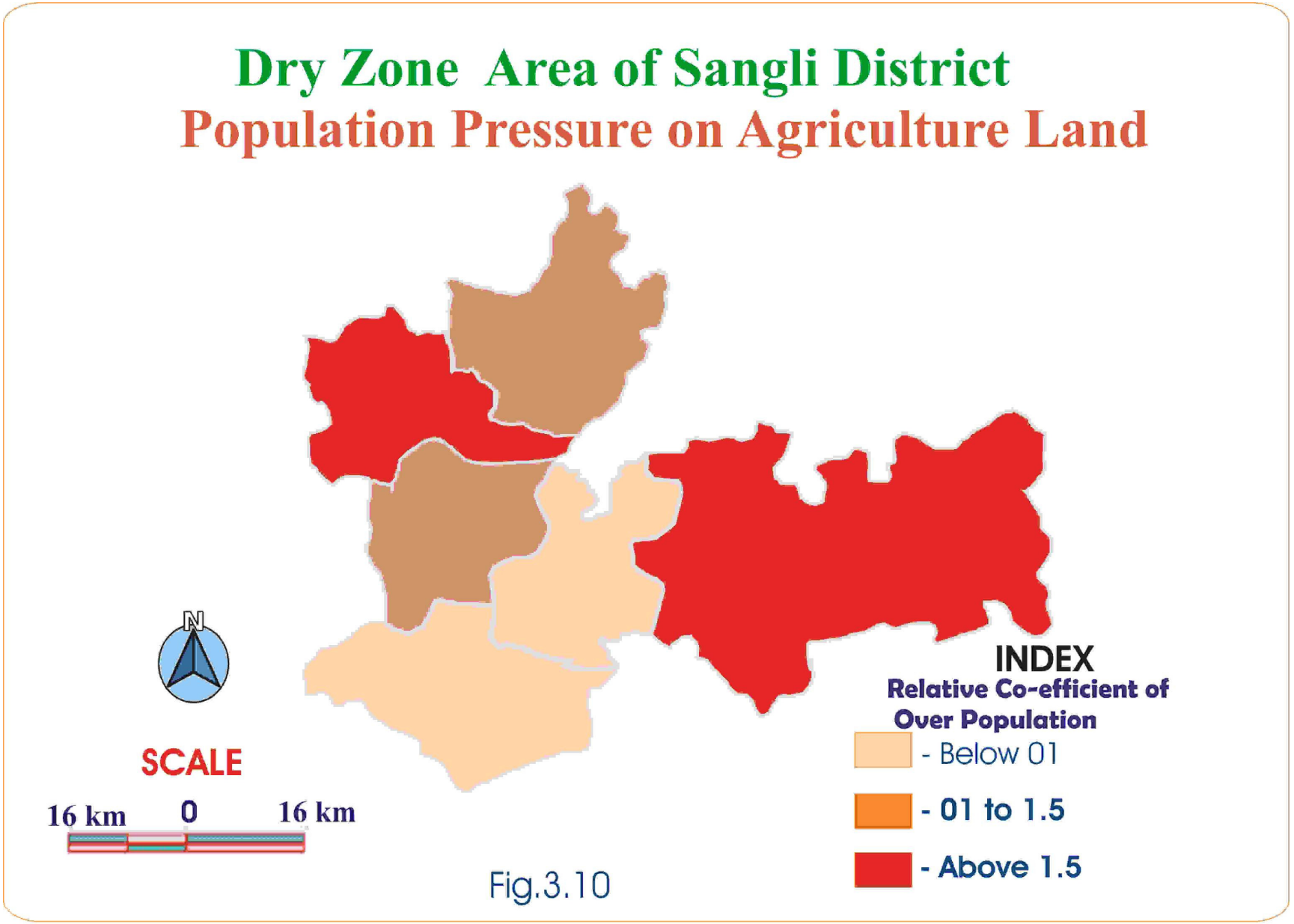

Dry Zone Area of Sangli District
Population Pressure on Agriculture Land
N
SCALE
16 km 0 16 km
INDEX
Relative Co-efficient of
Over Population
- Below 01
- 01 to 1.5
- Above 1.5

Fig.3.10

Sources of Irrigation

Irrigation is key element in the success of farming. The study region has suffered by scanty, erratic, uneven and uncertain rainfall. Therefore, irrigation is essential to ensure stable yields and success of agriculture in the study area. Irrigation facilities in the study region are available through major, medium and minor irrigation projects.

i. Medium Irrigation Projects:

Medium irrigation projects are those which provide irrigation facilities to cultivable areas between 2000 to 10,000 hectares. There are four medium irrigation projects in the study area. Out of two is located in Jath Tahsil and one each in K.Mahankal and Tasgaon tehsil.

Table 3.8
DZSD: Sources of Irrigation

Sr	Tahsil	Medium project	Small project	Percolation tank	KP Dam	Wells
1	Khanapur	00	08	76	15	9226
2	Atpadi	00	12	179	09	2675
3	Tasgaon	01	07	73	22	7910
4	Miraj	00	03	49	07	9294
5	K. Mahankal	01	10	136	18	7100
6	Jath	02	19	276	12	10466
	Total DZSD	04	59	789	83	46671

Source: Socio-economic Abstract of Sangli District 2011.

ii. Minor Irrigation Projects:

An irrigation project which covers less than 2000 hectares as the cultivate command area is called minor irrigation scheme**.** There are 59 minor irrigation projects in the study area. Maximum minor irrigation schemes are in Jath Tahsil (19 projects), Atpadi (12 projects) and minimum (03 projects) in Miraj tahsil.

iii. Percolation Tanks:

The construction of local level percolation tank is indirect irrigation project which helps to increase ground water table. Percolation tanks are very useful for indirect irrigation in drought prone area. More than 789 percolation tanks are registered in study region.

DZSD

Irrigation Sources

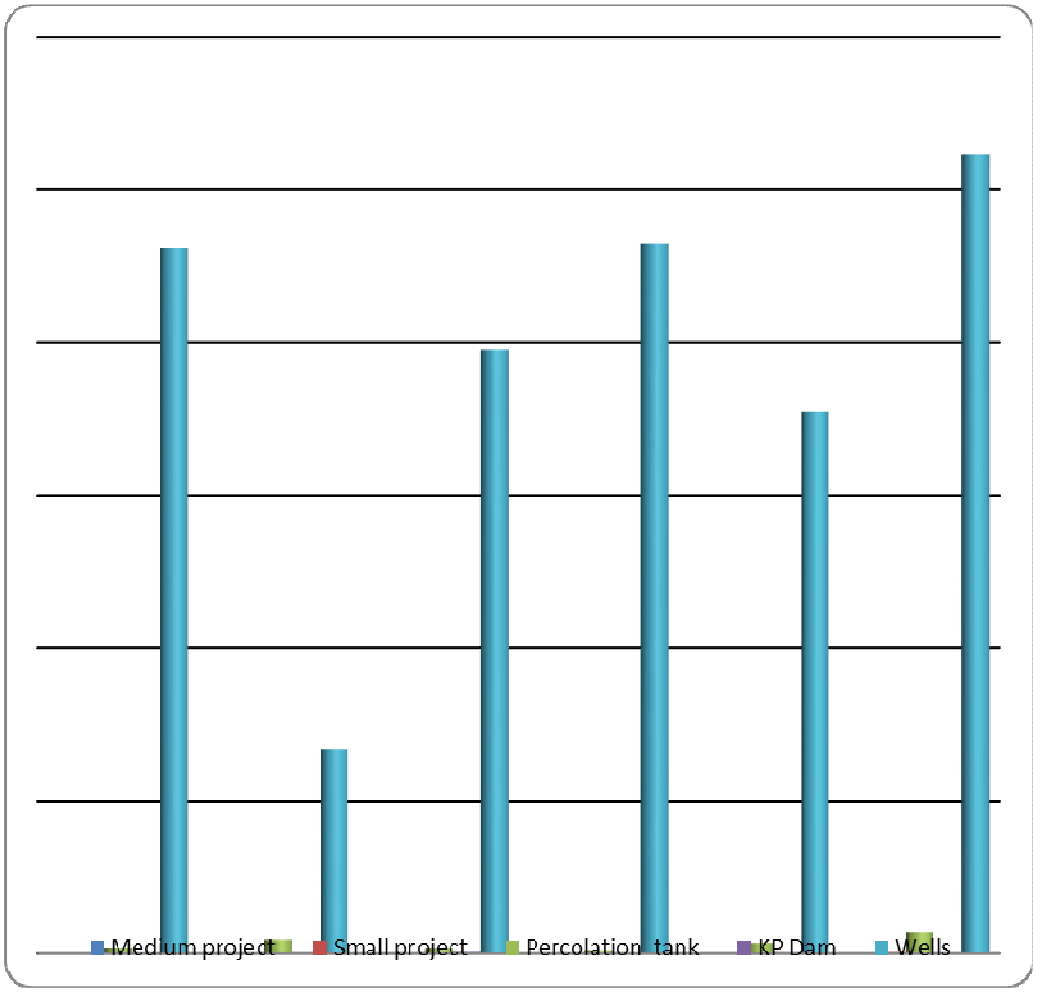


Fig 3.11

Recently state government provide 100 percent subsidy for the construction of percolation tank in the study region. Maximum Percolation tanks are observed in Jath (276), Atpadi (179), K.Mahankal tahsils (136) and minimum (less than 100) in remaining tahsils of the study area.

iv. Kolhapur Types Bandhare:

The construction of local level Kolhapur type bandhare has been introduced in study region in the year 1989. The irrigation potential of this K.T.Bandhare 50 to 100 hectares which are help to increase underground water table of the region. There are 83 K.T.B. observed in study region, mostly K.T.B are observed in Tasgaon (22), K.Mahankal (18), Khanapur Tahsil (15) and minimum in Miraj (07) and Atpadi tahsils (09).

v. Wells

Well irrigation is an important and indigenous method of irrigation. There are about 46671 irrigation wells in study area. The large number of irrigation of well are observe in Miraj Tahsil (9294) and Khanapur Tahsil (9226). The lowest density of well is mainly in Atpadi Tahsil (2675). Generally the water lifting means used in well irrigation in DZSD are motors, mechanical pumps viz. electrical pumps and oil engines.

3.3. B. Agriculture implements

Agriculture implements play a vital role in enhancing the productivity of land. Agriculture implements driven in study region are bullock carts, ploughs, irrigation pumps, sugarcane crushers, tractors and others.

a.Agriculture Plough: It can be seen in table 3.8 that the 24695 wooden ploughed used in DZSD farmers. The spatial distribution is uneven. The high (31.85 percent) wooden ploughed lie in Jath tahsil and low (8.74 percent) in Khanapur tahsil. This is due to subdivision of holding and increase the number of house holds.

b. Bullock Cart: The agriculture implements are subject to constant change an account of changing socio-economic status of farmers and technological change. Carts are more unevenly distributed but they are more in talukas of Jath, K.Mahankal

and Miraj tahsil. Remaining tahsil has observed low bullock carts. There is significant use of carts in the study region.

Table 3. 9
DZSD; Agriculture Implements

Sr. No.	Tahsil	Agri. Plough	Bullock cart	Sugarcane crusher	Irrigation pump	Tractor
1	Khanapur	2160	1755	50	2315	208
	percent	8.74	13.27	7.15	10.29	12.21
2	Atpadi	4537	2395	101	3820	209
	percent	18.37	18.11	14.44	16.98	12.27
3	Tasgaon	2338	1685	07	3643	294
	percent	9.46	7.25	1.00	16.20	17.26
4	Miraj	4333	2249	146	3481	480
	percent	17.54	17.01	20.88	15.48	28.18
5	K. Mahankal	3461	2357	364	5346	195
	percent	14.01	17.83	52.07	23.77	11.45
6	Jath	7866	2777	31	3882	317
	percent	31.85	21.00	4.43	17.26	18.61
	Total DZSD	24695	13218	699	22487	1703

Source :

c.Sugarcane Crusher: It is labor and time saving and more spare time to farmers to look after other farm activities. It is 699 crushers in 2009. Table 3.11 shows the spatial distribution of crusher in study region. The high number of crusher used in K.Mahankal tahsil and low in Tasgaon tahsil.

DZSD

Agriculture Implements

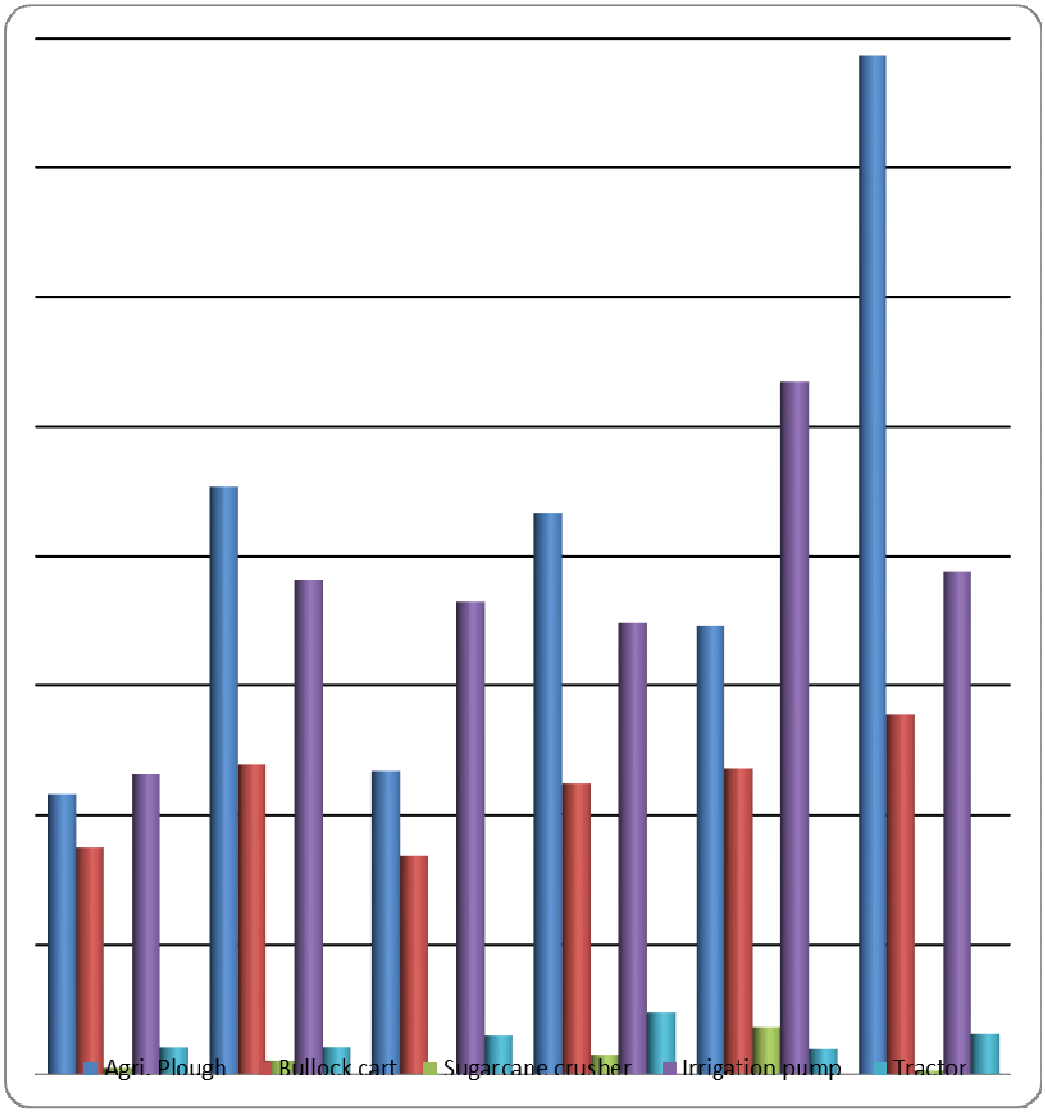


Fig 3.12

d. Irrigation Pump: One of the major technological developments of the post Independence period has been application of mechanical power to agriculture. The two type of irrigation pumps used in DZSD is oil and electronic pumps. There were differences in spatial distribution. The high number of pumps used in K.Mahankal and low in Khanapur tahsil.

e. Tractors: Tractors replaced many implements driven by bullock and other. In the region the use of tractor increased in last some years. In taluka of Miraj the use of tractors is large and in K.Mahankal it is low observed.

3.3. C. Transport network

Transport plays an important role in the growth and distribution of rural and urban settlements as well as in developing the economy and rural- urban interaction. The modes of transport in study region are mainly roads and railways.

Table 3.10
DZSD: Road Transport Network

Sr	Tahsil	State highway	District road	Other	Total	Road per 100 sq.km
1	Khanapur	100.89	127.91	229.66	458.46	101.95
2	Atpadi	64.85	213.40	206.58	484.83	94.53
3	Tasgaon	90.50	198.67	734.15	1023.32	106.73
4	Miraj	153.94	243.97	1224.2	1622.10	175.15
5	K. Mahankal	78.09	253.22	654.30	985.61	134.27
6	Jath	232.61	429.88	662.49	1803.26	82.11
	Total DZSD	720.88	1467.05	3711.38	6377.58	
	percent	11.30	23.00	58.19	100	-

Source : Socioeconomic Abstract of Sangli District-2009.

i. Roads:

Road is important means of transportation for the social and economic development in a particular region. Unlike railway, roads provide door to door services. In terms of road transportation, the DZSD is better off, since it has total length of 6377.58 km. Out of this, 720.88 km. (11.30 percent) roads are major state highway. Apart from this, the major district roads have the length of 1467.05 (23 percent) km. while other roads occupy 3711.38 km. (58.19 percent). The village roads comparatively have a large sizeable length in kilometers which means district connecting all the villages in the district.

Spatial distribution of road network is uneven in DZSD. The state highway is highest in Jath (232.61 km) and lowest in Atpadi tahsil (64.85 Km). The district road is also as high as in Jath tahsil and lowest in Tasgaon tahsil. But, the other roads are more in Miraj tahsil and lowest in Atpadi tahsil. The road density means length of road per sq. km in a region. The highest road density per 100 km is highest in Miraj tahsil (175.15 km) and lowest in Atpadi tahsil (82.11 km).

ii. Railway

Railway network is fast and guaranteed mode of transport. It is huge capacity mode transport. The development of region is also depend on transport network as well as railway network. The broad-gauge railway type is observed in study region. Miraj is very important railway junction which connect kokan or coastal area of arebian sea, southern india, north india, eastern part of Maharashtra state. The total length of railway network in study area is 96. This railway network available in some part of three tahsils.

Dry Zone Area of Sangli District

Transport Network

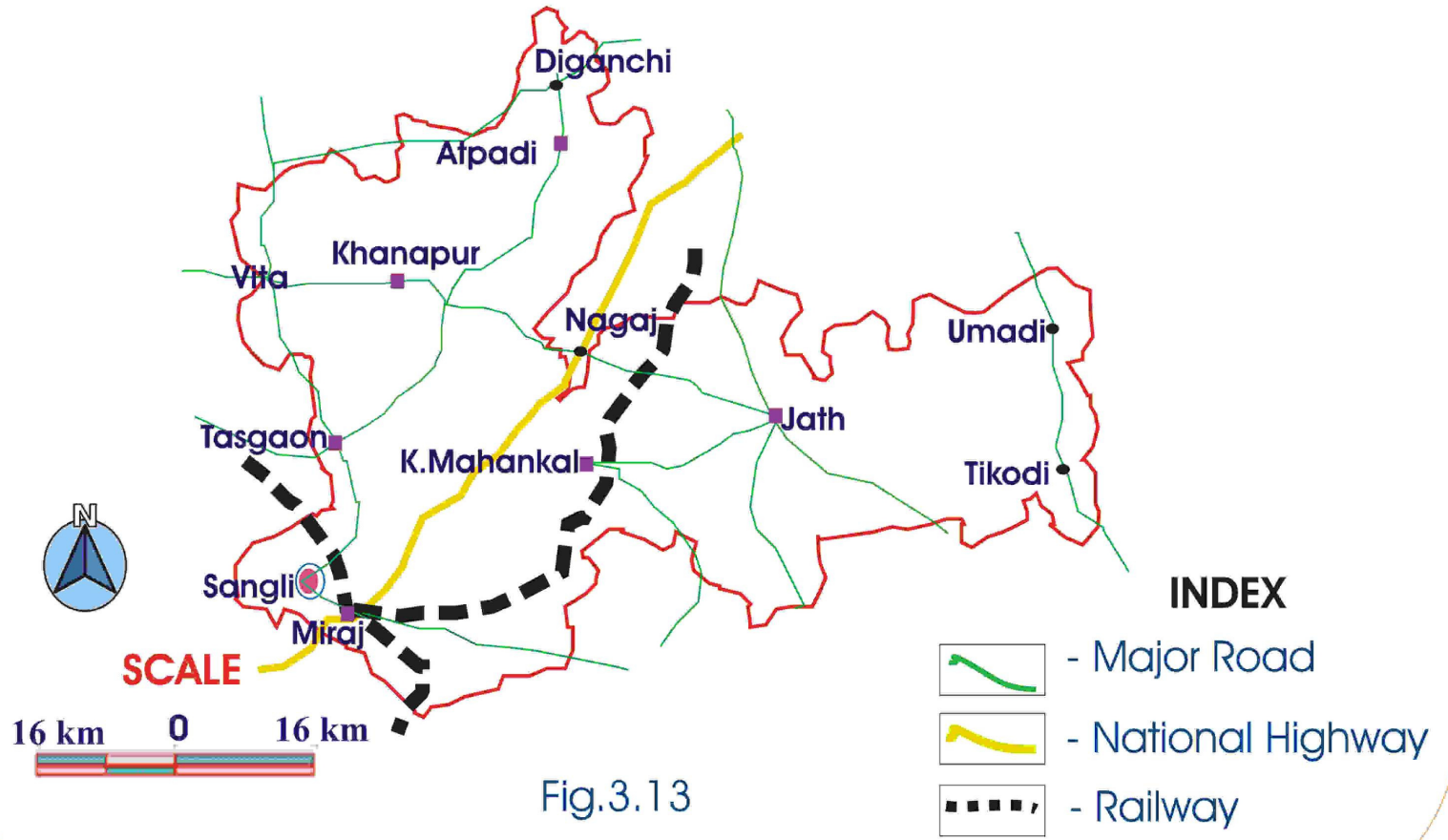


Fig.3.13

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CHAPTER – IV
LANDUSE

4. 1 Introduction

In the present chapter study has been made to analyze and interpret general landuse and cropping pattern of the study area. In human life every inch of land is very important, because land is a basic natural resource of human society. Every development depends upon land resources. In India worlds 2.4% land is available and 16% of the world's population has been living in our country. It is a totally imbalanced distribution, so every inch of land should be used for any purpose with a proper way. Its utilization shows a reciprocal relationship between the prevailing ecological condition of a particular region and man. Land-use is the surface utilization of all developed and vacant land on specific point, at a given time and space. As a matter of fact geography deals with the spatial relationship between this aspect and planning. This is because the land-use changes to meet the variable demand for the land by the society in its new ways and conditions of life. The demand for new uses of land may be inspired by a technological change. Some changes are short lived, whereas, others represent a more constant condition.

4.2 Meaning and importance of Landuse

Geographically, land has been regarded as the specific areas of the Earth surface. It is by far the most important asset of the nation and from the earliest time man has used it to satisfied his multiple needs. Land-use is a primary indicator of the extent and degree to which man has modified the land resources. It is the manifestation of the impact that man has made on ecology, through which the development is insured.

Land-use is the use actually made of any particular use of land; house, apartments and industrial location are land-use categories, whereas the firms, residential, industrial and agricultural refer to the system of land utilization implying roads, neighborhood retail and service activities as well as location of industries and the carrying of agricultural pursuit. In a rural area, tree crops or row crops would identify land-use; whereas herding, truck farming and grazing indicate a system of land utilization. The term 'land utilization' is also used for varied utilization of land

and soil surveys e.g. land under cultivation, pasture, barren, orchard, fallow waste, cultivable waste, settlements, forests and water bodies. According to J. L. Buck "Land Utilization is the satisfaction which farm population derives from the type of agriculture developed the provision for future production and contribution to national needs". While the definition given by Salter is, "land utilization research can be described as dealing with the problem situations in which people in a given locality are in the process of transformation from activities with certain land requirements to activities with different land requirement.

Land-use pattern is a key to understand geographical adjustment of agricultural recourses (Balak Ram and Joshi 1984). Land-use study in its spatial context is essential to understand regionalization of the areas of optimum land-use. (Shinde S. D.) Land-use studies are important as they are aimed to explain the occurrence of different uses in different areas. Land-use in which human efforts are applied to the land resources for the satisfaction of human needs is important. It is essential to understand the variation in the land-use as a human reaction & the satisfaction of human wants.

In shortly, Landuse means use of land for different purpose. It is a combined result of the natural set up and human dynamism within socio economic set up and technological development. Physical limitation of the site finds a direct expression in land-use.

4.3 General Land-Use

Land-use is an important aspect of studies in agricultural geography and for making the study of land-use, it is classified into different categories. The concept of land-use has been used in so many ways that no generally accepted scheme of classification exists, despite many years of land-use studies by geographers. In most of such schemes, activity on the land has been the major criterion for classifying land-use which is an essential qualitative rather than quantitative variable. Several scholars have used the concept in many ways. Therefore, there is no generally accepted scheme of quantitative rather than qualitative variables. Land classification is based largely on quantity and intensity of the use of land (Ali Mohammad 1978). Census of India has classified land utilization in nine different categories, but in the present study they have been grouped into five major relatively significant categories. ,

General Land-use Classification

Nine Fold Classification	*Five Fold Grouped Classification*
1. Forest	1. Forest
2. Land put to Non-agricultural uses	2. Non- agricultural Land
3. Barren Land uncultivable land	3. Potential Land
4. Permanent Pastures &other Grazing land	4. Fallow land
	5. Cultivated area
5. Miscellaneous tree crops and Groves, not included in the area sown	
6. Cultivable waste	
7. Fallow land, other than Current fallow	
8. Current follows	
9. Net Sown area	

This chapter proposes to examine the general land-use pattern of the district with the help of the area data from the census handbooks of the district. Land-use statistical figurers for the reference period 1990/91 to 2004/05 have been abstracted from the socio-economic review and district statistical abstract, prepared by the Bureau of Economics and Statistics, Government of Maharashtra, Mumbai. Taluka-level statistical figurers have been used for analysing the temporal and Spatial patterns of general land-use and changes there in.

4.3.A. Temporal variations in landuse

Temporal variation means the change in general landuse pattern in a given period of time. The temporal variations in landuse pattern in the DZSD have been studied for a period of about three decades (i.e.1980 to 2005) and to find out nature of change, and possible causes for this change in study area.

Table - 4.1

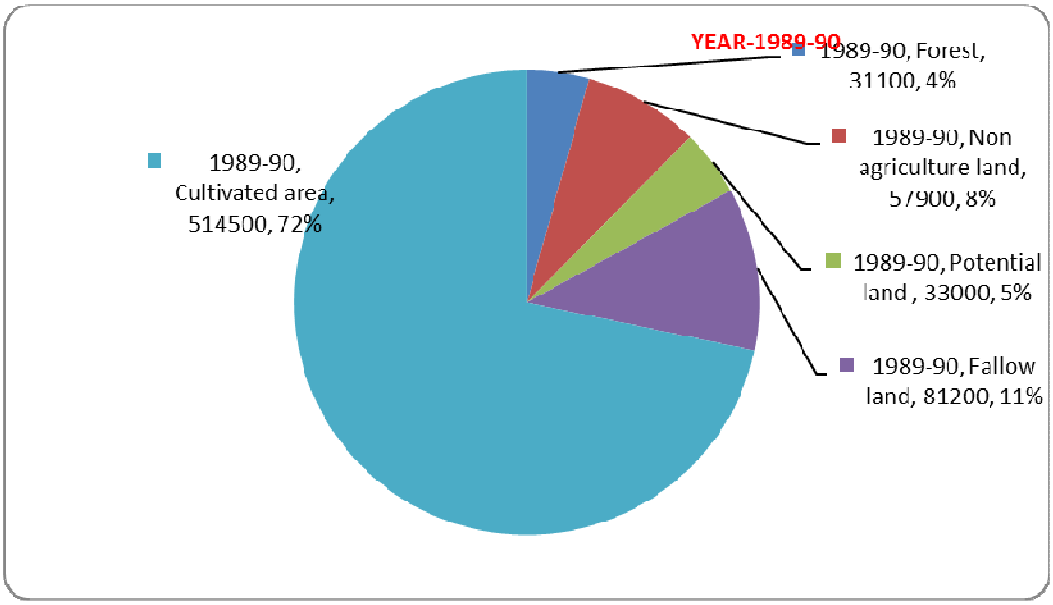
DZSD : General Land-use & Change *(area in Hect.)*

Sr. No.	Land-use category	1989-90	% to total	2009-10	% to total	Change	% to total
1	Forest	31100	4.32	31519	4.38	+419	+ 0.06
2	Non agriculture land	57900	8.06	65756	9.15	+7856	+ 1.10
3	Potential land	33000	4.59	54574	7.59	+21574	+ 2.99
4	Fallow land	81200	11.30	26277	3.66	- 54923	- 7.76
5	Cultivated area	514500	71.72	540741	75.22	+26241	+ 3.61
	Total	718600	100	718867	100	+267	-

Source: - The Socio-economic Abstract of Sangli District 1989-90, 2009-10.

Table No 4.1 shows that the lowest area is under the forest (4.32 %) in reference year 1989-90. But it is very slightly (**+ 0.06 %**) increased in the investigation period.

DZSD
General Landuse Pattern



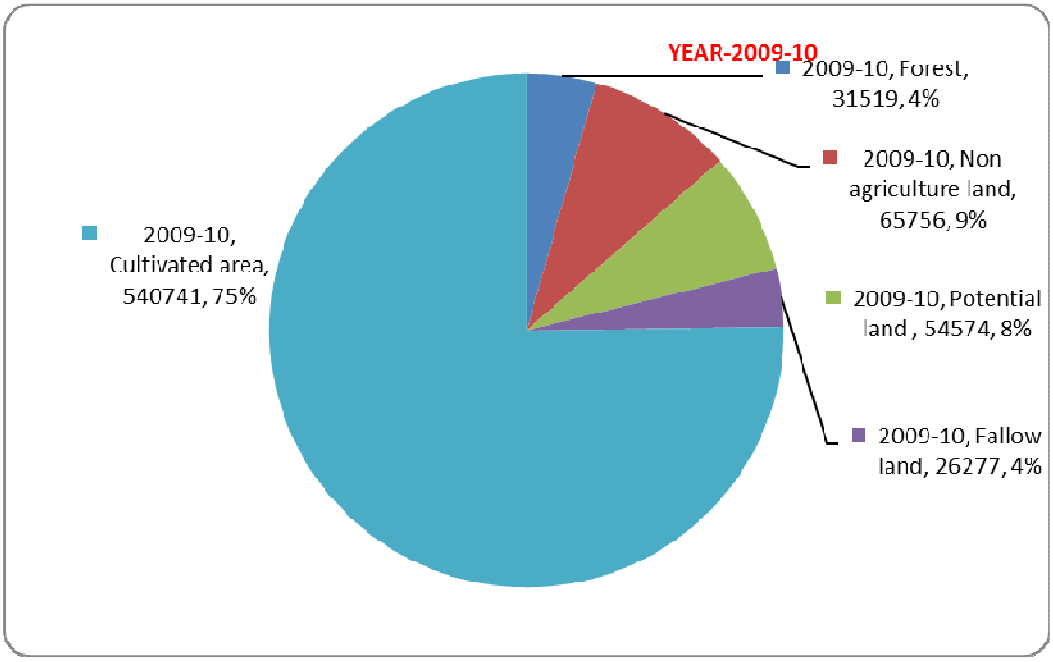


Fig-4.1

The share of potential land is 4.59 percent to total geographical area in 1989-90. It is increasing 2.99 percent. The non-agriculture lands capture 8.06 percent area in DZSD. Due to the economic development, it is increased only 1.10 percent. As per reference year 1989-90, the fallow land is 11.30 percent, but it is decreasing 7.8 percent. The cultivated area of DZSD was 71 percent in 1989-90, but it increased 3.61 percent during study period. Therefore, the temporal change of DZSD suggest that the fallow land is decreased near about 8 percent, but it is replaced by agriculture is only 3.61 percent.

4.3.B. Spatial variations in landuse pattern

The spatial pattern of landuse in the Thane district is the result of interaction between physical environment and socio- economic environment but the impact of local and regional factors is clearly evident from the landuse patterns. Besides these factors, amount of rainfall, nature of relief and land, distance from ocean coast etc. has influence on the types of lanuse in the region. The overall landuse has been categorized into different sub types on the basis of recommendations made by Food and Agricultural Department, Government of India. The spatial distribution has studied for Sangli district for the categories, namely, Net sown area, Land not available for cultivation, Cultivable waste, Fallow land and Forest.

A. Forest

Forest includes all areas actually under forests whether state owned or private and classified or administrated as forests under any legal enactment dealing with the forest. The distribution of forest lands in the study region is as shown in Table 4.2 and Fig 4.2. In the year 2009-10 all the talukas had low area under forest and it occupies

about 4.32 percent of the total geographical area of the district. There are remarkable variations at taluka level low proportion under forest (below 3 percent) in K.Mahankal, Miraj, Atpadi tahsil and moderate proportion (3 - 6 %) of area under forest can be found in Tasgaon and Jat tahsil. High percentage (above 6%) of forest can be found in only Khanapur tahsil.

Table - 4.2
DZSD : Forest Area & Change *(area in Hect.)*

Sr. No.	Tahasils	1989-90	% to total	2009-10	% to total	Change	% to total
1	Khanapur	11200	8.45	10936	8.24	-264	- 0.21
2	Atpadi	2000	2.29	2314	2.65	+314	+ 0.36
3	Tasgaon	5000	4.50	4961	4.46	-39	- 0.04
4	Miraj	1000	1.08	1079	1.16	+79	+ 0.08
5	K. Mahankal	600	0.84	924	1.31	+324	+ 0.44
6	Jath	11300	5.02	11305	5.03	+05	+ 0.01
	Total DZSD	31100	4.32	31519	4.38	+419	+ 0.06

Source: - The Socio-economic Abstract of Sangli District 1989 & 2009.

The large scale variation is not marked in the pattern, the region has undergone some small changes in the forest cover. Only in Khanapur and Jat Tahsil, it is increased near about 0.3 to 0.4 percent to geographical area, other wise it is stable or decreased in DZSD. It clearly shows that the strong decision may not be taken about the increasing forest area.

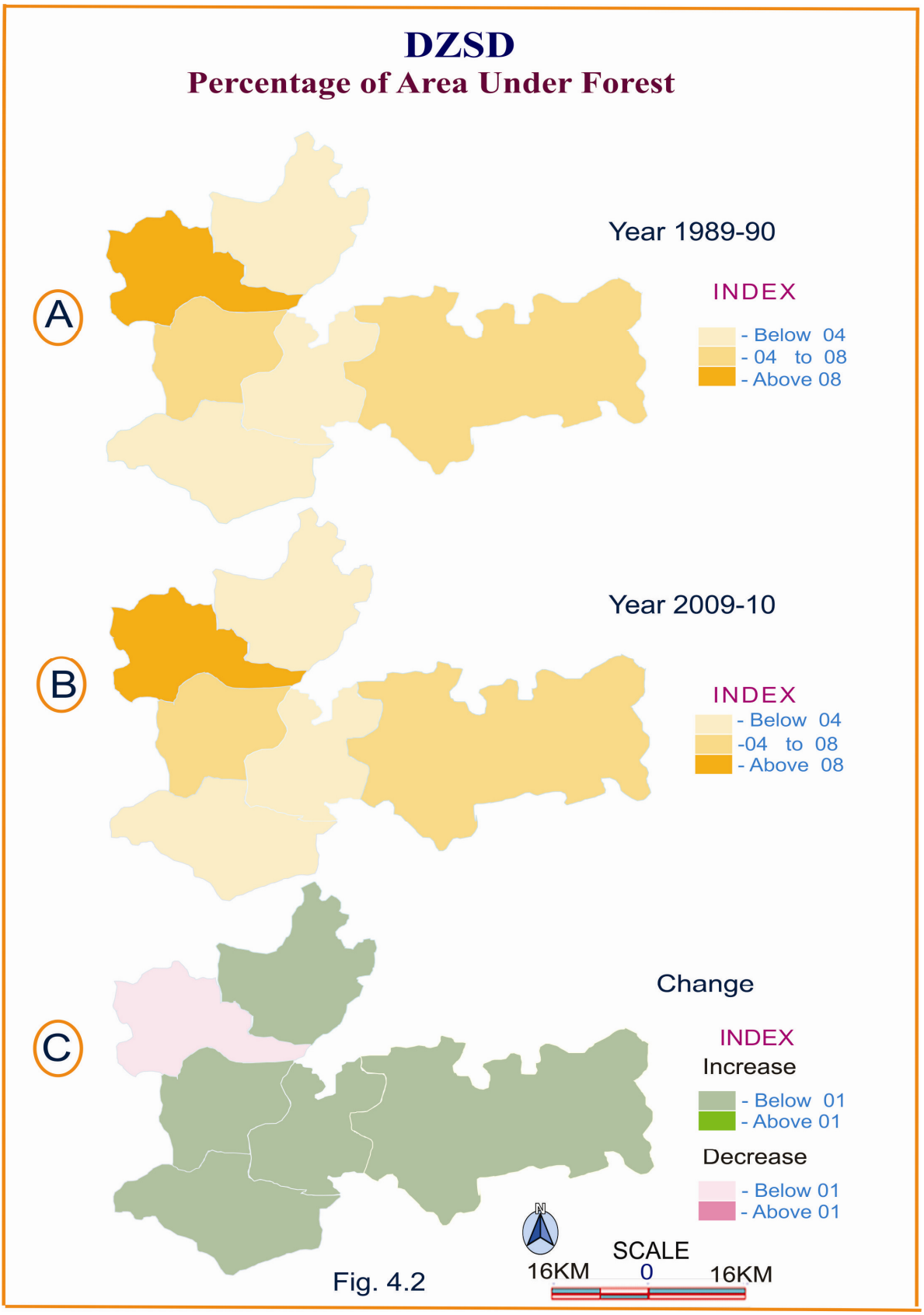

DZSD
Percentage of Area Under Forest
A
Year 1989-90
INDEX
- Below 04
- 04 to 08
- Above 08
B
Year 2009-10
INDEX
- Below 04
-04 to 08
- Above 08
C
Change
INDEX
Increase
- Below 01
- Above 01
Decrease
- Below 01
- Above 01
N
SCALE
16KM 0 16KM

Fig. 4.2

B. Non Agriculture Land

Non Agriculture Land include the land put to non agriculture use , barren and cultivable waste land. Area under non agriculture uses comprises the area under settlement, roads, railways, embankments, canals, tanks and burials etc. whereas barren and uncultivable lands are those covered by barren out crops of rocky hills, swamps silted lands, old quarry pits deserts , river beds, etc. In other words this is land which can not be brought under cultivation.

Table - 4.3

DZSD: Non Agriculture Land & Change *(area in Hect.)*

Sr. No.	Tahasils	1989-90	% to total	2009-10	% to total	Change	% to total
1	Khanapur	9500	7.16	13324	10.01	+3824	+ 2.85
2	Atpadi	8900	10.20	10602	12.16	+1702	+ 1.96
3	Tasgaon	9100	8.18	10076	9.06	+976	+ 0.88
4	Miraj	5400	5.85	10910	11.78	+5510	+ 5.93
5	K. Mahankal	9800	13.86	11647	16.48	+1847	+ 2.62
6	Jath	15200	6.76	9197	4.10	-6003	- 2.66
	Total DZSD	57900	8.06	65756	9.15	+7856	+ 1.09

Source: - The Socio-economic Abstract of Sangli District 1989 & 2009.

About 8.06 percent of area belongs to this category in 1989-90 which is slightly (1.09%) increased in investigation period. There are notable variations in the distribution of land under these categories. K.Mahankal tahsil ranks first (16.48 percent) in the area under this category, followed by Atpadi (12.16 percent), Miraj (11.78 percent) and Khanapur (10.01 percent) in 2009-10.

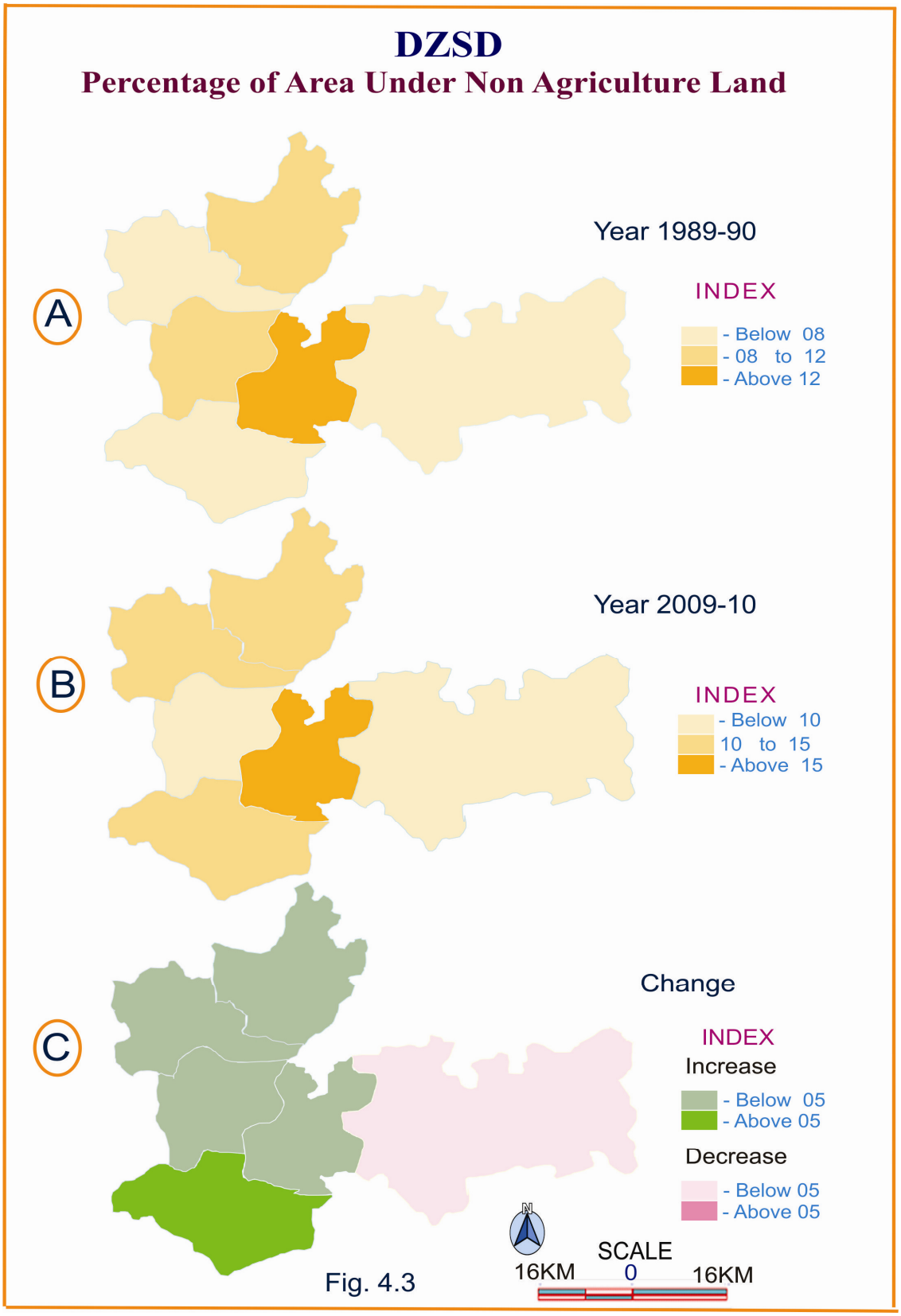

DZSD
Percentage of Area Under Non Agriculture Land
A
Year 1989-90
INDEX
- Below 08
- 08 to 12
- Above 12
B
Year 2009-10
INDEX
- Below 10
10 to 15
- Above 15
C
Change
INDEX
Increase
- Below 05
- Above 05
Decrease
- Below 05
- Above 05
N
SCALE
16KM
0
16KM

Fig. 4.3

Jath and Tasgaon tahsil have substantial proportion (4 to 9 percent) of area under this category. Non-uniform pattern of change in the land under this category is observable in the distribution of area involved in the period from 1989-90 to 2009-10. High increase in the area under this category has been found in Miraj (5.93 percent). Significant (above 2 %) increase is observed in Khanapur and K.Mahankal tahsil. To the other end decrease area under this category is confined to Jath (2.66 percent). Remaining tahasils come under positive change, but to small extent.

C. Potential Land

The term potential broadly means something existing but not yet fully exploited. The land reserved for the purpose of extension of the cultivation can be found only in this category, the land which could be used for cultivation but it has not been cultivated owing to certain reasons. It generally consists of 1) uncultivable wasteland 2) permanent pastures and grazing land and 3) miscellaneous tree crops and growers. Cultivable waste land includes the land which can be brought under cultivation for some time but which has not been cultivated successively for more than 5 years. The category of land under miscellaneous tree crops includes land under caesura trees, grass, bamboo buses or other trees used for fuel. Actually this land is put to some agriculture use but the aerial extent of it is not included in the category of net sown area.

The spatial distribution represented in Fig 4.4 varies from under 2 to over 14 percent in 2009-10. Significantly high (above 10 percent) of potential agricultural land embrace Khanapur and Atpadi tahsil. This is mainly due to adverse climatic conditions and physical handicaps. A coverage of 5 to 10 percent may be observed in the talukas of Tasgaon, K.Mahankal and Miraj tahasils.

Table - 4.4
DZSD: Potential Land & Change *(area in Hect.)*

Sr. No.	Tahasils	1989-90	% to total	2009-10	% to total	Change	% to total
1	Khanapur	2800	2.11	18710	14.11	+15910	+12.00
2	Atpadi	10200	16.36	11554	13.25	+1354	- 3.11
3	Tasgaon	3600	3.23	7994	7.19	+4394	+ 3.96
4	Miraj	4900	5.31	5850	6.32	+950	+ 1.01
5	K. Mahankal	2700	3.82	4741	6.71	+2041	+ 2.89
6	Jath	8800	3.92	5725	2.55	-3075	- 1.37
	Total DZSD	33000	4.59	54574	7.59	+21574	+ 3.00

Source: - The Socio-economic Abstract of Sangli District 1989 & 2009.

Rest of the talukas have merge land (under 5 percent) available for future extension under cultivation. Potential agriculture land slightly increased from 33000 hect. in 1980-81 to 54574 hect. in 2009-10. The regional distribution of change in potential agriculture land as depicted in Fig 4.4 appears to very uneven. Sizable increase (over 4 %) are confined to Tasgaon tahsil. They may be due to the increase in village grazing lands or common lands and area under tree crops and secondly due to natural hazards. While the increase in land in talukas of Tasgaon and K.Mahankal is 2 to 4 percent. Striking decrease in (below 4 %) are confined to Atpadi and Jath tahsils. This is mostly due to proportion of potential agriculture land which has gone non agriculture land and agriculture land.

D. Fallow Land

The term fallow land is applied to land, not under cultivation at the time of reporting, but which had been under cultivation in the past. The fallow land includes current fallow land and older fallow land, which are largely found due to inadequate water supply or excess of moisture supply, extensive holding and heavy clayey soils difficult for tilling at proper time. Some times, they are kept fallow for preserving fertility and to prevent soil exhaustion. Thus, efficiency of fallow land system in preserving fertility and maintaining crop yields to be acknowledged. The fallow land may be divided into two groups, i.e.

a) Current Fallow Land: - Land lying fallow during the current year only or the land which was uncultivated in the previous year is known as the current fallow land. The main reason of fallow land is scarcity of water, unfavorable climate, farmer's poverty and quarrels between two farmers.

b) Other Fallow land: - Lands lying fallow for more than one agricultural year but less than five agricultural years. The area which is uncultivated more than one to five years is known as other fallow land.

Table - 4.5

DZSD : Fallow Land & Change *(area in Hect.)*

Sr. No.	Tahasils	1989-90	% to total	2009-10	% to total	Change	% to total
1	Khanapur	1900	1.43	2290	1.72	+390	+ 0.29
2	Atpadi	2100	2.40	1427	1.63	-673	- 0.77
3	Tasgaon	5800	5.22	8442	7.59	+2642	+ 2.37
4	Miraj	4700	5.09	2048	2.21	-2652	- 2.88
5	K. Mahankal	11600	16.40	1939	2.74	-9661	- 13.66
6	Jath	55100	24.52	10131	4.51	-44969	- 20.01
	Total DZSD	81200	11.30	26277	3.66	-54923	- 7.64

Source: - The Socio-economic Abstract of Sangli District 1989 & 2009.

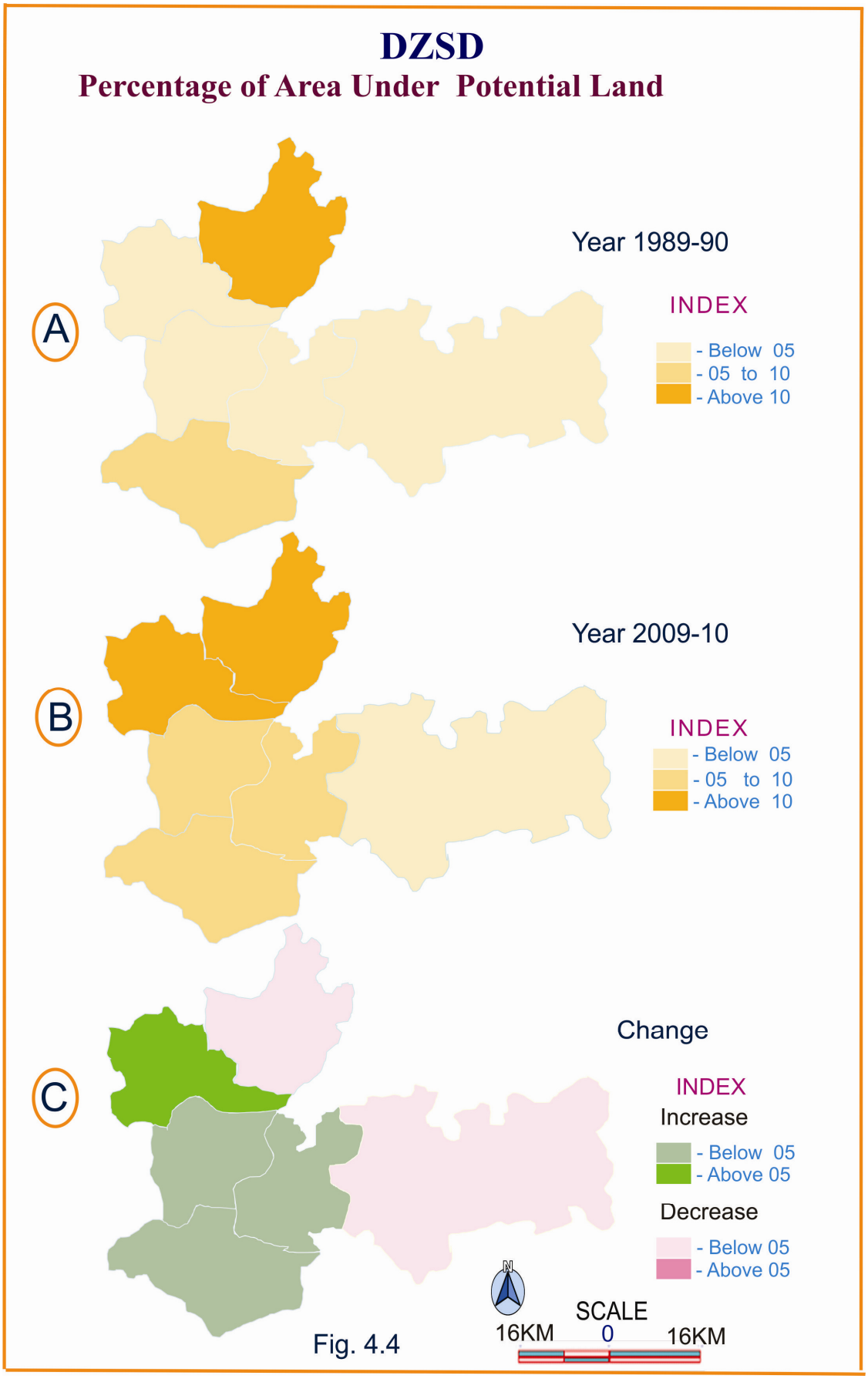

DZSD
Percentage of Area Under Potential Land
A
Year 1989-90
INDEX
- Below 05
- 05 to 10
- Above 10
B
Year 2009-10
INDEX
- Below 05
- 05 to 10
- Above 10
C
Change
INDEX
Increase
- Below 05
- Above 05
Decrease
- Below 05
- Above 05
N
SCALE
16KM 0 16KM

Fig. 4.4

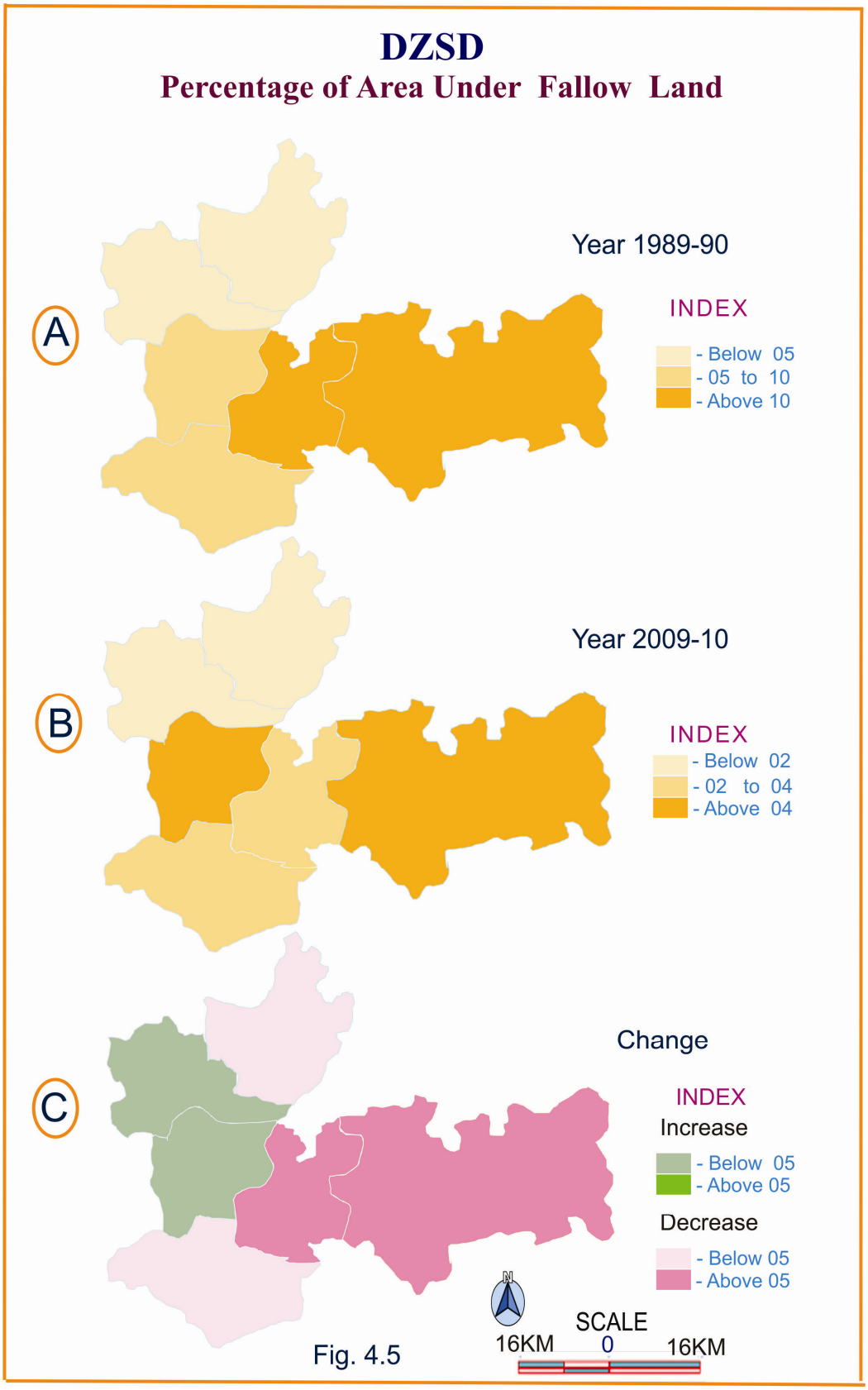

DZSD
Percentage of Area Under Fallow Land
A
Year 1989-90
INDEX
- Below 05
- 05 to 10
- Above 10
B
Year 2009-10
INDEX
- Below 02
- 02 to 04
- Above 04
C
Change
INDEX
Increase
- Below 05
- Above 05
Decrease
- Below 05
- Above 05
N
SCALE
16KM 0 16KM

Fig. 4.5

DZSD has a substantial proportion of fallow with an average of 11.30 percent for the reference year 1989-90 and it is largely(7.64%) decreased in the reference year 2009-10. The decay of fallow lands influenced either by growing population pressure on land, modernization of agriculture or development in irrigation facilities. The regional variation in these factors individually or collectively loads to range of values in distribution of fallow land from under one percent to over seven percent of the total. The high proportion (above 4 %) of fallow land is observed in Tasgaon and Jath tahsils. The moderate (2 to 4 %) fallow land area captures by K.Mahankal and Miraj tahsils.

The lowest (below 2 %) fallow land defined in remaining part of DZSD. The large variation observed in fallow land during investigation period. The high share (above 10 %) of fallow land decrease in K.Mahankal and Jath tahsil dominantly due to population pressure and no other option towards the people expect agriculture. While small fallow land (below 5 %) decrease in Miraj and Atpadi tahsil. Rest of tahsil's of DZSD fallow land increased in small scale (below 5 %) show in Fig 4.5

E. Net Sown Area

The area under food crops, cash crops and fodder crops is included under net sown area category. Net sown area represents the actual net sown area during an agriculture year. The environmental factors directly affect agriculture land-use or net sown area. Traditionally agriculture is practiced intensively on a large scale.

Table 4.6 and Fig 4.6 exhibits the regional variation in the share of net sown area. The extent of net sown area in the DZSD has changed over the 30 years from merely 515400 hect. during 1989-90, it rose to about 540741 hect. in during 2009-10.

The most direct explanation of the changes in the net sown area can of course be had by reference to the percentage change in the fallow land, intensity of irrigation, population pressure and the improvements in the method of farming. In 2009-10 the highest net sown area is observed at Jath tahsil (83.81 percent) and lowest has identified at Khanapur tahsil (65.87 percent) in study area. In Miraj tahsil having more than 78.53 percent net sown area. Remaining tahsils in study area have 70to 75 percent net sown area.

The net sown area in DZSD has increased by 3.50 percent from 1989-90 to 2009-10. Maximum increase is recorded in Jath tahsil (24.05 percent) followed by K.Mahankal (7.70 percent). These tahsils are, namely, Khanapur (14.96 percent), Tasgaon (7.15 percent), Miraj (4.13 percent) and Atpadi (3.10 percent).

Table - 4.6
DZSD: Net Sown Area & Change *(area in Hect.)*

Sr. No.	Tahasils	1989-90	% to total	2009-10	% to total	Change	% to total
1	Khanapur	107100	80.83	87342	65.87	-19758	- 14.96
2	Atpadi	64000	73.39	61274	70.29	-2726	- 3.10
3	Tasgaon	87700	78.86	79786	71.71	-7914	- 7.15
4	Miraj	76300	82.66	72737	78.53	-3563	- 4.13
5	K. Mahankal	46000	65.06	51422	72.76	+5422	+ 7.70
6	Jath	134300	59.76	188180	83.81	+53880	+ 24.05
	Total DZSD	515400	71.72	540741	75.22	+25341	+ 3.50

Source: - The Socio-economic Abstract of Sangli District 1989 & 2009.

This decline is a result of conversion of agricultural land into commercial or non-agricultural use.

4.4 Agriculture Landuse

Agricultural landuse means the extent of the gross cropped area under various crops during the agricultural year. The cultivated area is known as net sown area, which is also known as agriculture land. In short agriculture land-use means a cropping pattern or the proportion of area under various crops at a point of time.

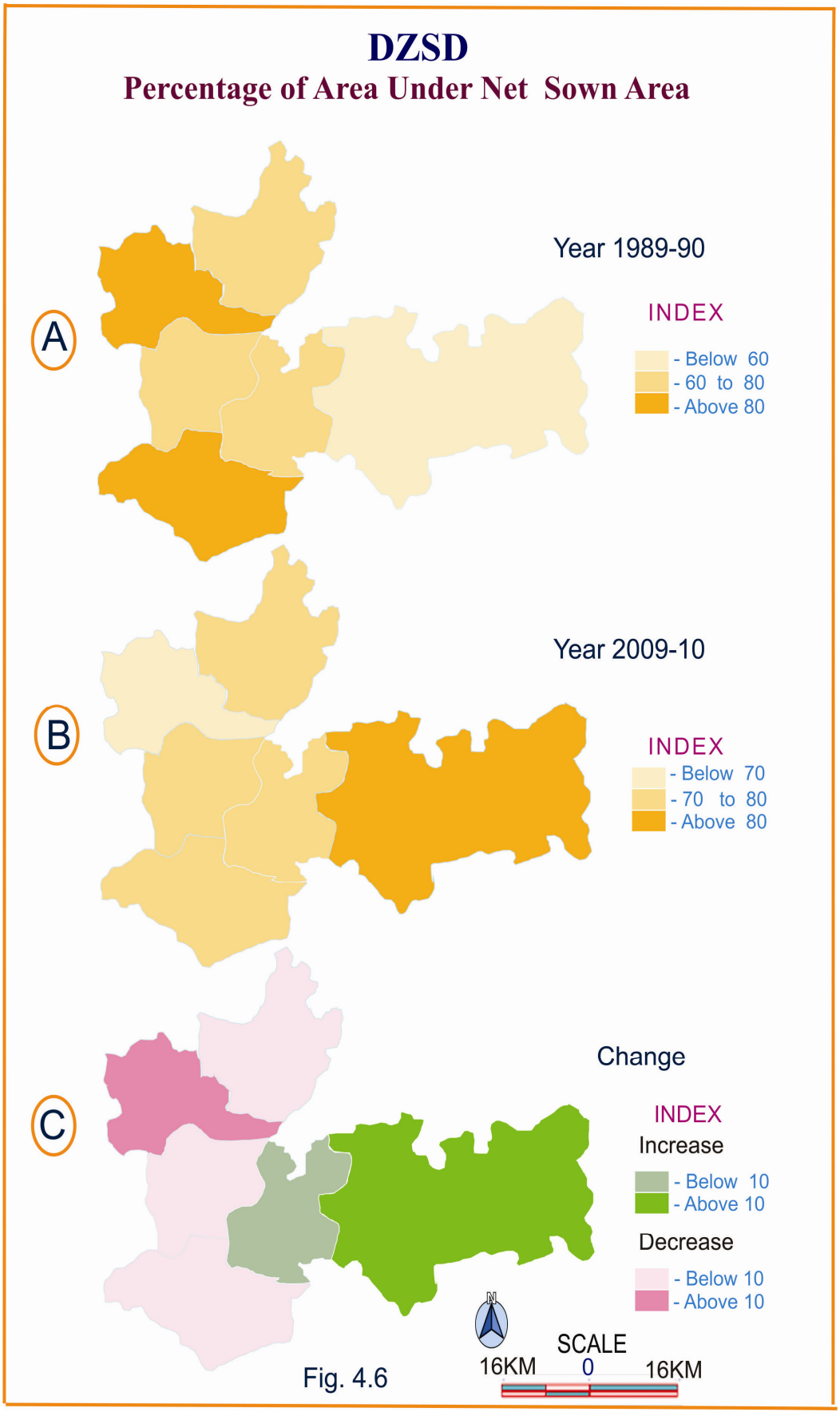

DZSD
Percentage of Area Under Net Sown Area
A
Year 1989-90
INDEX
- Below 60
- 60 to 80
- Above 80
B
Year 2009-10
INDEX
- Below 70
- 70 to 80
- Above 80
C
Change
INDEX
Increase
- Below 10
- Above 10
Decrease
- Below 10
- Above 10
N
SCALE
16KM 0 16KM

Fig. 4.6

Table No 4.7

DZSD : Agriculture Land-use & Change *(area in Hect.)*

Sr. No.	Land-use category	1989-90	%	2009-10	%	Change	%
A	Food Crops	470263	91.24	451088	83.43	-19175	- 7.81
A.1.	Food Grain	406944	78.95	410891	75.98	+3947	- 2.97
	a. Cereals	331084	64.24	337609	62.43	+6525	-1.81
	b. Pulses	75860	14.71	73282	13.55	-2578	-1.16
A.2.	Non Food Grain	63319	12.29	40197	7.43	-23122	-4.86
	a. Sugarcane	20498	3.97	11940	2.28	-8558	-1.69
	b. Fruit	3393	0.65	16030	2.96	+12637	+2.31
	c. Vegetables & other	39428	7.64	18773	3.47	-20655	-4.13
B	Non Food Crops	45137	8.75	89653	16.57	+44516	+ 7.82
B.1.	Oil Seeds	37192	7.22	80049	14.80	+42857	+ 7.58
B.2.	Cotton	3217	0.62	3058	0.56	-159	- 0.06
B.3	Other	4728	0.92	6546	1.21	+1818	+ 0.29
	Total DZSD	515400	100	540741	100	+25341	-

Source: - The Socio-economic Abstract of Sangli District 1989 & 2009.

It is essential to evaluate the agricultural landuse for the individual crop in order to understand crop pattern and growth. Agricultural landuse pattern in any region depends on socio-economic, physical and climatic conditions.

The crops are generally classified as food crops and non food crops. According to some agricultural economist's a cropping pattern means the proportion of area under various crops at a point of time. In the DZSD's over all cropping pattern food crops occupy the largest area (470263 hect.) in 1989-90 which is about 91.20 percent of the total cropped area.

But in 2009-10, it is deceased near about 7.81 percent. Among the food crops, cereals capture largest area (62.46 percent) followed by pulses (13.55), sugarcane (2.98 percent) and fruit (2.96 percent). All food crops area decreasing expect fruit crops. The main reason of increasing fruit crops are : they need low water, planted in shallow soil, new method of irrigation, etc. Non food crop area was 8.75 percent to total cropped area in 1989-90, but it is 16.57 percent in 2009-10. Amongst the non food crops, oil seeds occupy dominant place (14.80 percent).

It has increased 7.58 percent during the study period. But other non food crops are insignificant in cropping pattern of study area.

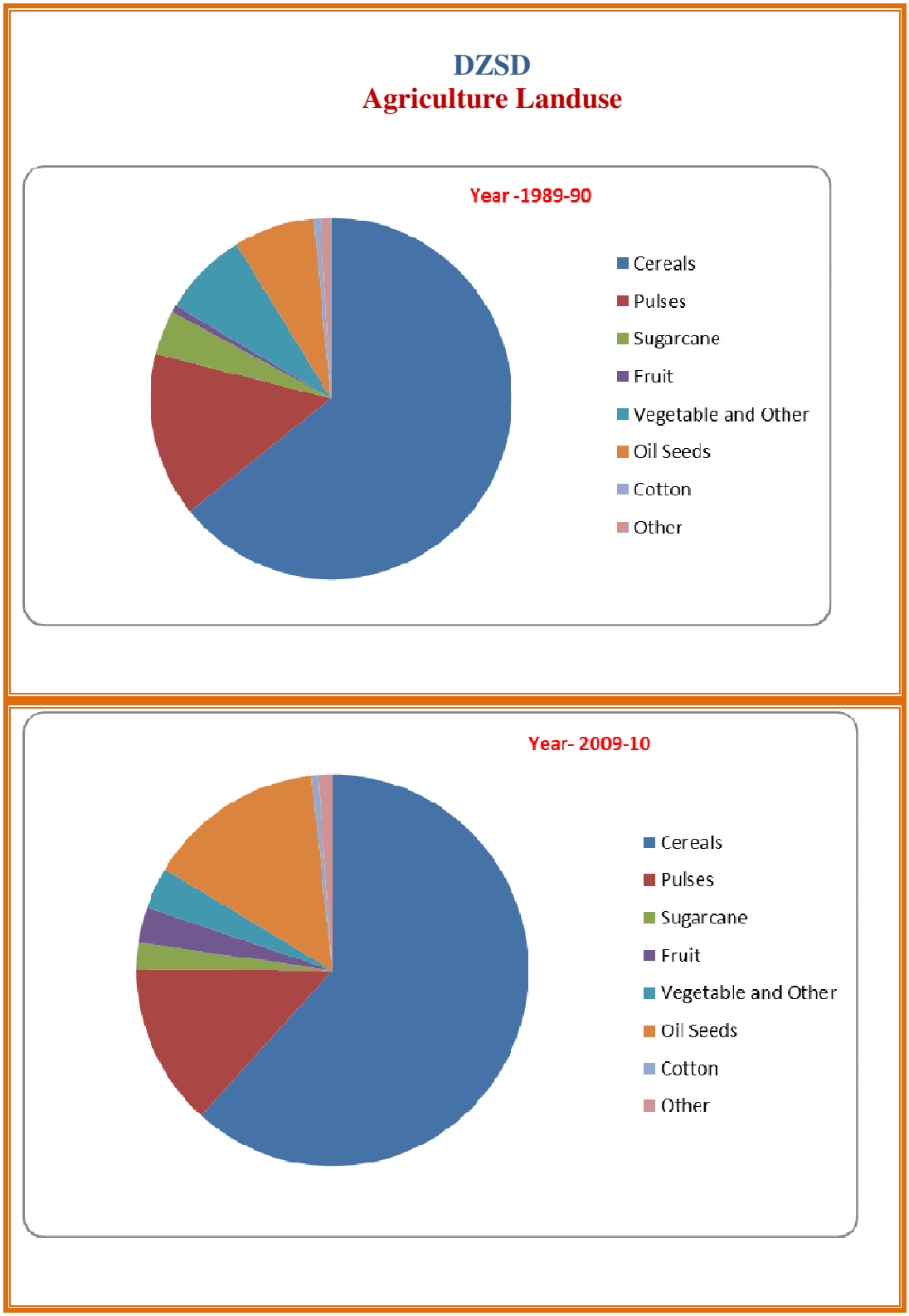

DZSD
Agriculture Landuse
Year -1989-90
Cereals
Pulses
Sugarcane
Fruit
Vegetable and Other
Oil Seeds
Cotton
Other
Year- 2009-10
Cereals
Pulses
Sugarcane
Fruit
Vegetable and Other
Oil Seeds
Cotton
Other

Fig. 4.7

4.4.A. Food Crops

The existing overall cropping pattern and the trend therein are tabulated in Table. In the region's overall cropping pattern, food crops occupy largest area (451088 hectors) which is about 83.43 percent of the total cropped area in 2009-10. The cereals, pulses, sugarcane, vegetables and fruits are in food crops. However the food crops are divided into major groups; Food Grain and Nonfood Grain.

4.5. A.1. Food Grain

Food grains play a major role in the cropping of land under tillage in DZSD. This is mainly due to their importance both as grains for human beings and straw for environment prevailing in the region. For only, under food grains can they produce enough to sustain the dense population in the study region. Moreover, food grain crops are relatively less demanding and less exacting in their soil moisture requirements than fiber crops.

i. Cereals :

Inferior cereals survive well in areas having poor soils while the superior cereals are raised in fertile soils. Cereals such as Jowar, Bajara, Rice, Wheat and Maize are of much importance among food grain crops. They are both of superior and inferior quality. Jowar, Wheat and Bajara are the major cereals of the region, whereas maize, Vari and rice are the minor crops in the over all cropping pattern of DZSD.

The spatial and temporal changes that occurred in cereals distribution during the period under investigation is shown in Table 4.9 and Fig 4.8. Jawar and Maize are major cereals of the region. Where as Bajara, Wheat are minor crops in over all cropping pattern of the region.

Table - 4.8

DZSD: Area under Cereal Crops and Change *(area in Hect.)*

Sr. No.	Tahasils	1989-90	% to NSA	2009-10	% to NSA	Change	% to NSA
1	Khanapur	61088	57.04	60948	56.90	-140	+12.84
2	Atpadi	40938	63.97	33768	55.10	-7170	- 8.87
3	Tasgaon	52629	60.01	52004	65.17	-625	+ 5.16
4	Miraj	40228	52.72	43910	60.37	+3682	+ 7.65
5	K. Mahankal	36245	78.79	34988	68.05	-1257	-10.74
6	Jath	99956	74.42	111981	59.50	+12025	-14.92
	DZSD	331084	64.23	337609	62.44	+6525	- 1.79

Source: - The Socio-economic Abstract of Sangli District 1989 & 2009.

These cereals crops gain some local significance but for the most part they remain unimportant.

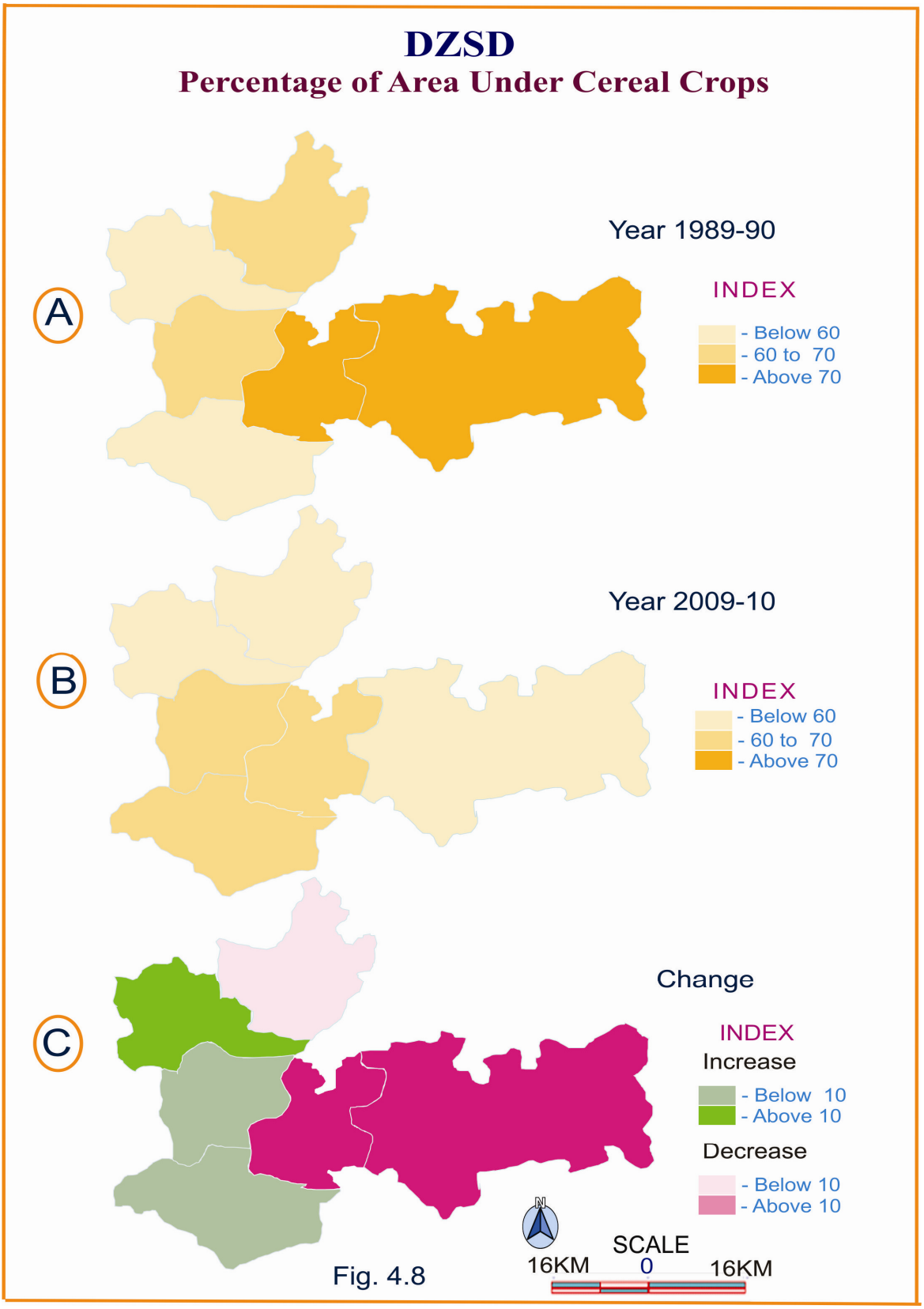

DZSD
Percentage of Area Under Cereal Crops
A
Year 1989-90
INDEX
- Below 60
- 60 to 70
- Above 70
B
Year 2009-10
INDEX
- Below 60
- 60 to 70
- Above 70
C
Change
INDEX
Increase
- Below 10
- Above 10
Decrease
- Below 10
- Above 10
N
SCALE
16KM 0 16KM

Fig. 4.8

Jointly all cereals crops occupy **337609** hect. (amounting to 62.44 % to NSA) in 2009-10. However, the highest cereals crops cultivated in Jath Taluka i.e. 111981 hect. (Amounting 59.50 % to NSA) and lowest in Atpadi and they capture 33768 hect. The share of cereals in NSA is highest in K.Mahankal (68.05 %) and lowest in Atpadi (55.10 %).

During the investigation period, the most noticeable change is observed in cereal crops in study region. the area under cereal crops increased near about 6525 hects. But the share of cereals crops in NSA is decreased the amount of 1.79 percent. Khanapur (12.84%), Miraj (7.65 %) and Tasgaon taluka (5.16%) has sown positive change and Jat(14.92%), K.Mahankal (10.74 %) and Atpadi (8.87 %) has observed negative change.

ii. Pulses

Pulses are very useful in many ways. They serve as excellent nutrition food and increase the fertility of the soil . They are grown both as kharif and rabi crop. The soil and moisture requirements vary from pulse to pulse but generally they need less moisture and most of them are rainfed. Pulses are the main source of protein in Sangli district.

Table - 4.9
DZSD: Area under Pulses Crops and Change *(area in Hect.)*

Sr. No.	Tahasils	1989-90	% to NSA	2009-10	% to NSA	Change	% to NSA
1	Khanapur	17292	16.14	19490	22.31	+2198	+ 6.17
2	Atpadi	6568	10.26	6824	11.14	+256	+ 0.88
3	Tasgaon	13306	15.17	15184	19.03	+1878	+ 3.86
4	Miraj	10329	13.53	12385	17.03	+2056	+ 3.50
5	K. Mahankal	5272	11.46	7007	13.63	+1735	+ 2.17
6	Jath	23093	17.20	12392	6.59	-10701	- 10.67
	DZSD	75860	14.72	73282	13.55	-2578	- 1.17

Source: - The Socio-economic Abstract of Sangli District 1989 & 2009.

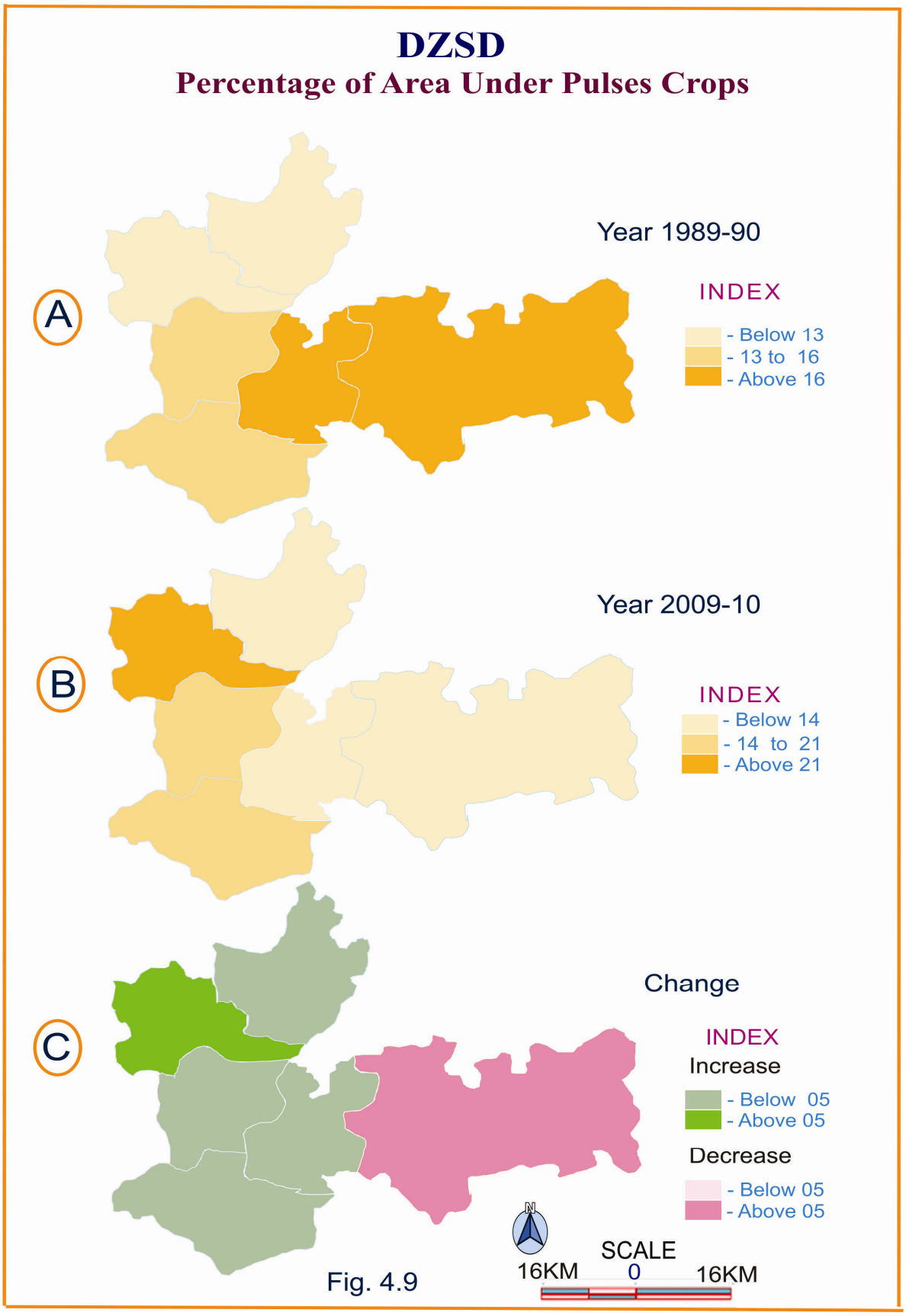

DZSD
Percentage of Area Under Pulses Crops
A
Year 1989-90
INDEX
- Below 13
- 13 to 16
- Above 16
B
Year 2009-10
INDEX
- Below 14
- 14 to 21
- Above 21
C
Change
INDEX
Increase
- Below 05
- Above 05
Decrease
- Below 05
- Above 05
N
SCALE
16KM 0 16KM

Fig. 4.9

Pulses rank third in DZSD. It accounts for 13.55 percent to the net sown area (73282 hectors) in the study area in 2009-10. The chief pulses grown in study area are gram, mug, udid, masur, tur etc. The highest pulses area (22.31%) is observed in Khanapur Tahsil and lowest (6.59 %) in Jath tahsil. The area under pulses has decreased (1.17 %) in the period of investigation. The highest positive change (6.17 %) is observed in Khanapur Tahsil. The negative change (10.67%) is observed in only Jath Tahsil. Indicates of area under all pulses indicates up and down in the study area. During the entire tahsil the slight increase in area under total pulses has been observed in DZSD.

4.4.A.2. Non-Food Grains

Sugarcane, fruits and vegetables are including this category. The non-food cultivation is large source of economic farmers in the study region. The area of non-food grains is 12.29 percent of the agricultural area in period of 1989-90. During the investigation period the oilseeds area decreased tremendously. The area under non-food grains is 7.43 percent of the agricultural area in the year 2009-10.

i. Sugarcane

The sugarcane plant is classified under the genus 'Saccharum' the word being derived from the Sanskrit word 'Sharkara'. It is locally called 'Oos'. It is the main source of sugar in India and a premier cash crop. It is grown mainly in the irrigated area in the study region. It holds the top most position in the economy of the district. It is used for making white sugar.

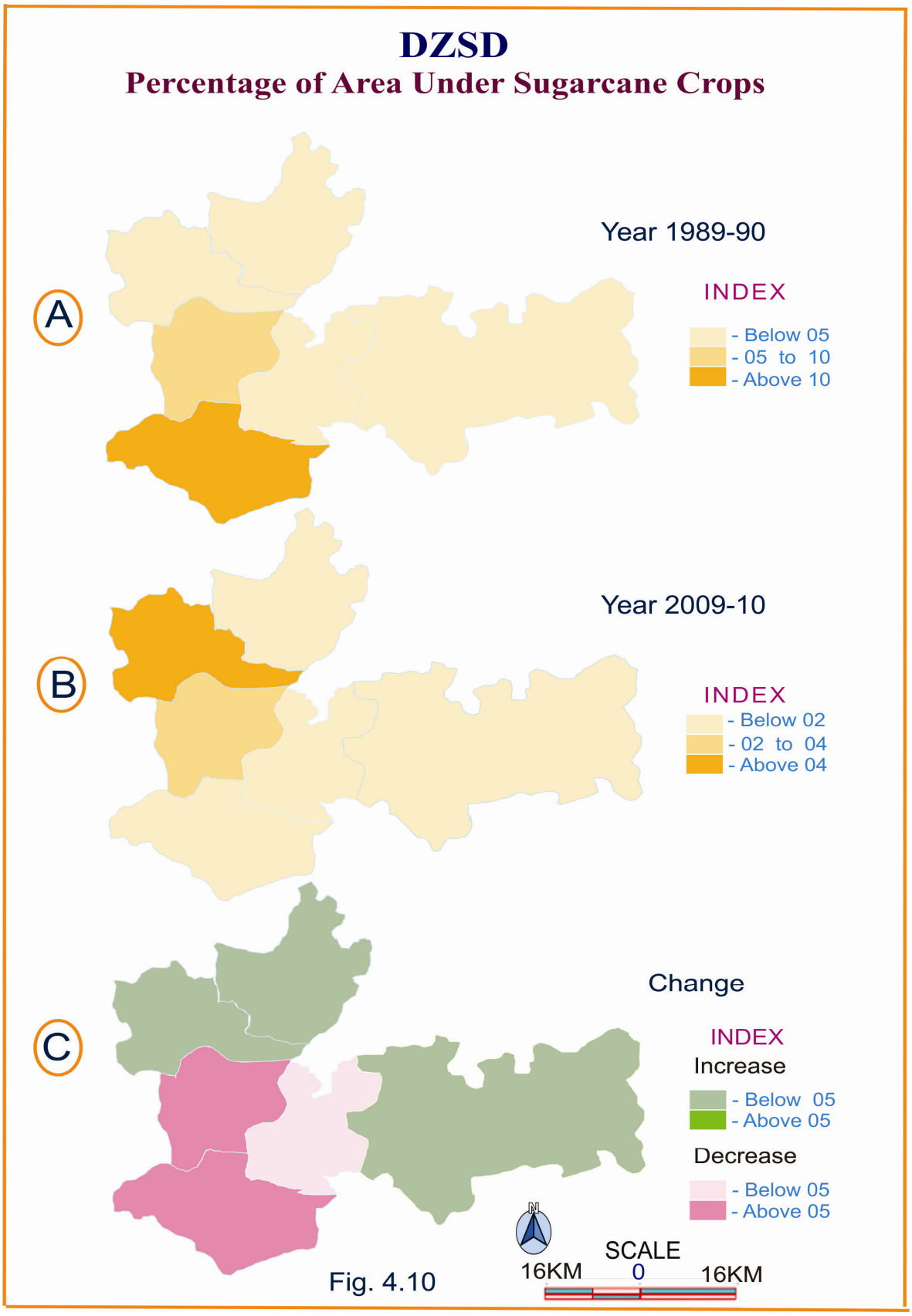

DZSD
Percentage of Area Under Sugarcane Crops
A
Year 1989-90
INDEX
- Below 05
- 05 to 10
- Above 10
B
Year 2009-10
INDEX
- Below 02
- 02 to 04
- Above 04
C
Change
INDEX
Increase
- Below 05
- Above 05
Decrease
- Below 05
- Above 05
N
SCALE
16KM 0 16KM

Fig. 4.10

Table - 4.10

DZSD: Area under Sugarcane Crop and Change *(area in Hect.)*

Sr. No.	Tahasils	1989-90	% to NSA	2009-10	% to NSA	Change	% to NSA
1	Khanapur	2241	2.09	4900	5.61	+2659	+ 3.52
2	Atpadi	174	0.27	840	1.37	+666	+ 1.10
3	Tasgaon	8089	9.22	2250	2.82	-5839	- 6.40
4	Miraj	8369	10.97	1380	1.90	-6989	- 9.07
5	K.Mahankal	1125	2.45	1010	1.96	-115	- 0.49
6	Jath	500	0.37	1560	0.83	+1060	+ 0.46
	DZSD	20498	3.98	11940	2.21	-8558	- 1.97

Source: - The Socio-economic Abstract of Sangli District 1981 & 2005.

It is an important cash crop cultivated on 11940 hectors (2.21 %) of cultivated area in 2009-10. Highest area (5.61%) is observed in Khanapur Tahsil and lowest area (0.83 %) is observed in Jath Tahsil. Within the twenty five years area under sugarcane crop is decreased by 8558 hectors (1.97%) in study region. It is decreased in Miraj (9.07 %), Tasgaon (6.40%) and K.Mahankal Tahsil (0.46%). But the positive change is observed in Khanapur (3.52%), Atpadi (1.10 %) and Jath Tahsil (0.46 %).

ii. Fruits

In the present investigation fruit crops are treated separately, primarily because their area is increased tremendously in the investigation period. Fruits have undoubtedly been man's oldest food but the development of fruits growing on commercial lines has taken place relatively recently in Sangli district. This district grows fruits such as mango, Banana, Grape, Pomegranate, Ber Guava and lime; these are important local fruit crops of the region. Grape and Pomegranate are the leading crops and leading commercial fruits of the region.

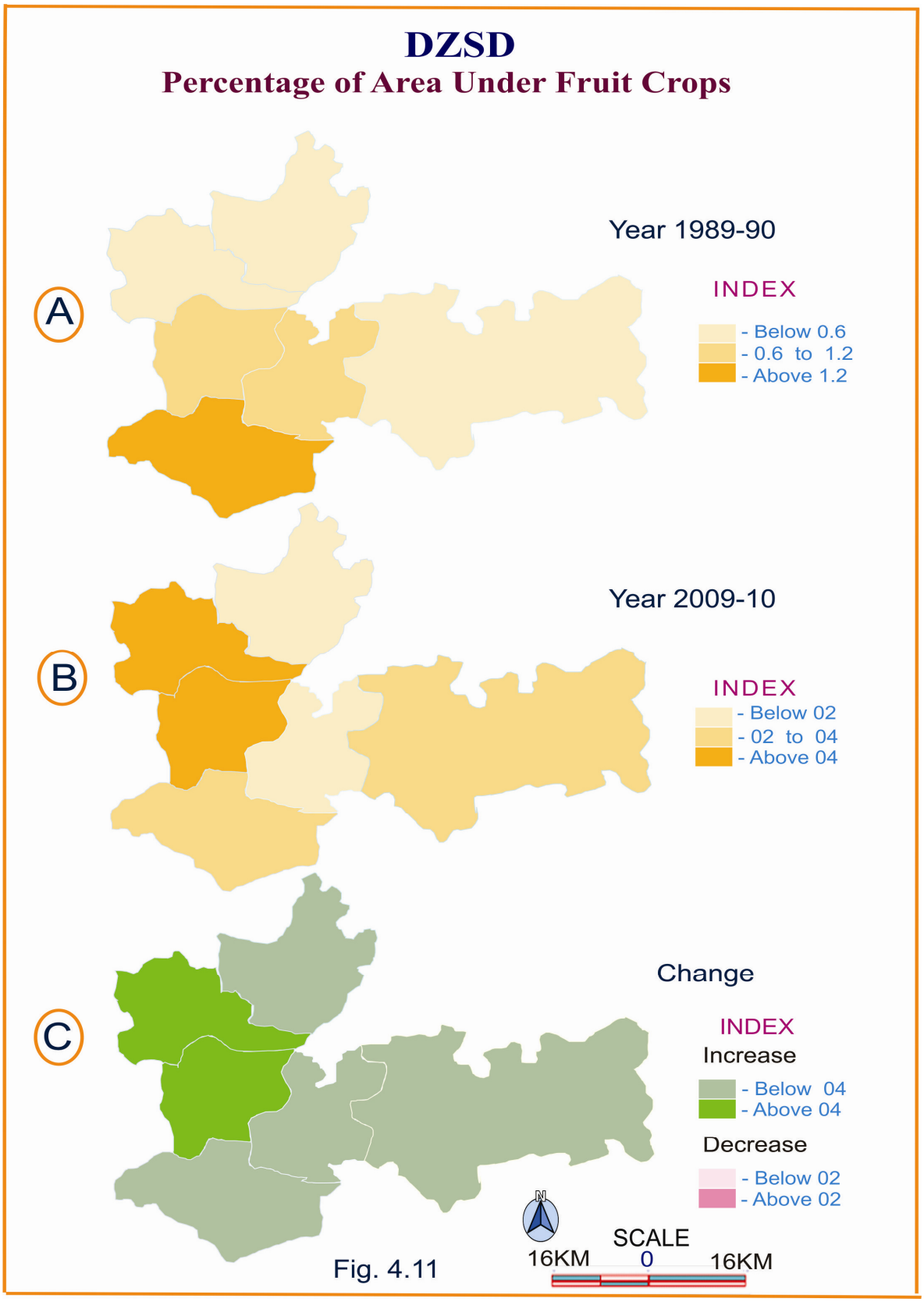

DZSD
Percentage of Area Under Fruit Crops
A
Year 1989-90
INDEX
- Below 0.6
- 0.6 to 1.2
- Above 1.2
B
Year 2009-10
INDEX
- Below 02
- 02 to 04
- Above 04
C
Change
INDEX
Increase
- Below 04
- Above 04
Decrease
- Below 02
- Above 02
N
SCALE
16KM
0
16KM

Fig. 4.11

Table - 4.11
DZSD: Fruit Crops & Change *(area in Hect.)*

Sr. No.	Tahasils	1989-90	% to NSA	2009-10	% to NSA	Change	% to NSA
1	Khanapur	416	0.39	4621	5.29	+4205	+4.90
2	Atpadi	195	0.30	1133	1.85	+938	+1.55
3	Tasgaon	726	0.82	3919	4.91	+3193	+4.09
4	Miraj	1058	1.39	1843	2.53	+785	+1.14
5	K. Mahankal	411	0.89	672	1.31	+2.61	+0.42
6	Jath	587	0.43	3842	2.04	+3255	+1.61
	Total DZSD	3393	0.39	16030	2.96	+12637	+2.57

Source: - The Socio-economic Abstract of Sangli District 1989 & 2009.

4.4.B. Non-Food Crops

The non-food crops like oil seed and cotton are discussed in this category. The non food crops covered 8.75 percent of the total agricultural area in 1989-90 which is increased 16.57 percent in the reference year 2009-10.

i. Oil Seeds

Oil seeds play a significant role in the agricultural economy of the study region, as they are used both for edible end and industrial purposes. Oilseeds are grown mainly in kharif season and among these groundnut is an important one. The other oilseeds cultivated on a very minor scale are sesame, sunflower, safflower, etc.

The area under oil seed was 7.22 percent in 1989-90 and it increased in 2009-10 i.e. 14.81percent and the total growth is 7.59 percent of the net sown area.

Table - 4.12
DZSD: Oil Seed Crops and Change *(area in Hect.)*

Sr.No.	Tahasils	1989-90	% to NSA	2009-10	% to NSA	Change	% to NSA
1	Khanapur	7317	6.83	18248	20.89	+10931	+14.06
2	Atpadi	1099	1.71	518	0.85	-581	- 0.86
3	Tasgaon	10817	12.33	15362	19.25	+4545	+ 6.92
4	Miraj	9047	11.86	28426	39.08	+19379	+27.22
5	K. Mahankal	1702	3.70	2086	4.05	+384	+ 0.35
6	Jath	7210	5.37	15409	8.19	+8199	+ 2.82
	DZSD	37192	7.22	80049	14.81	+42857	+ 7.59

Source: - The Socio-economic Abstract of Sangli District 1989 & 2009.

The highest oilseeds area is observed in Miraj Tahsil (39.08 %) and lowest area in Atpadi tahsil (0.85 %). Map 4.12 and Table 4.12 reveals that almost all in tahsils expect Atpadi tahsil in study area recorded increased area under oilseeds during the period of investigation.

The high positive change is observed in Miraj (27.22 %) and Khanapur Tahsil (14.06 %).

ii. Cotton:

Cotton locally named as 'Kapashi' is another important cloth seed in the study region. Cotton is mostly raised as a kharif rained crop. Cotton is mostly known as a cash crop and it is most lucrative cash crop in Maharashtra. Because of cotton mills are dependent on productivity of cotton in the Sangli district.

Table 4.13 DZSD: Cotton Crop and Change *(area in Hect.)*

Sr.No.	Tahasils	1989-90	% to NSA	2009-10	% to NSA	Change	% to NSA
1	Khanapur	152	0.14	230	0.26	+78	+0.12
2	Atpadi	1017	1.59	360	0.59	-657	- 1.00
3	Tasgaon	87	0.10	49	0.06	-38	- 0.04
4	Miraj	365	0.48	231	0.32	-134	- 0.16
5	K. Mahankal	295	0.64	259	0.50	-36	- 0.14
6	Jath	1301	0.97	1929	1.02	+628	+0.05
	DZSD	3217	0.62	3058	0.57	-159	- 0.05

Source: - The Socio-economic Abstract of Sangli District 1989 & 2009

Table 4.13 shows that the share of cotton crop is only 0.62 percent in total agriculture land in 1989-90, however it is decreased in 2004-05 and capture 0.57 percent to NSA in DZSD. This change is noticed in the study region due to variability of rainfall and shortage of irrigational facilities. The highest area under cotton crop is observed in Jath Tahsil and lowest in Tasgaon tahsil. during the investigation period area under cotton crop decreased all DZSD expecting Jath and Khanapur Tahsils.

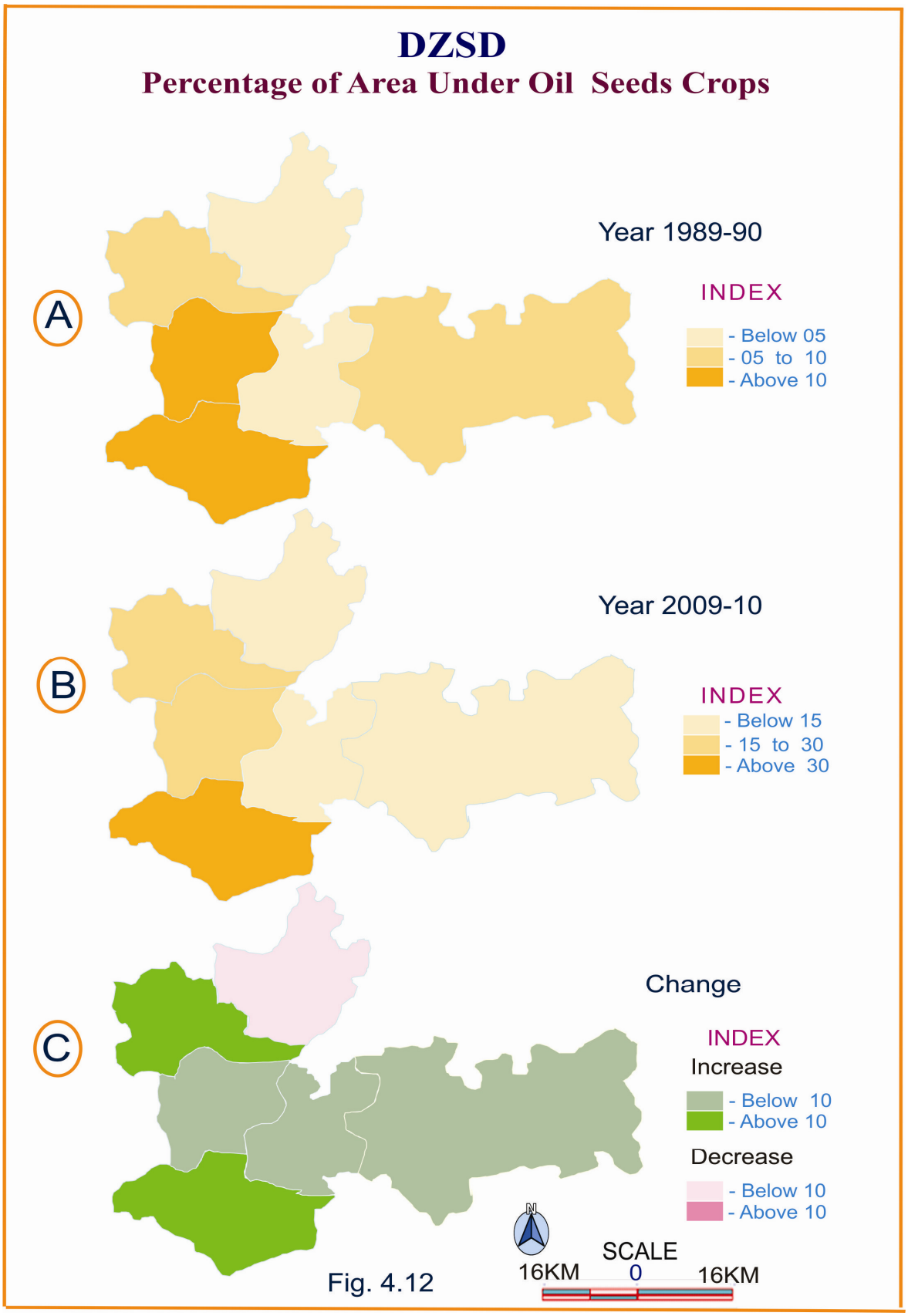

DZSD
Percentage of Area Under Oil Seeds Crops
A
Year 1989-90
INDEX
- Below 05
- 05 to 10
- Above 10
B
Year 2009-10
INDEX
- Below 15
- 15 to 30
- Above 30
C
Change
INDEX
Increase
- Below 10
- Above 10
Decrease
- Below 10
- Above 10
N
SCALE
16KM 0 16KM

Fig. 4.12

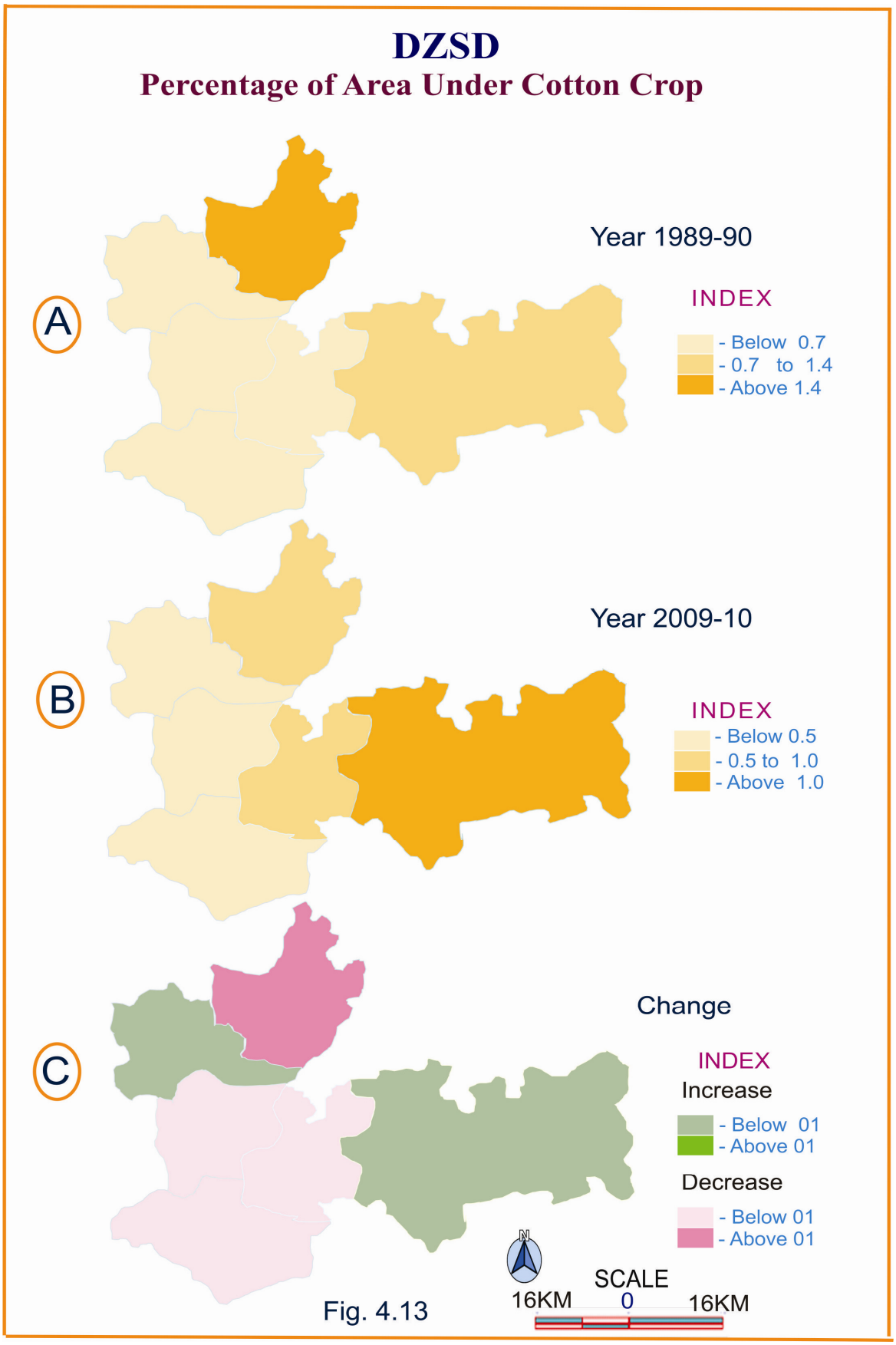

DZSD
Percentage of Area Under Cotton Crop
A
Year 1989-90
INDEX
- Below 0.7
- 0.7 to 1.4
- Above 1.4
B
Year 2009-10
INDEX
- Below 0.5
- 0.5 to 1.0
- Above 1.0
C
Change
INDEX
Increase
- Below 01
- Above 01
Decrease
- Below 01
- Above 01
N
SCALE
16KM 0 16KM

Fig. 4.13

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CHAPTER - V

GRAIN FARMING TO FRUIT FARMING TRANSFORMATION

5.1 Introduction

The previous chapter deals with the extent of board categories of general landuse and agriculture landuse. Now it would be pertinent to examine how intensively the food grains and fruit crops are being cropped. In this chapter the focus is on spatial and temporal cropping pattern of principal food grain and fruit crops. The overall cropping of the region is outlined and it is followed by a discussion of individual crops. Each crop has three maps that first two shows the distribution and the 'c' the changes.

5.2 Annual variation in area under various crops in DZSD

Taking into consideration annual area variation of selected crops in the study region the table No. 5.1 clearly indicates that there is positive and negative change. It means that the area under different foodgrain and fruit crop crops have been increased or decreased within the twenty years in DZSD and 1980-81 is treated as the base year and other all years figures are compare to base year.

Formula -

Annual Variation= Area under crop in Base Year – Area under crop in current year

A. Food Grain Crops

The food grain area is varied year to year. During the investigation period of 20 years, the food grain area is increase in 16 years and decreased in 8 years which period is 1990 to 1995. The highest increase (72708Hect.) is observed in 1986-87 and lowest increase (3987 Hect.) is in 2004-05. The rate of growth continuously is decreasing after 1997-98. It is strongly present that it is replaced by other cash crops or fruit crops. The crop wise area under different crops annually explained as follows:-

Table - 5.1

DZSD : Annual variation in food grain crops (area in Hect.)

Year	Jowar	Wheat	Bajara	Maize	Gram	Tur	Moog	Other	Total
1989-90	202878	32637	85898	3811	13938	11753	821	52208	406944
	Base Year								
1990-91	+17513	-12438	+13906	-1457	-3531	-1817	+304	+2043	+11523
1991-92	+11946	-15568	+18008	-1184	-3368	+1024	+260	-12150	-4032
1992-93	+16217	-16392	+22137	+5448	-2930	-2592	+867	+3936	+23691
1993-94	+59505	-14022	+35536	-625	+9317	+2512	+1066	-17581	+72708
1994-95	+25821	-18798	+7511	-364	+9672	+1488	+1032	-2359	+21003
1995-96	+25906	-12225	+29709	+11044	+927	+1828	+1120	-4372	+50937
1996-97	-169259	-14797	-78976	-1403	-10598	-10733	+1165	-18993	-308561
1997-98	-179715	-24039	-80364	-2207	-10279	-11017	-167	-49428	-360116
1998-99	+8989	-16105	-14728	+3185	+1467	-762	+1576	+49067	-68445
1999-00	-3488	-18916	-81761	-904	-7920	-10786	+739	-47622	-173658
2000-01	+51043	-16115	-5955	+179	+6095	-3193	+3123	+24933	+57130
2001-02	+105852	-13662	-80869	-1512	-6103	-2432	+4552	+33649	+36475
2002-03	+36835	-19123	+24003	+3216	+3114	-2175	+3755	+12402	+59027
2003-04	+35242	-10341	+13502	+4643	+13453	+52	+5175	-1170	+57656
2004-05	+42998	-10824	-36365	+7887	+12202	+357	+5422	+12964	+32461
2005-06	+46818	-11273	-83221	-810	+12599	+3558	+3148	+4504	-17677
2006-07	+25821	-18798	+7511	-364	+9672	+1488	+1032	-2359	+21003
2007-08	+43867	-8798	-42489	+9636	+9672	+1488	+4032	-2359	+12049
2008-09	+50771	-9302	-43372	+9430	+9495	-2368	+5061	-9978	+6847
2009-10	+32771	-9302	-43372	+9430	+9495	-2368	+4148	+6525	+3947

Source : Compiled by Researcher

The food grain area is varied year to year. During the investigation period of 20 years, the food grain area is increase in 14 years and decreased in 6 years. Among them major period is 1996 to 1999. The highest increase (72708Hect.) is observed in 1993-94 and lowest increase (3987 Hect.) is in 2009-10. The rate of growth continuously decreasing after 2003-04. It strongly present that it is replaced by other cash crops or fruit crops. The crop wise area under different crops annually explained as follows:-

1. Jawar

Jawar is Kharif and rabii crop. Particularly jawar is cultivated in large scale in Rabbi season in study region. The area under jawar has increased in 20 years. During the period of twenty years the area under jawar is increased in 17 years in comparison to base year area and it is decreased in three years. The highest increase (105852 Hectors) in area is in 2001-02 and lowest increase (8989 Hect.) is in 1998-99. The highest decrease (179715 Hect.) in area under jawar is in 1997-98 and lowest decrease (3488 Hect.) is in 1999-2000.

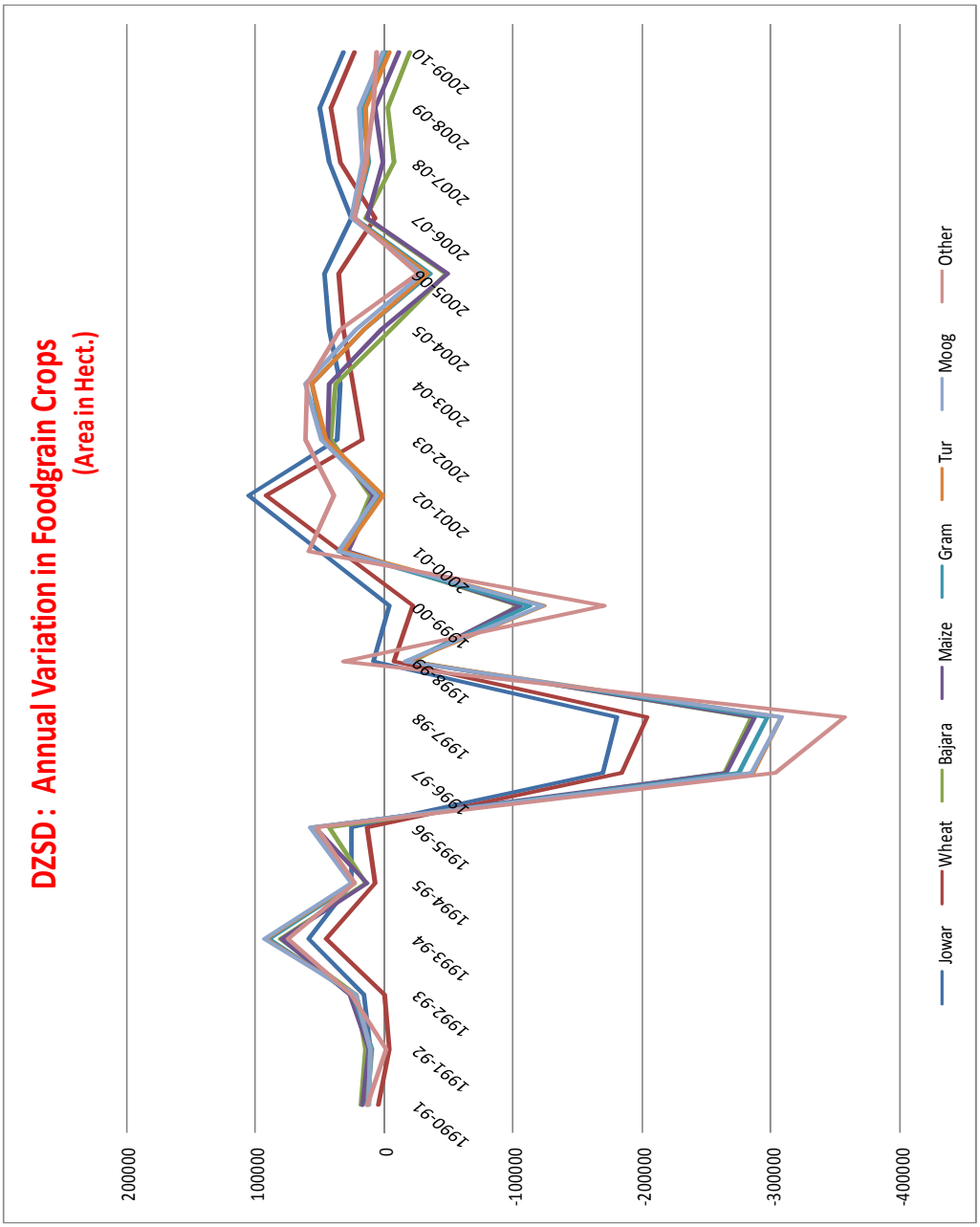

DZSD : Annual Variation in Foodgrain Crops
(Area in Hect.)
200000
100000
0
-100000
-200000
-300000
-400000
1990-91
1991-92
1992-93
1993-94
1994-95
1995-96
1996-97
1997-98
1998-99
1999-00
2000-01
2001-02
2002-03
2003-04
2004-05
2005-06
2006-07
2007-08
2008-09
2009-10
Jowar
Wheat
Bajara
Maize
Gram
Tur
Moog
Other

Fig -5.1

2. Wheat

Wheat is Rabbi crop in study area. Wheat requires a moderate cool climate with moderate rainfall. It has continuously decreased in twenty years in DZSD. The highest decrease in DZSD is observed in 1997-98 and i.e. 24039 hect. and lowest decrease (8798 hect.) in area under wheat is observed in 2007-08. The main reason of decreasing wheat area is uncertain rainfall & irrigation facilities and high input but low in put compare to fruit crop.

3. Bajara

Bajara is very important staple food grain of rural population. Area under bajara crop is flexible in DZSD because it is cultivated in especially shallow soil in kharip season. It is totally depend on uneven and irregular rainfall. Area under bajara crop was increased from 1990 to 1995. Among these period, the highest growth (35536 Hect) is recorded in 1993-94 and lowest growth (7511 Hect.) was in 1994-95.

4. Maize

Maize is also important cereal crop in Sangli District. It is mainly grown for animals in DZSD. The area under maize was increased during the investigation period. But the growth is not continuous. The maize area was decreased in nine year and increased in11 years. After 2002-03, it is continuously increasing because of it is used for especially milk cow food. The highest growth is recorded in 1995-96 and highest decrease is observed in 1997-98.

5. Gram

Gram is one of the important crops in total pulses in DZSD. It is raised in rabbi season. The decrease in gram was observed in 7 years during the period of investigation. The highest decrease (10598 hectors) was observed in 1996-97 and lowest decrease (2930 Hect.) was observed in 1992-93. But the 13 years especially last four-five years the gram area was increased. The highest positive change is observed of 13453 hectors in 2003-04 and lowest positive change (927 hect.) was recorded in 1995-96.

6. Tur

Tur is second important pulses in DZSD. It is raised in kharip and rabbi season. In all twenty year of investigation, the area under tur crop was decreased in 11 years. The highest (11017 hect.) area under tur has decreased in 1997-98 and the lowest (762 hect) in 1998-99. During the entire period of investigation the slight (52 to 4885 hect.) increase in area under tur crop has been observed in DZSD.

7. Moog

Mug is leading crop in DZSD. It is raised in kharip season. The area under moog has continuously increasing in study region during the investigation period exemption the Year of 1997-98. The maximum positive (5422 hect.) change has observed in 2004-05 and the minimum change (260 hect.) has observed in 1991-92.

B. Fruit Crops

The total area under fruit crop is low compare to food grain because of the climatic conditions. Area under fruit crop has continuously increasing during the investigation period. The growth rate was below 1300 hect. in first decade (1989-90 to 1999-2000) compare with base year of 1989-90. During the second decade (1999 to 2009) the growth rate was between 3000 to 11000 hect. After the 2004-05, the fruit crop area has increasing tremendously because of the development of irrigation type and mode, new variety of fruit crops, traditional way of fruit cultivation and increasing demand of fruit crops in overall world.

Table - 5.2

DZSD: Annual variation of fruit crops

Year	Grape	Pomegranate	Ber	Mango	Crusted Apple	Banana	Sapota	Guava	Other	Total
1989-90	1123	709	482	186	148	220	185	99	241	3393
	Base Year									
1990-91	+3	+46	-2	0	0	+5	+14	+46	+269	+380
1991-92	+155	+278	+9	+9	+5	-5	+35	+53	-51	+488
1992-93	+233	+436	+8	+10	+1	+91	+38	+75	-15	+882
1993-94	+275	+488	0	+10	+2	+85	+54	+77	-27	+962
1994-95	+299	+636	+10	+17	+3	+78	+54	+72	-27	+1142
1995-96	+345	+701	+17	+19	+3	+87	+69	+73	-33	+1281
1996-97	+467	+1680	+20	+28	+4	+147	+171	+80	+672	+3269
1997-98	+1052	+2447	+52	+51	+28	+135	+197	+86	+413	+4479
1998-99	+1733	+3523	+45	+57	+35	+119	+120	+53	+229	+5914
1999-00	+2198	+4711	+80	+70	+50	+113	+247	+57	+271	+7795
2000-01	+2617	+4789	+76	+78	+68	+107	+247	+53	+129	+8162
2001-02	+2897	+4914	+81	+84	+81	+5	+300	+51	+57	+8570
2002-03	+3118	+4981	+88	+95	+88	+5	+331	+54	+13	+8873
2003-04	+3248	+4990	+86	+94	+93	-1	+352	+60	+5	+9027
2004-05	+4292	+5316	+88	+100	+140	-7	+428	+64	+2	+10523
2005-06	+5110	+5203	+135	+75	+141	-8	+468	+66	+4	+11294
2006-07	+6156	+4491	+105	+137	+147	+87	+530	+72	+11	+11736
2007-08	+6550	+4423	+98	+224	+157	+87	+563	+85	+19	+12176
2008-09	+7167	+3756	+94	+370	+162	+83	+621	+91	+13	+12357
2009-10	+7227	+2737	+90	+484	+171	+78	+706	+115	+1029	+12637

Source : Compiled by Researcher

1. **Grape** :

Grape is one of the most commercially important crops in DZSD. It is highly beneficial fruit crop in all crops in study region. Area under grape crop is continuously growing. In reference 1990-91, the growth rate of the area under grape is only 3 hectors, however in 2009-10 year, it is recorded maximum growth (7227 hect.) in area under grape.

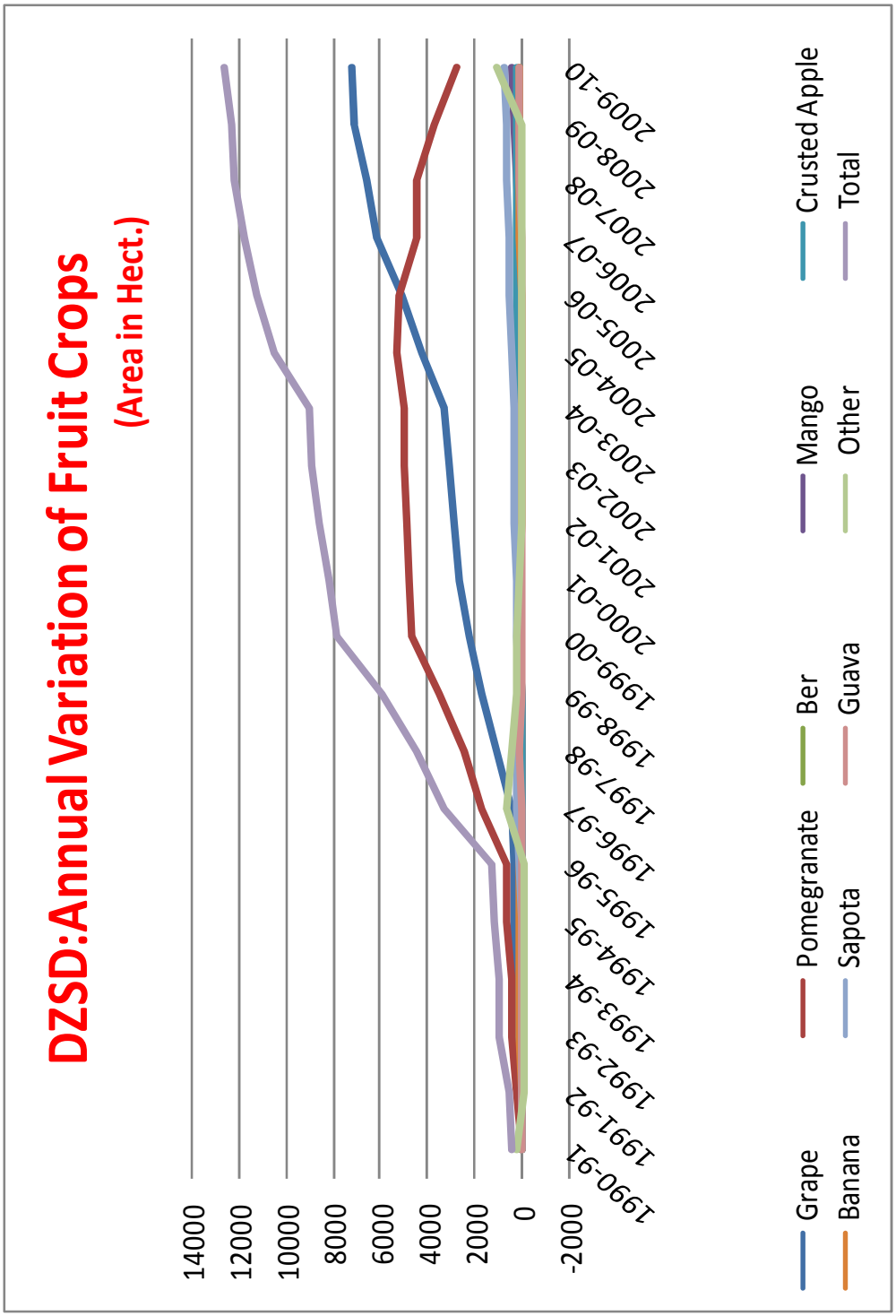

DZSD:Annual Variation of Fruit Crops
(Area in Hect.)
14000
12000
10000
8000
6000
4000
2000
0
-2000
1990-91
1991-92
1992-93
1993-94
1994-95
1995-96
1996-97
1997-98
1998-99
1999-00
2000-01
2001-02
2002-03
2003-04
2004-05
2005-06
2006-07
2007-08
2008-09
2009-10
Grape
Pomegranate
Ber
Mango
Crusted Apple
Banana
Sapota
Guava
Other
Total

Fig 5.2

After 1998-99, the area under grape has increased tremendously. This large change happens due the development of new technology, irrigation facility, Govt. policy and huge outcome.

2. Pomegranate

Along with grape, pomegranate is another important fruit crop is DZSD. It is most beneficial fruit crop in study region. The quality of pomegranate in DZSD is best and popular in over all world. The area under pomegranate is increased during the investigation period, but the growth rate is flexible in year to year. The highest positive change (5316 hect.) is observed in 2004-05. After 2004-05, the area under pomegranate has declining slightly due the attack of '*Telya*' disease and always incoming of droughts.

3. Ber

Ber is a sturdy fruit crop. Ber is grown in dry land region. It is being majorly cultivated in barren land where other cultivation is not possible. During the twenty five year of investigation, the ber area has been increased in 23 years. The highest positive change (135 Hect.) has observed in 2005-06 year. The negative change (2 Hect.) has been noticed in only 1990-91. It is also observed that the growth of ber area has been decreased after 2004-05 year.

4. Mango

The Mango (Mangifera India) is a long-living commercial fruit crop. It is the leading fruit crop of India and considered to be the king of fruit. The area under mango crop is very small in DZSD. It is planted on shore farm or uncultivated area of farm on a scale of one or two tree. However the new commercial variety developed, the farmers has cultivated it on way commercial base and planted it in whole selected area. During the investigation period, the positive change has been observed. But growth rate is low compare to grape, pomegranate and ber fruit crop.

5. Custard apple :

It is also known as '*sitaphal'*. It is dominantly cultivated in drought prone area due to its low requirement of water. The area under crusted apple has been increased in all years of study in DZSD. The highest positive change has noticed in 2009-10 and it is 171 hect. The growth rate of crusted apple is below 10 hect. in the period of 1990 to 1997 and it is remaining between 10 to 100 hect. in the period of 1997 to 2003. After the 2003-04 year, it is always growing above 100 hect. in study area.

6. Banana

Banana is a very popular fruit due to its low price and high nutritive value. Processed products, such as chips, banana puree, jam, jelly, juice, wine and halwa can be made from the banana fruit. In all twenty 16 year of study, the area under Banana crop are decreased in 20 years. The highest (147 hect.) area under Banana has

increased in 1996-97. During the entire period of investigation, the area under Banana crop has been decreased in five years. The highest negative change is observed in 2005-2006 and it is only 8 hect.

7. Sapota

Sapota is locally known as '*Chikku'*. The area under sapota fruit crops has been increased in all 20 years of study. The first eighteen years of study, the growth rate is below 100 hect. After the 2001-02, it is continuously increased above 300 hect. and it is growing on 706 hect. in 2009-10 compare to base year.

8. Guava

Guava is known as '*Peru'*. It is cultivated on a very small scale in DZSD. The under guava fruit has been increased in all years of investigation in DZSD, but the growth rate is below 100 hect. in 19 years. The highest positive change in Guava fruit has been observed in 2009-10 and it is 115 hect. compare to base year area.

5.3. Index number of area of selected crops

An index number is a statistical device for comparing the general level of magnitude of a group of related variables in two or more situation. Index Numbers in Agriculture are required in order to study the trends over time in respect of area, yield, production, productivity, prices, etc. and for studying the comparative picture of the performance of agricultural sector *vis-à-vis* other sectors. The index numbers are constructed after making due allowance for changes in the coverage and methods of estimation as the absolute figures of area, yield, production, etc. are known to be unsuitable for a study of trends over time. Here, the area of crops area compared to base year (1980-81). For this following statistical equation is used.

$$\text{Area Index} = \frac{P_1}{P_o} \times 100$$

Where_

P_1 = Area crop in current year

P_o = Area of crop in base year

A. Index number of Food grain crop

Table No 5.3 shows the various selected food grain crops. The analysis of area under food grain crops was available on the base year 1989-90 = 100 %. The total food grain crops indices are remaining over 100 % during the period of 1991 to 1995 and 2001 to 2009. Remaining period of study, it is decreased and reached below 100 percent.

It is evident from the table no 5.3 the index of Moog is highest in the year 2004-05 and it is 760.41 %. Followed by Maize is second leading crop in index number 389.79 % in 1995-96 in all food grain crops in DZSD. The indices of Bajara and Tur crop shows us ups and downs through out the period of under study. Wheat crop indices is always remaining below 100 during the investigation period in study area. In the table no 5.3 also observed that all food grains crops are remaining below 100 % in during between 1996-97 to 1999-2000.

Especially in investigation period, Jawar, Maize and Moog these crops are increased and wheat, Bajara and tur these crops are decreased. Bajara crop indices has been increased in the period of 1991 to 1995, but after that it always remain below 100 % except period of 2003, 2004 and 2006. The indices of maize crop always increased over 300 % after the year of 2007.

Table - 5.3
DZSD: Index Number of Foodgrain Crops

Year / Crop	Jowar	Wheat	Bajara	Maize	Gram	Tur	Moog	Other	Total
1989-90	202878	32637	85898	3811	13938	11753	821	52208	406944
	100	100	100	100	100	100	100	100	100
1990-91	108.63	61.88	116.18	61.76	74.66	84.54	137.02	103.91	102.83
1991-92	105.88	52.29	120.96	68.93	75.83	108.71	131.66	76.72	99.01
1992-93	107.99	49.77	125.77	242.95	78.97	77.94	205.60	107.53	105.82
1993-94	129.33	57.03	141.36	83.60	166.84	121.37	229.84	66.32	117.86
1994-95	112.72	42.40	108.74	90.44	169.39	112.66	225.70	95.48	105.16
1995-96	112.77	62.54	134.58	389.79	106.65	115.55	236.41	91.62	112.51
1996-97	16.57	54.66	8.05	63.18	23.96	8.67	241.90	63.62	24.17
1997-98	13.68	40.56	6.30	64.47	21.83	7.92	86.96	6.35	13.97
1998-99	104.43	50.65	79.16	183.57	110.52	93.51	291.96	6.01	83.18
1999-00	9.82	42.04	4.81	76.27	43.17	8.22	190.01	8.78	13.22
2000-01	125.15	50.62	93.06	104.69	143.72	73.00	480.38	147.75	114.03
2001-02	152.17	58.13	5.85	60.32	56.21	79.30	654.44	164.45	108.96
2002-03	118.15	41.40	127.94	184.38	122.34	81.49	557.36	123.75	114.50
2003-04	117.37	68.31	115.71	221.83	196.52	100.44	730.32	97.75	114.16
2004-05	121.19	69.28	57.68	306.95	187.54	103.83	760.41	124.83	107.97
2005-06	123.07	65.45	3.11	78.74	190.39	130.27	483.43	108.62	95.65
2006-07	112.72	42.40	108.74	90.44	169.39	112.66	225.70	95.48	105.16
2007-08	121.62	73.04	50.53	352.84	169.39	112.66	591.18	95.48	102.96
2008-09	125.02	71.49	49.50	347.44	168.12	79.85	716.44	81.08	101.68
2009-10	116.15	71.49	49.50	347.44	168.12	79.85	605.23	111.77	100.96

Source : Compiled by Researcher

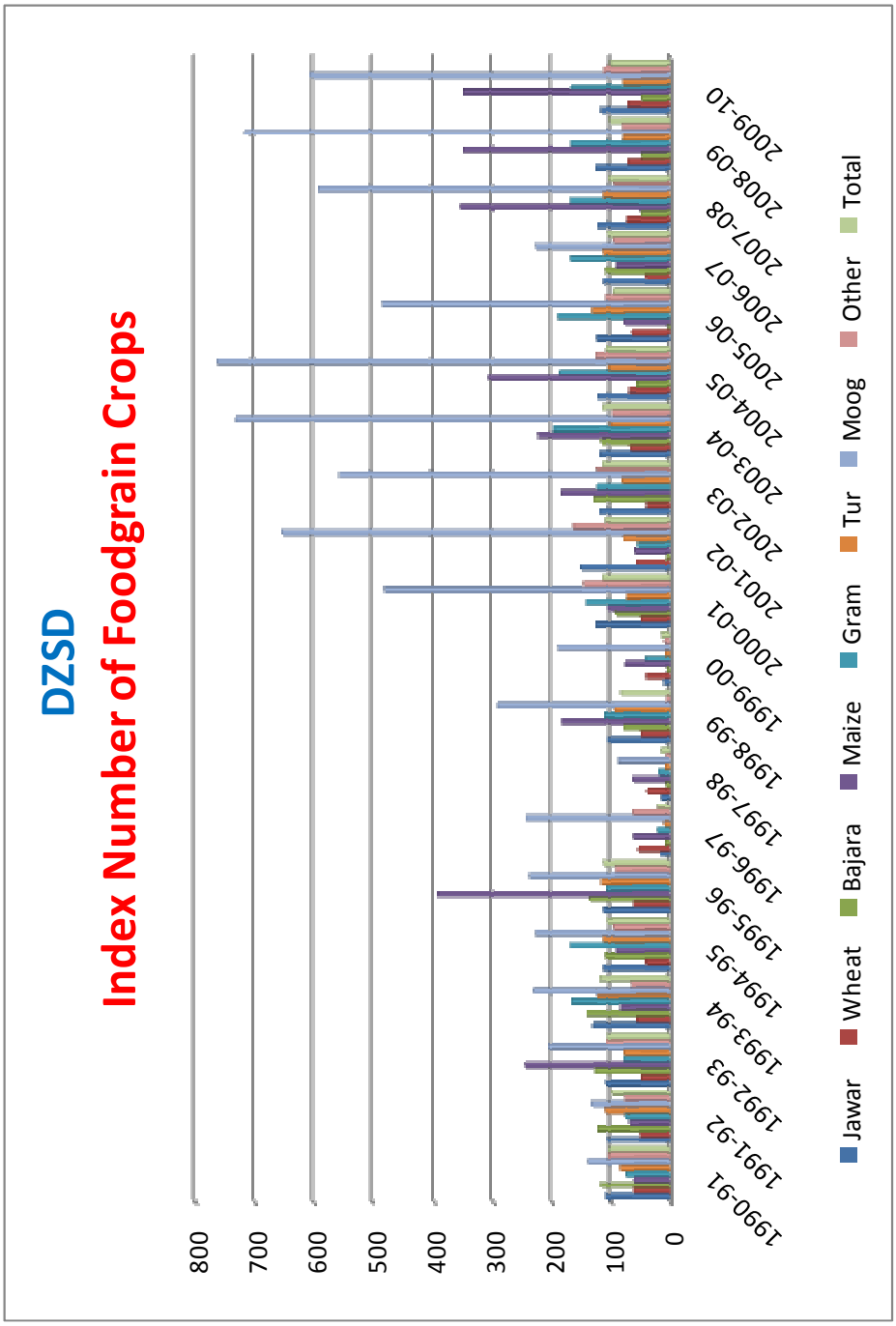

DZSD
Index Number of Foodgrain Crops
800
700
600
500
400
300
200
100
0
1990-91
1991-92
1992-93
1993-94
1994-95
1995-96
1996-97
1997-98
1998-99
1999-00
2000-01
2001-02
2002-03
2003-04
2004-05
2005-06
2006-07
2007-08
2008-09
2009-10
Jawar
Wheat
Bajara
Maize
Gram
Tur
Moog
Other
Total

Fig 5.3

B. Index number of Fruit crops

Table No 5.4 shows the details of area increased and decreased of different fruit crops in DZSD during the period under study. The index of area under total fruit crops are continuously increased and growth rate are also increased during the study region.

Table – 5.4

DZSD: Index Number of Fruit Crops

Year / Crops	Grape	Pomegranate	Ber	Mango	Crusted Apple	Banana	Sapota	Guava	Other	Total
1989-90	1123	709	482	186	148	220	185	99	241	3393
	100	100	100	100	100	100	100	100	100	100
1990-91	100.26	106.34	99.58	100	100	102.27	107.56	146.46	211.61	111.19
1991-92	113.80	139.21	101.66	104.83	103.37	97.72	118.91	153.53	78.83	114.38
1992-93	120.74	161.49	101.65	105.37	100.67	143.63	120.54	175.75	93.77	125.99
1993-94	124.48	168.82	99.58	105.37	101.35	138.63	129.18	177.77	88.79	128.35
1994-95	126.62	189.70	102.07	109.13	102.02	135.45	129.18	172.72	88.79	133.65
1995-96	130.72	198.87	103.52	110.21	102.02	139.54	137.29	173.73	86.30	137.75
1996-97	141.58	336.95	104.14	115.05	102.70	166.81	192.43	180.80	378.83	196.34
1997-98	193.67	445.13	110.37	127.41	118.91	161.36	206.48	186.86	271.36	232.00
1998-99	254.31	596.89	108.92	130.64	123.64	154.09	164.86	153.53	195.02	274.30
1999-00	295.72	764.45	116.18	137.63	133.78	151.36	233.51	157.57	212.44	329.73
2000-01	333.03	775.45	115.35	141.93	145.94	148.63	233.51	153.53	153.52	340.55
2001-02	357.96	793.08	116.80	145.16	154.72	147.72	262.16	151.51	123.65	352.57
2002-03	377.64	802.53	118.25	151.07	159.45	147.72	278.91	154.54	105.39	361.50
2003-04	389.22	803.80	117.84	150.53	162.83	144.99	290.27	160.60	102.07	366.04
2004-05	482.19	849.78	118.25	153.76	194.59	142.27	331.35	164.64	100.82	410.13
2005-06	555.03	833.85	128.00	140.32	195.27	141.81	352.97	166.66	101.65	432.86
2006-07	648.17	733.42	121.78	173.65	199.32	139.54	386.48	172.72	104.56	445.88
2007-08	680.58	723.83	120.33	220.43	206.08	139.54	404.32	185.85	107.88	458.85
2008-09	738.20	629.76	119.50	298.92	209.45	137.72	435.67	191.91	105.39	464.19
2009-10	743.54	486.03	118.67	360.21	215.54	135.45	481.62	216.16	526.97	472.44

Source: Compiled by Researcher

The highest indices are observed in grape fruit crop in 2009-10 and it is 743.54 %. Followed by pomegranate, Sapota fruit crops are also high indices. Grape fruit crop indices are continuously extent. But pomegranate indices are becoming low after 2005-06. Ber fruit crops index remaining below 100 % in only two years out of 20 years. However the rage of increasing of ber fruit crop area is below 130 %.

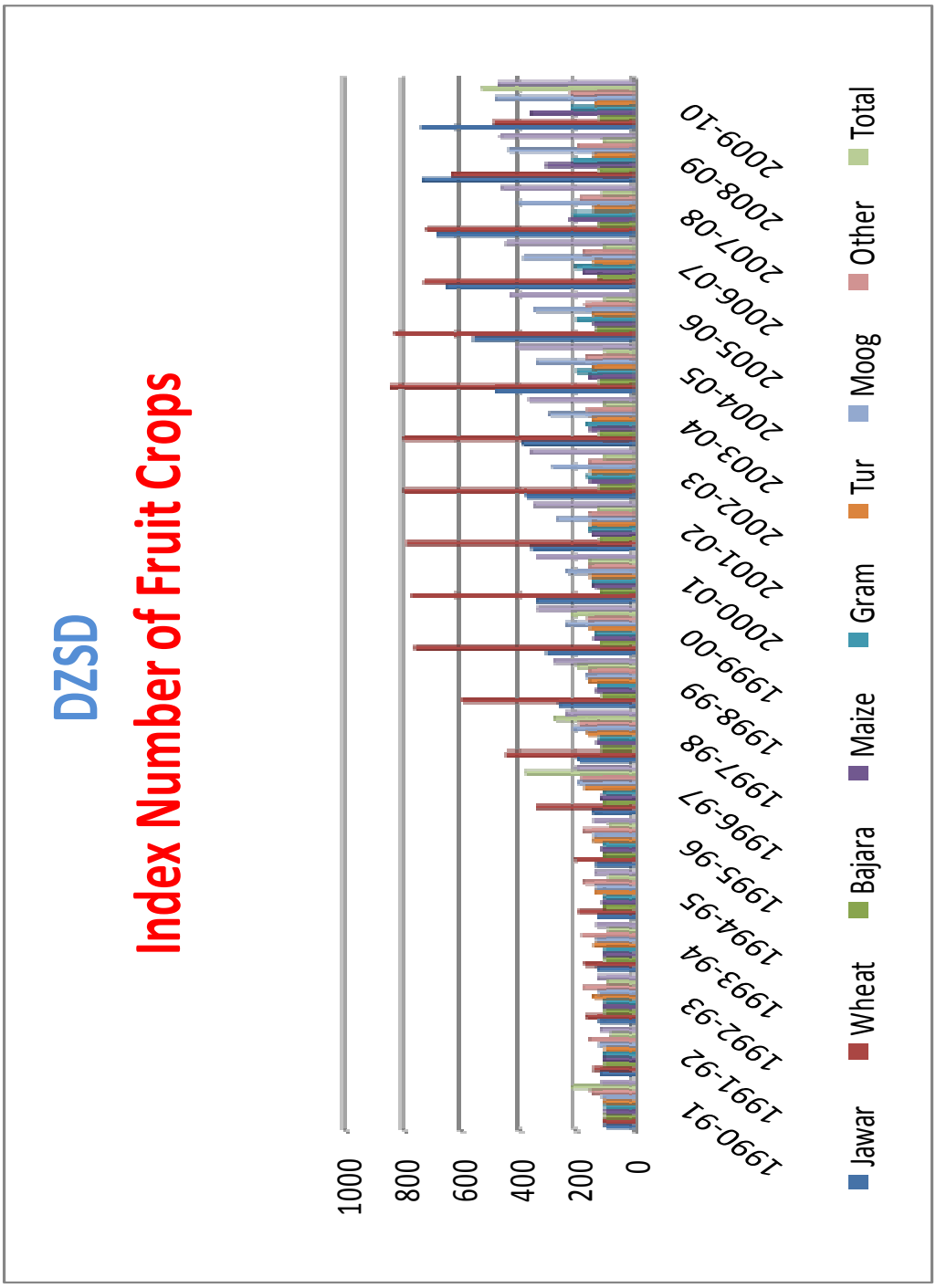

DZSD
Index Number of Fruit Crops
1000
800
600
400
200
0
1990-91
1991-92
1992-93
1993-94
1994-95
1995-96
1996-97
1997-98
1998-99
1999-00
2000-01
2001-02
2002-03
2003-04
2004-05
2005-06
2006-07
2007-08
2008-09
2009-10
Jawar
Wheat
Bajara
Maize
Gram
Tur
Moog
Other
Total

Fig 5.4

The index number of mango fruit crop is increased, but the growth rate is high (above 150) after the year of 2002-03. Crusted apple average index are increased in small scale or remain constant before 1997. After the year of 1996, the crusted apple indices are increased on large scale (above 110). The indices of Banana fruit crop has been increased near about 140 during the study region. Area under sapota crop index is continuously increasing and it becomes 481.62 % in 2009-10. The index number always remains up and down in study region but it always remain above 100 %.

1.4. Spatiotemporal Variation of Crops

The spatial distribution of food grain crops and fruit crops are uneven due to the scocio-economic and environmental variation in study region. The spatial distribution is studied in the reference year 2009-10 which is selected earlier year of study. In this section, the temporal changes in during the investigation period of 20 years area also analysised.

A. Food Grain

Foodgrains play a major role in the cropping of land under tillage in DZSD. For, only under foodgrains can the land produce enough to sustain the dense population in the region. Moreover foodgrain crops are relatively less demanding and less exacting in their soil moisture requirements than fiber crops. Further it is said that the cropping of some food pulses is unavoidable since it lends to satisfactory rotation. Foodgrains accounting for a major proportion (78.95 % in year 1989-90 and 75.98 % in year 2009-10) of net sown area in study region.

1. Jawar

Jawar is most importance as a staple crop in the DZSD. It is purely a tropical crop. It is grown as rabi crop in study region. It is one of the important Indian millets. The crop thrives well under the condition of high temperature and moderate rainfall. Generally, the local varieties of jowar are draught resistant and therefore, it is a very ideal crop in study region.

Table - 5.5
DZSD: Tahsilwise area under Jawar crop & change

Sr. No.	Tahasils	1989-90	% to NSA	2009-10	% to NSA	Change	%
1	Khanapur	36739	34.30	45247	51.80	+8508	+17.50
2	Atpadi	17154	26.80	28127	45.90	+10973	+19.10
3	Tasgaon	42108	48.01	40829	51.17	-1279	+3.16
4	Miraj	26249	34.40	29878	41.07	+3629	+6.67
5	K. Mahankal	17543	38.14	22760	44.26	+5217	+6.12
6	Jath	63085	46.97	68808	36.56	+5723	-10.41
	Total DZSD	202878	39.36	235649	43.58	+32771	+ 3.39

Source: Socio-economic Abstract of Sangli District 1989-90 & 2009-10

Among all the food grains, in the region, Jawar is staple food crop of the most of the rural population. It is first ranked crop. In the DZSD, jawar accounts for about 39.36 percent of net sown area as per reference year 1989-90. During the period of study under consideration, the area has increased by 3.39 percent. It has become 43.58 percent in reference year 2009-10. Nearly all tahsils of DZSD, the area under Jawar crop varies from 36 percent to above 50 percent. High area under jawar crop is observed in Khanapur tahsil (51.80 %) and low area is in Jath Tahsil (36.56 %). Temporal analysis of area under jawar crop brings out either positive or negative change (Table No 5.5). Area under jawar crop increased in five tahsils of DZSD out of these two tahsil, Khanapur and Atpadi have high (above 15 %) positive change observed and followed by 6 to 7 percent in Miraj & K.Mahankal and above 3 percent in Tasgaon Tahsil. only in Jath taluka has observed negative change. It is located in southeastern part of the DZSD. In this tahsil above 10 percent area under jawar crop is decreased.

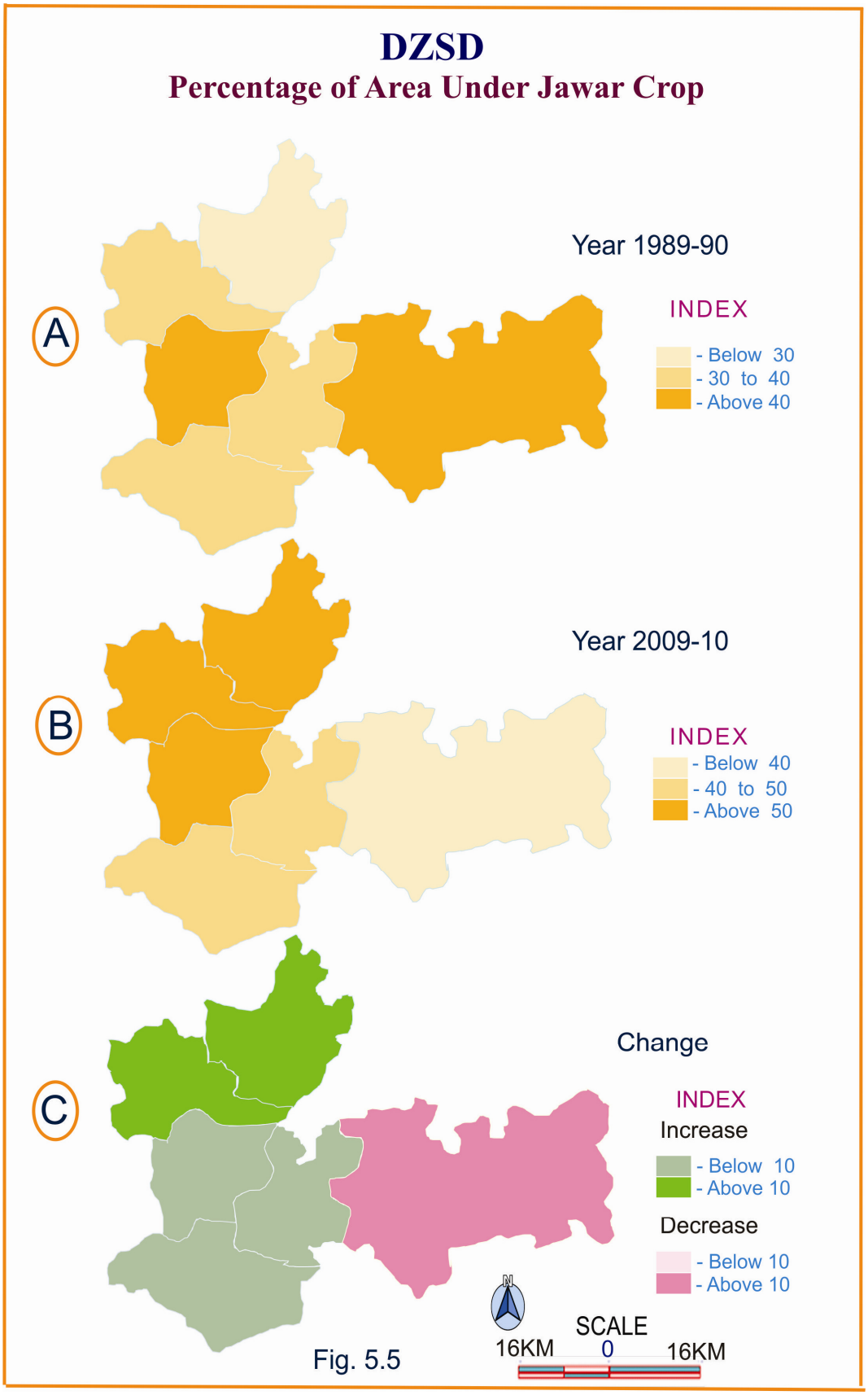

DZSD
Percentage of Area Under Jawar Crop
A
Year 1989-90
INDEX
- Below 30
- 30 to 40
- Above 40
B
Year 2009-10
INDEX
- Below 40
- 40 to 50
- Above 50
C
Change
INDEX
Increase
- Below 10
- Above 10
Decrease
- Below 10
- Above 10
N
SCALE
16KM 0 16KM

Fig. 5.5

2.**Bajara**

Bajara is second important foodgrains in the study region. It is a typical tropical plant and usually thrives in warm and drier types of climate. It is a kharif crop and is sown in Jun-July. It can withstands drought to a great extent and hence is suitable for tracts receiving about 400 to 500 mm rainfall and the ideal temperature range from 25° C to 34° C. It is a staple food crop which makes it staple food of a poor population in DZSD. It also provides good quality fodder for the livestock.

Table - 5.6
DZSD: Tahsilwise area under Bajara crop & change

Sr. No.	Tahasils	1980-85	% to NSA	2006-10	% to NSA	Change	%
1	Khanapur	12727	11.88	7325	8.38	-5402	-3.50
2	Atpadi	19292	30.14	1624	2.65	-17668	-27.49
3	Tasgaon	2314	2.64	1412	1.77	-902	-0.87
4	Miraj	6259	8.20	8260	11.35	+2001	+3.15
5	K. Mahankal	14572	31.67	9100	17.69	-5472	-13.98
6	Jath	30734	22.88	14805	7.87	-15929	-15.01
	Total DZSD	85898	16.67	42526	7.86	-43372	-15.02

Source: Socio-economic Abstract of Sangli District 1989-90 & 2009-10

Bajara is the second rank crop in the district accounting for a major proportion (16.67 percent in 1989-90 and 7.86 percent in 2009-10) to the net sown area. The spatial distribution of bajara is uneven. The highest proportion of bajara is observed in K.Mahankal tahsil (17.69 %) and lowest is in Tasgaon (1.77 %) and Atpadi tahsil (2.65 %). During the period of study under consideration, the area has decreased by 15.02 percent. It has become 7.86 percent in reference year in 2006-10. Tendency of all talukas has been found negative change expect Miraj tahsil. In Miraj tahsil, it has been increasingly only 3.15 percent to NSA. However the bajara area is largely decreasing in Atpadi (27.49 %) and followed by Jath (15.01 %) and K.Mahankal tahsil (13.98 %).

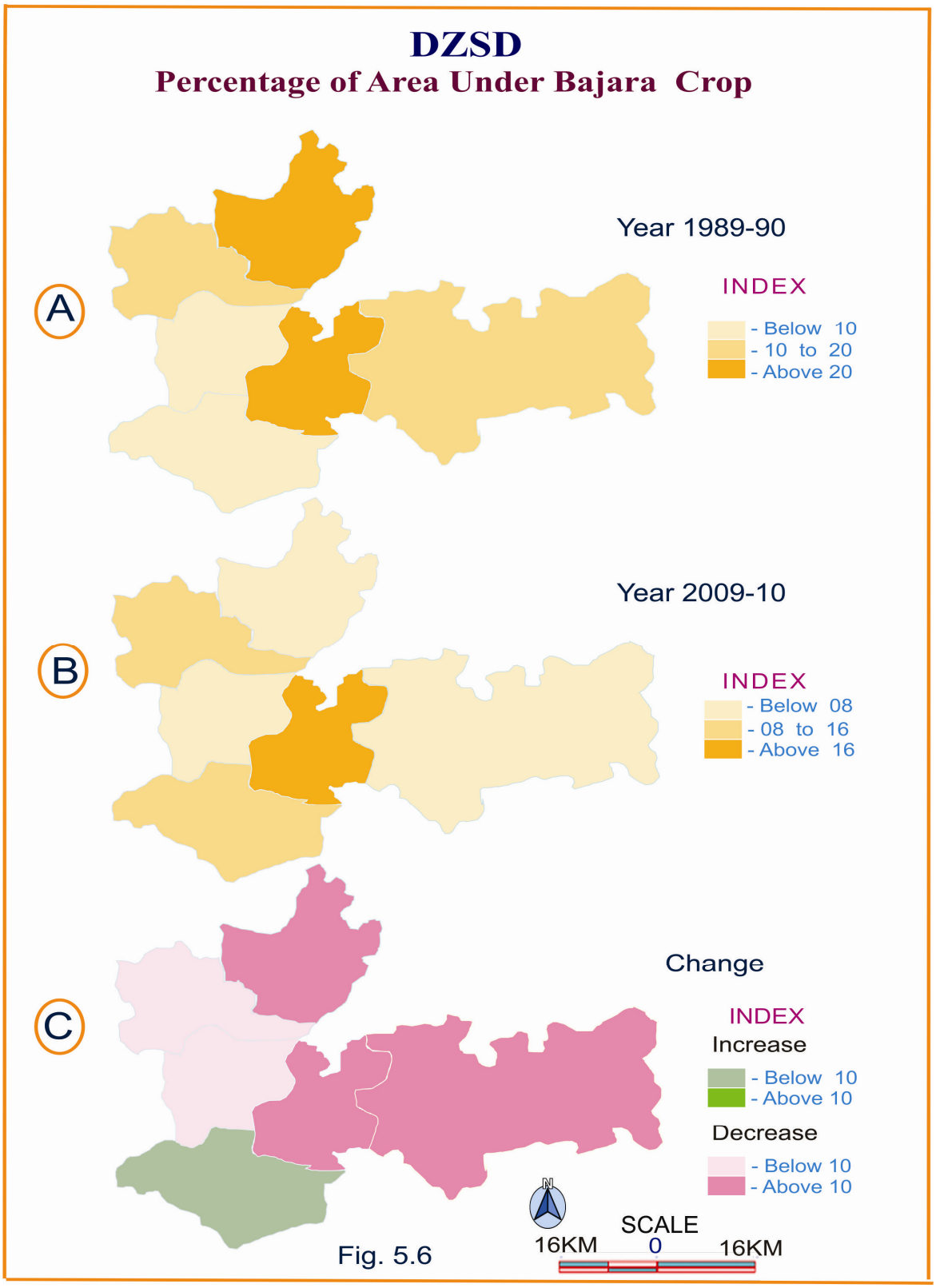

DZSD
Percentage of Area Under Bajara Crop
A
Year 1989-90
INDEX
- Below 10
- 10 to 20
- Above 20
B
Year 2009-10
INDEX
- Below 08
- 08 to 16
- Above 16
C
Change
INDEX
Increase
- Below 10
- Above 10
Decrease
- Below 10
- Above 10
N
SCALE
16KM 0 16KM

Fig. 5.6

3. Wheat

Wheat is another important food crop in DZSD. It is mainly a rabi crop. It is adopted to varying conditions of climate and soil. It grows better in winter when temperature between 10°C to 15°C., rainless days with clear and bright sunshine during ripening and harvesting period are necessary to have better quality of grains. Areas that are always moist and warm are not suited to this crop. It can be grown in the areas where rainfall is less than 500 mm, with the help of irrigation.

Table - 5.7
DZSD: Tahsilwise area under Wheat crop & change

Sr. No.	Tahasils	1989-90	% to NSA	2009-10	% to NSA	Change	%
1	Khanapur	10187	9.51	4557	5.21	-5630	- 4.30
2	Atpadi	4194	6.55	3021	4.93	-1173	-1.62
3	Tasgaon	5641	6.43	5347	6.70	-294	+ 0.27
4	Miraj	4151	5.44	3810	5.24	-341	- 0.20
5	K. Mahankal	3639	7.91	2673	5.20	-966	- 2.71
6	Jath	4825	3.59	3927	2.08	-898	- 1.51
	Total DZSD	32637	6.33	23335	4.31	-9302	- 2.02

Source: Socio-economic Abstract of Sangli District 1980-81 & 2004-05

The regional pattern of wheat distribution in table No 5.7 shows that the expansion of this crop in areas where irrigation is more developed as in 2006/10.

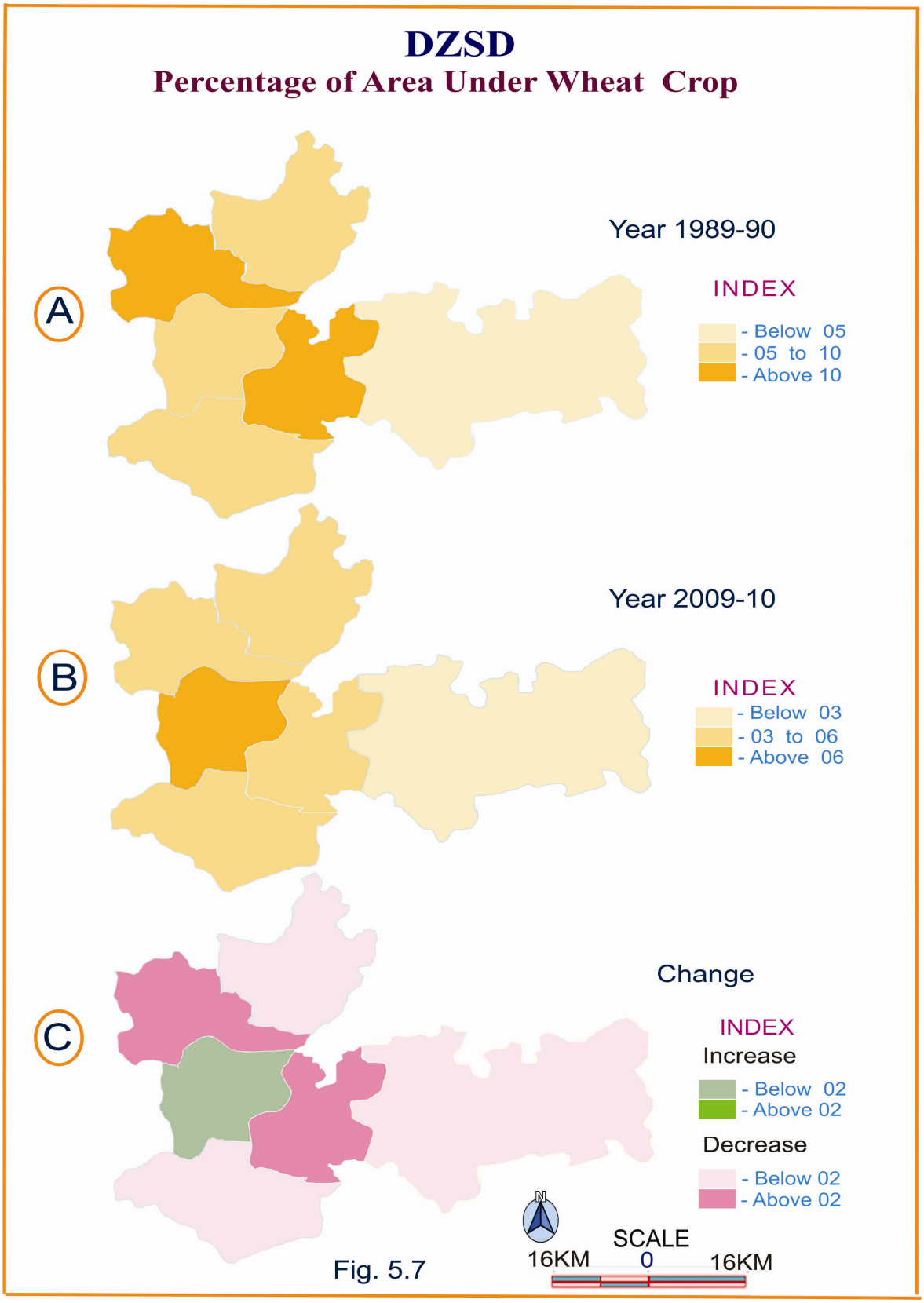

DZSD
Percentage of Area Under Wheat Crop
A
Year 1989-90
INDEX
- Below 05
- 05 to 10
- Above 10
B
Year 2009-10
INDEX
- Below 03
- 03 to 06
- Above 06
C
Change
INDEX
Increase
- Below 02
- Above 02
Decrease
- Below 02
- Above 02
N
SCALE
16KM
0
16KM

Fig. 5.7

The highest percentage of area under wheat is at Tasgaon (6.70 %). The moderate percentage (5 to 6 % of the net sown area) of wheat crop is observed in Khanapur, Miraj and K.Mahankal whereas the lowest percent (2.08 %) of the area under wheat crop is in Jath tahsil. It may be observed from Fig -5.7 that the area under wheat cultivation was 6.33 percent in 1989-90, which decreased to 4.31 percent of the net sown area in 2009-10. It decreased highly (above 4 %) in Khanapur and Jath, Miraj, K.Mahankal, & Atpadi tahsils also decreased to small extent (below 2 %). However, it is increased (0.27%) in only Tasgaon tahsils of the district due to the development of irrigation facilities.

4. Maize

Maize is the fourth most important food grain in the study area. It is locally called 'Maka'. It grows well in well-drained alluvial soil and black cotton soil. It requires warm and moist geographical condition. Maize is a rabbi crop grown in the month of winter season between October and March, so it needs irrigation facility. It is entirely produced as an irrigated crop.

Table - 5.8
DZSD: Tahsilwise area under Maize crop & change

Sr. No.	Tahasils	1989-90	% to NSA	2009-10	% to NSA	Change	%
1	Khanapur	122	0.11	2240	2.57	+2118	+ 2.46
2	Atpadi	261	0.40	824	1.35	+563	+ 0.95
3	Tasgaon	557	0.64	2491	3.12	+1934	+ 2.48
4	Miraj	2255	2.96	1668	2.29	-587	- 0.67
5	K. Mahankal	349	0.76	402	0.78	+53	+0.02
6	Jath	267	0.20	5616	2.98	+5349	+ 2.78
	Total DZSD	3811	0.74	13241	2.45	+9430	+ 1.71

Source: Socio-economic Abstract of Sangli District 1989-90 & 2009-10

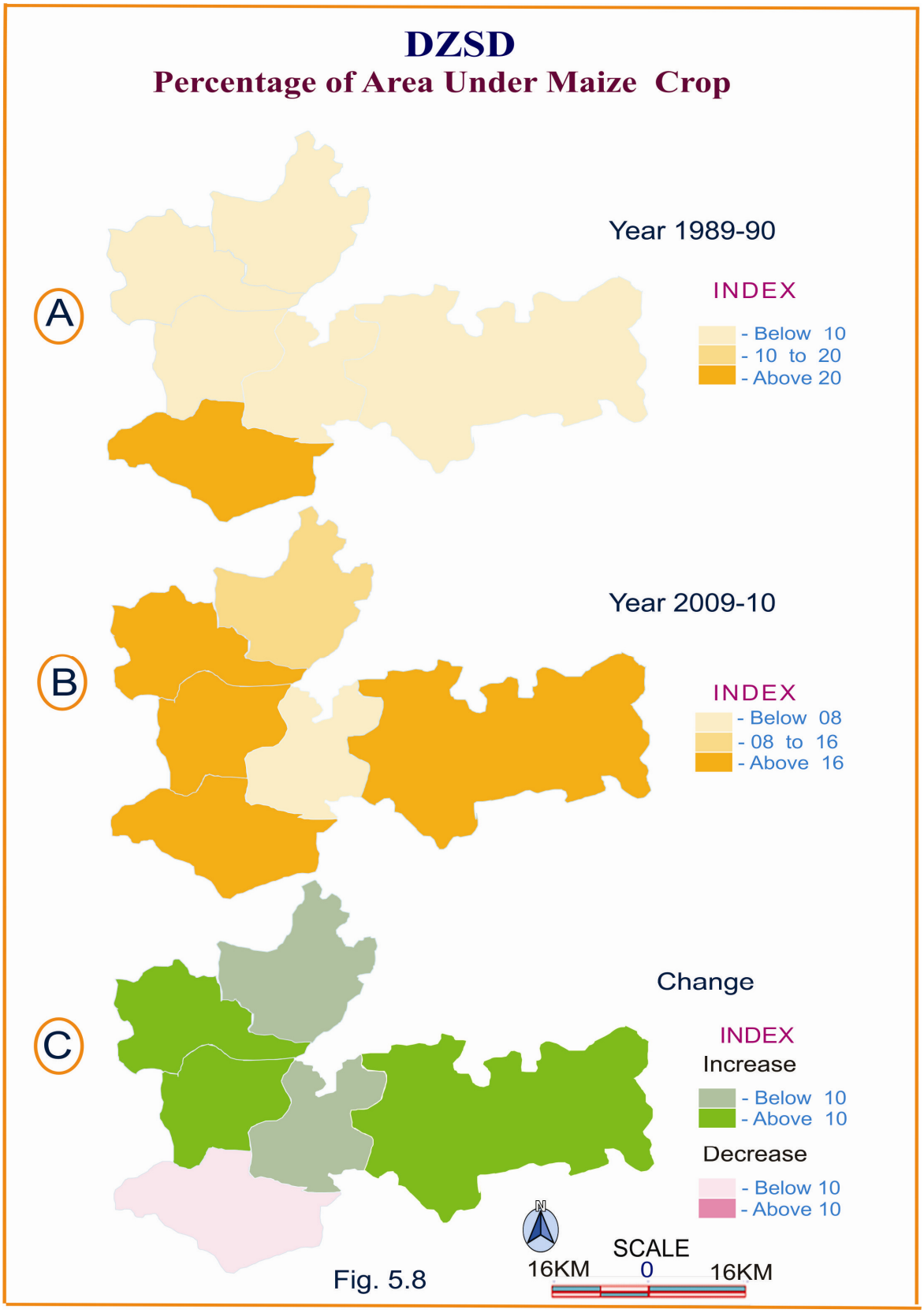

DZSD
Percentage of Area Under Maize Crop
A
Year 1989-90
INDEX
- Below 10
- 10 to 20
- Above 20
B
Year 2009-10
INDEX
- Below 08
- 08 to 16
- Above 16
C
Change
INDEX
Increase
- Below 10
- Above 10
Decrease
- Below 10
- Above 10
N
SCALE
16KM 0 16KM

Fig. 5.8

Table No 5.8 and Fig.5.8 observed that maize covered 0.74 percent of the net sown area in 1989-90 and 2.45 percent in 2009-10, it increased by 1.71 percent of the net sown area. Farmers grow maize on a small or large scale everywhere in the study area. It increased because it is largely used for livestock or growth of dairy farming.

The highest percentage of area under this crop is at Tasgaon (3.12 %) and then follows Jath (2.98 %) and Khanapur (2.57 %) and Miraj (2.29 %). The lowest area (0.78 %) of this crop is observed in K.Mahankal tahsil. However, it is increased (below 2 %) over all study area expect Miraj tahsil. In Miraj Tahsil, it is decreased because fruit crops and vegetables get maximum benefit compare to maize crop.

5. Gram

Gram or *chana* is a very important variety of pulses. It is an important rabbi crop mainly sown in sep-Oct and harvested in February in the study region. It is best suited to moderate rainfall and mild cold winter. It is best grown on sandy loam to clay loam and also grown in water-retentive clay loams and black cotton soil.

Table - 5.9
DZSD: Tahsilwise area under Gram crop & change

Sr. No.	Tahasils	1989-90	% to NSA	2009-10	% to NSA	Change	%
1	Khanapur	3832	3.58	4979	5.70	+1147	+ 1.82
2	Atpadi	313	0.49	1575	2.57	+1262	+2.08
3	Tasgaon	4506	5.14	6921	8.67	+2415	+3.53
4	Miraj	3172	4.16	5308	7.30	+2136	+3.14
5	K. Mahankal	932	2.03	2165	4.21	+1233	+2.18
6	Jath	1183	0.88	2485	1.32	+1302	+0.44
	Total DZSD	13938	2.70	23433	4.33	+9495	+1.63

Source: Socio-economic Abstract of Sangli District 1989-90 & 2009-10

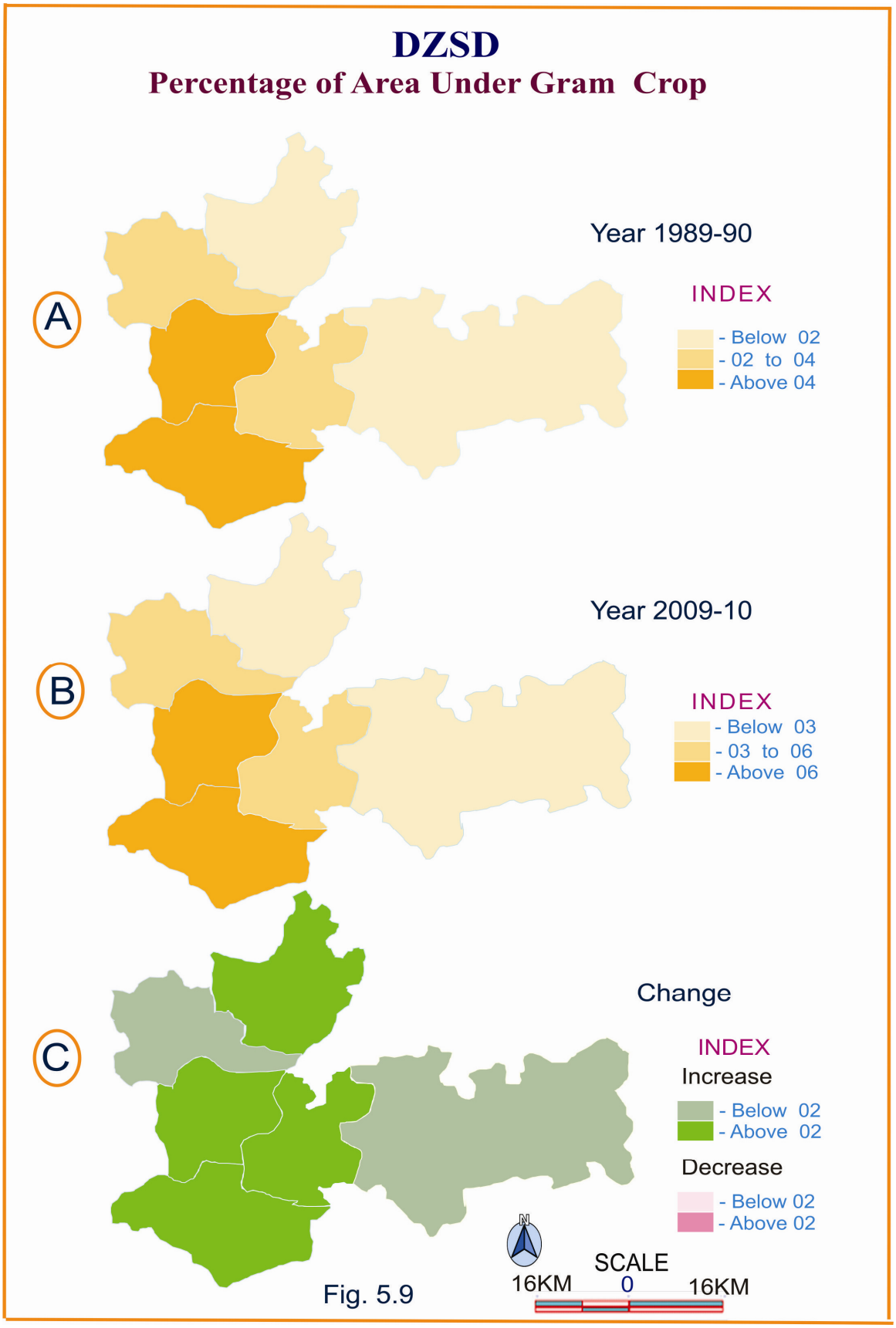

DZSD
Percentage of Area Under Gram Crop
A
Year 1989-90
INDEX
- Below 02
- 02 to 04
- Above 04
B
Year 2009-10
INDEX
- Below 03
- 03 to 06
- Above 06
C
Change
INDEX
Increase
- Below 02
- Above 02
Decrease
- Below 02
- Above 02
N
SCALE
16KM
0
16KM

Fig. 5.9

Table No 5.9 and Fig 5.9 shows the area under gram was 2.70 percent in 1989-90, which has been increased 1.63 percent and reach 4.33 percent in 2009-10. High area (8.67%) under gram is observed in Tasgaon tahsil followed by Miraj (7.30%). The moderate area (3 to 6 %) is observed in Khanapur and K.Mahankal tahsil. The low area (below 3 %) of gram is observed in Atpadi and Jath tahsils. The area under gram is increased over all tahsils of DZSD. The area under gram crop highly increased (above 3 %) in Tasgaon and Miraj tahsils between investigations. The moderate (2 to 3 %) increase is observed in only two tahsil i.e. Atpadi and K.Mahankal tahsil. Remaining part of DZSD has been observed small scale increase.

6. Tur

Tur is a kharif crop. It is cultivated in a wide range of soil from black clay to sandy. However, it is very sensitive to water logging condition. It is best suitable for dry land farming and is predominantly used as an intercrop with other crops like cotton, groundnut, etc.

Table - 5.10
DZSD: Tahsilwise area under Tur crop & change

Sr. No.	Tahasils	1989-90	% to NSA	2009-10	% to NSA	Change	%
1	Khanapur	3251	3.04	3624	4.15	+373	+1.11
2	Atpadi	776	1.21	1086	1.77	+310	+0.56
3	Tasgaon	3743	4.27	1636	2.05	-2107	-2.22
4	Miraj	2797	3.67	1192	1.64	-1605	-2.03
5	K. Mahankal	703	1.53	1000	1.94	+297	+0.41
6	Jath	483	0.36	847	0.45	+364	+0.09
	Total DZSD	11753	2.28	9385	1.74	-2368	-0.54

Source: Socio-economic Abstract of Sangli District 1989-90 & 2009-10

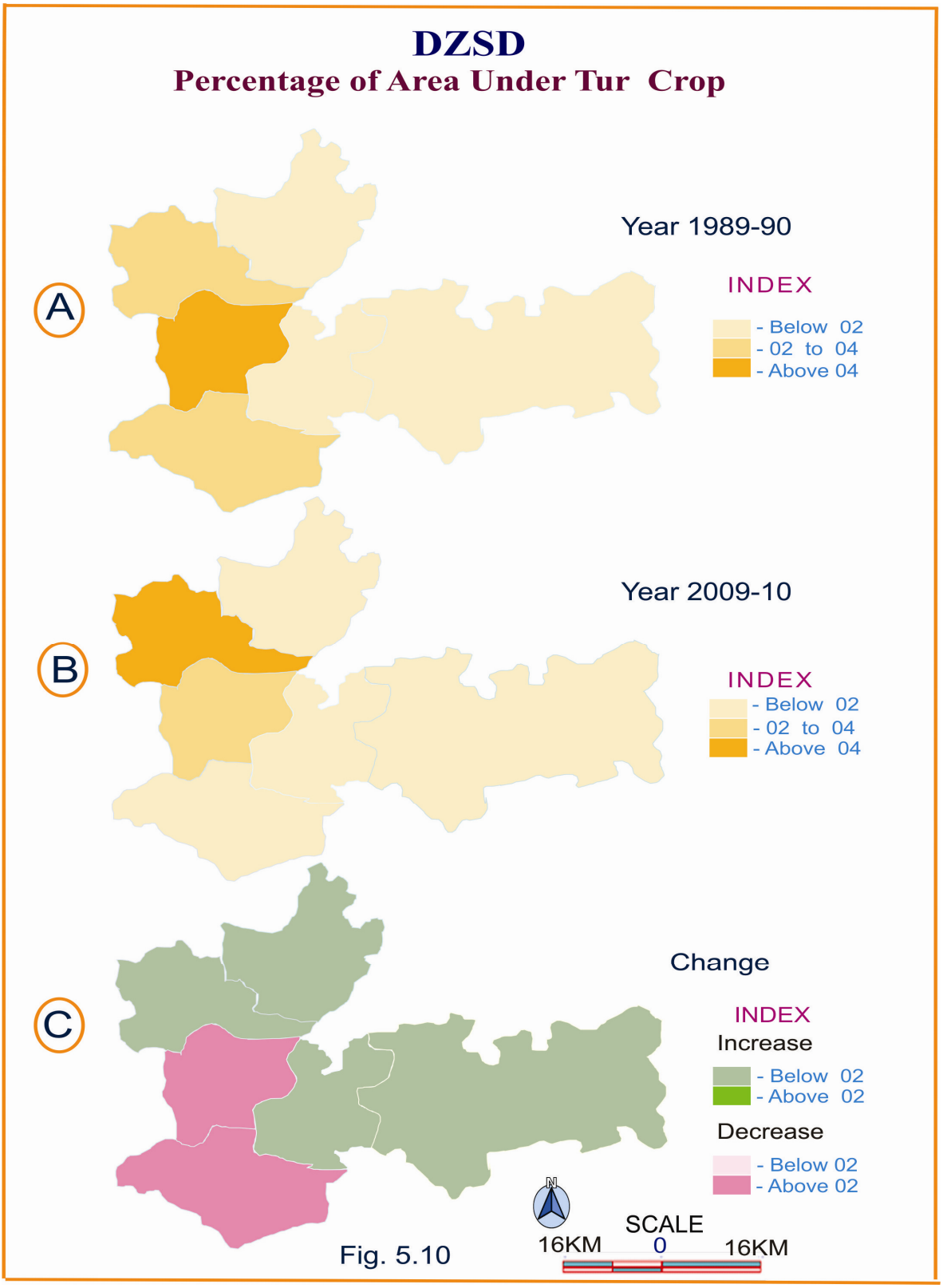

DZSD
Percentage of Area Under Tur Crop
A
Year 1989-90
INDEX
- Below 02
- 02 to 04
- Above 04
B
Year 2009-10
INDEX
- Below 02
- 02 to 04
- Above 04
C
Change
INDEX
Increase
- Below 02
- Above 02
Decrease
- Below 02
- Above 02
N
SCALE
16KM 0 16KM

Fig. 5.10

Tur is common and important cash crop in DZSD. The area under tur was 11753 hectors (2.28 % to NSA) in 1989-90 and 9385 hectors (1.74 % to NSA) in 2009-10. The area under tur crop has been decreased by 0.54 percent in DZSD during the period under study. The positive changes have been observed in area under tur in Khanapur (1.11%), Atpadi (0.56 %), K.Mahankal (0.41%) and Jath tahsil (0.09 %) during the period under study. The negative changes have been recorded in area under tur crop in Tasgaon (2.22 %) and Miraj tahsil (2.03%). (Map No 5.10)

7. Mug

Mug is very important crop in total pulses. It is an important kharif crop mainly sown in jun-july and harvested in September-October in the study region. It is best suited to moderate rainfall. It is best grown on sandy loam to clay loam and also grown in water-retentive clay loams and black cotton soil. It is dominantly cultivated dry land farming.

Table - 5.11
DZSD: Tahsilwise area under Mug crop & change

Sr. No.	Tahasils	1989-90	% to NSA	2009-10	% to NSA	Change	%
1	Khanapur	169	0.16	1502	1.72	+1333	+1.65
2	Atpadi	09	0.02	122	0.20	+113	+0.18
3	Tasgaon	209	0.23	405	0.50	+196	+0.27
4	Miraj	276	0.36	1408	1.94	+1132	+1.58
5	K. Mahankal	76	0.16	100	0.19	+24	+0.03
6	Jath	82	0.06	1432	0.76	+1350	+0.70
	Total DZSD	821	0.16	4969	0.92	+4148	+0.76

Source: Socio-economic Abstract of Sangli District 1989-90 & 2009-10

The area under gram was 821 hectors (0.16 %) in 1989-90, which increased in 2009-10 i.e. 0.92 percent of the net sown area. Table No 5.11 and Fig No 5.11 show the area under moog below 2 percent of the net sown area in the study region in 2009-10. High area (1.94 %) under moog is observed in Miraj tahsil followed by Khanapur (1.72%). All remaining part of district the area under moog is very low. The area under moog crop increased (above 1 to 2 %) in Khanapur and Miraj tahsils between investigation period. Remaining part of study area small scale (below 1%) positive change is observed.

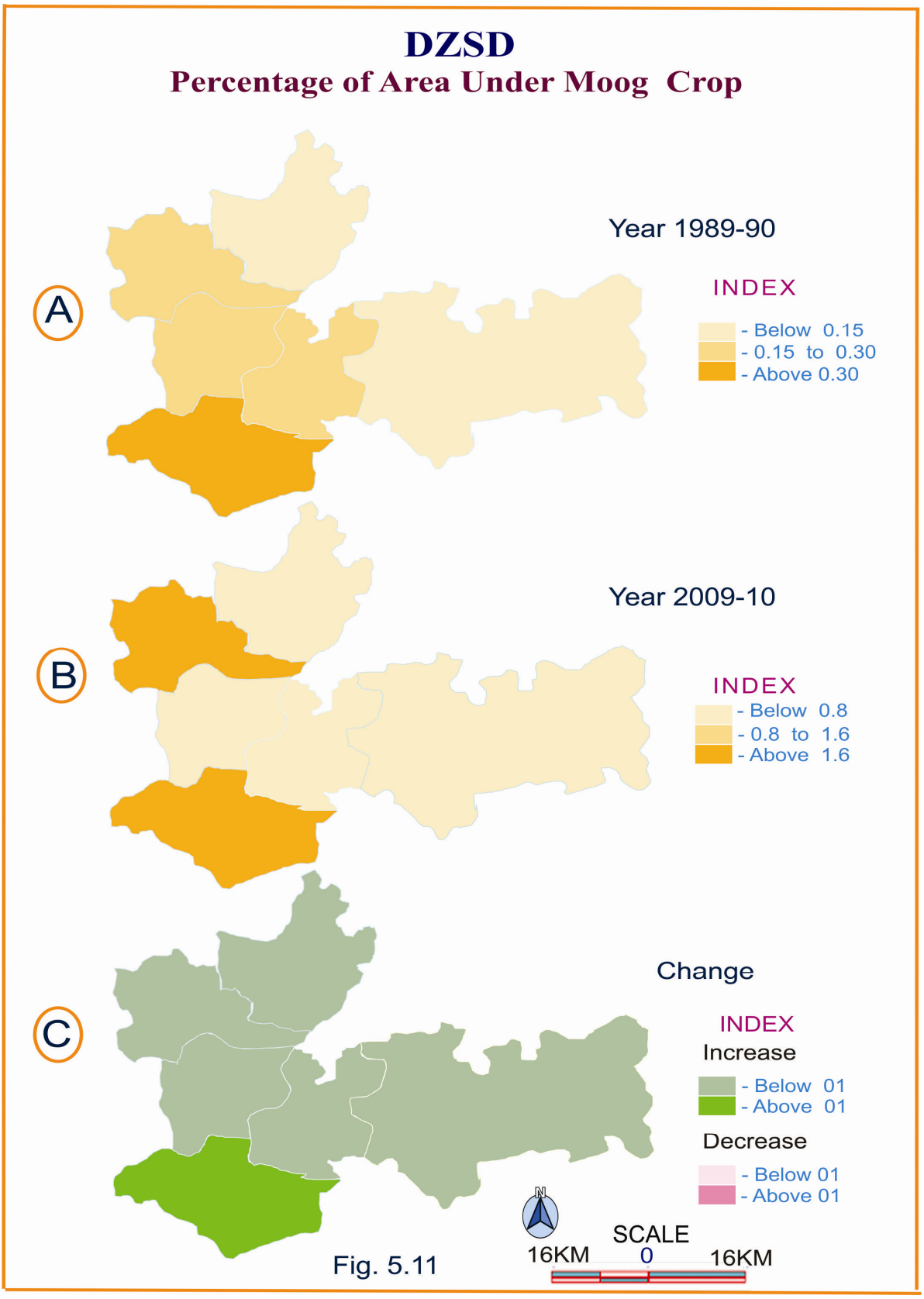

DZSD
Percentage of Area Under Moog Crop
A
Year 1989-90
INDEX
- Below 0.15
- 0.15 to 0.30
- Above 0.30
B
Year 2009-10
INDEX
- Below 0.8
- 0.8 to 1.6
- Above 1.6
C
Change
INDEX
Increase
- Below 01
- Above 01
Decrease
- Below 01
- Above 01
N
SCALE
16KM 0 16KM

Fig. 5.11

B. Spatial Distribution of fruit crops

Fruits comprise a large range of crops which differ in their perishability, seasonality and value and also their soil and climatic requirements. These physical and socio-economical factors are varied region to region in DZSD. Varieties of fruits are grown in study region which share insignificant (0.65 %) land under these crops to net sown area in the reference year 1989-90. The percentage has increased by 2.31 percent during the period of 20 years. (period under consideration). However, the spatial patterns of fruit crops are uneven in study region.

Table - 5.12
DZSD: Tahsilwise area under fruit crop & change

Sr. No.	Tahasils	1989-90	% to NSA	2009-10	% to NSA	Change	%
1	Khanapur	416	0.38	4621	5.30	4205	+ 4.92
2	Atpadi	195	0.30	1133	1.84	938	+ 1.54
3	Tasgaon	726	0.83	3919	4.91	3196	+ 4.08
4	Miraj	1058	1.38	1843	2.53	785	+ 1.15
5	K. Mahankal	411	0.89	672	1.30	261	+ 0.41
6	Jath	587	0.43	3842	2.04	3255	+ 1.61
	Total DZSD	3393	0.65	16030	2.96	12637	+ 2.31

Source: Socio-economic Abstract of Sangli District 1989-90 & 2009-10

Table No 5.12 noticed that the spatial distribution of fruit crops for the reference year 2009-10 and change during investigation period. All the talukas possess some area under fruit crops.

This percentage varies from 1.30 percent to 5.30 percent. Of these nearly 65 percent talukas belong to low grade (1.30 % to 2.53 %). These talukas lie in central, southern and south-eastern part of the study region. Two talukas belong to the highest percentage under these crops found in Khanapur and Tasgaon tahsil (Above 4.5 %). These talukas lie in central and north-western part of the DZSD.

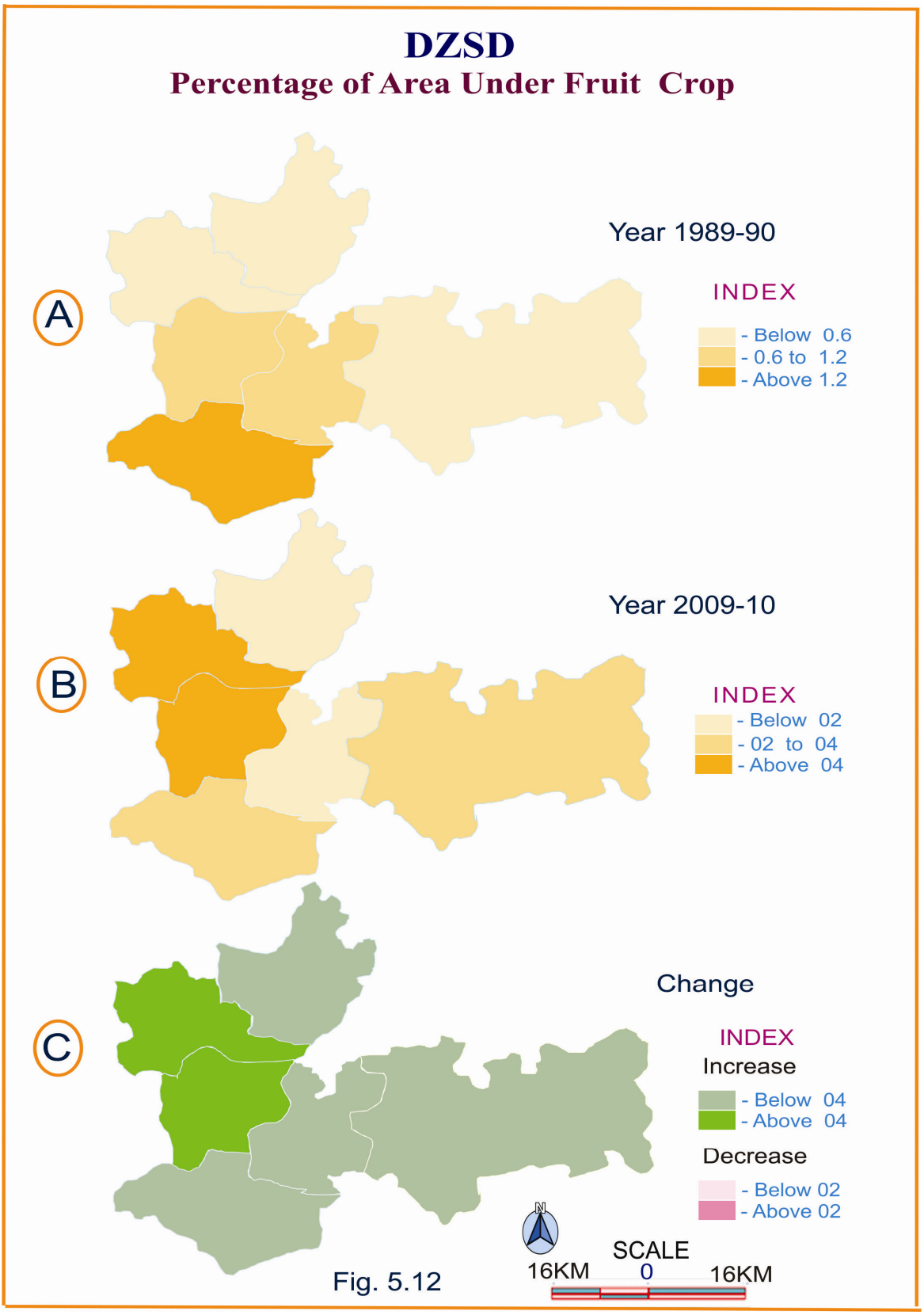

DZSD
Percentage of Area Under Fruit Crop
A
Year 1989-90
INDEX
- Below 0.6
- 0.6 to 1.2
- Above 1.2
B
Year 2009-10
INDEX
- Below 02
- 02 to 04
- Above 04
C
Change
INDEX
Increase
- Below 04
- Above 04
Decrease
- Below 02
- Above 02
N
SCALE
16KM 0 16KM

Fig. 5.12

During the period under consideration drastic changes have taken place so far as fruit are concerned. Land under these crops is increased in the year 2009-10 because of the rainfall amount decreasing day by day. Fruit crops demand and market rate are higher than other traditional crops i.e. jawar, bajara, etc. Sugarcane and wheat crops require more water than these crops. So the tendency of farmers change, they replace the traditional crops by fruits crops. All the talukas in DZSD are involved in positive change. Of the total talukas, the high positive (above 2 %) change observed in Khanapur and Tasgaon tahsil. The medium positive change (1% to 2%) are three talukas and these talukas are Atpadi, Miraj and Jath. The lowest positive change (below 1 %) is observed in only K.Mahankal tahsil.

In present investigation fruit crops are treated separately because many fruit crops are cultivated in study region and their distribution is uneven. However, it is need to spatial distribution different crops and change in study region. The fruit crops are very low, that's why its percentage can't be calculated to net sown area, these calculated to total fruit crop area in each tahsil.

1. Grape

Grape is very important fruit crop in drought prone area of Sangli District. Sangli region grape is popular in whole national and international market for its quality and taste. It is need very few water compare to other food grain crop. It is more beneficial compare to other fruit crops in study region. The environmental condition is more responsible for grape cultivation. So the farmers are turned to grape cultivation in study region.

Table - 5.13
DZSD: Tahsilwise area under Grape fruit crop & change

Sr. No.	Tahasils	1989-90	% to FCA	2009-10	% to FCA	Change	%
1	Khanapur	89	21.39	2580	55.83	+ 2491	+ 34.44
2	Atpadi	39	20.00	279	24.62	+ 240	+ 4.62
3	Tasgaon	358	49.31	3126	79.76	+2768	+30.45
4	Miraj	470	44.42	948	51.43	+478	+07.01
5	K. Mahankal	62	15.08	277	41.22	+215	+26.14
6	Jath	105	17.88	1140	29.67	+1035	+11.79
	Total DZSD	1123	33.09	8350	52.09	+7227	+19.00

Source: 1. Socio-economic Abstract of Sangli District 1989-90 & 2009-10
2. Agriculture Dept. of Zila Parishad, Sangli

Table No 5.13 describes the spatio-temporal distribution of grape crop in DZSD. It is leading and continuous growing crop in study region. It is cultivated only 1123 hect. in the reference year 1989-90, but it is tremendously growing during the investigation period. It is capture 8350 hect. in 2009-10. It is growing over all tahsil of DZSD. It is highly (above 75% to FCA) cultivated in only Tasgaon tahsil because the irrigation facilities are more developed. It is moderately (50 to 75 % to FCA) cultivated in Khanapur and Miraj tahsil. The low area (Below 50%) is observed in Jath, Atpadi and K.Mahankal tahsil which are waiting of development of irrigation facilities.

During the investigation period grape is increased 19 percent to total fruit crop area. However this growth is uneven in all tahsils. It is more (above 30 %) in Khanapur and Tasgaon Tahsil and low (below 10%) in Atpadi and Miraj tahsil.

2. Pomegranate

Pomegranate is another important fruit crop in DZSD. It is very popular and low water required crop. It is cultivated only 709 hect. on DZSD in the reference year 1989-90, however it is increasing 3446 hect. in the reference year 2009-10. After the socio-economic development of farmers, they have been seen to agriculture on a commercial way. Among the commercial farming grape and pomegranate are dominant fruit crop.

Table - 5.14
DZSD: Tahsilwise area under Pomegranate fruit crop & change

Sr. No.	Tahasils	1989-90	% to FCA	2009-10	% to FCA	Change	%
1	Khanapur	92	22.11	860	18.61	+ 768	-3.50
2	Atpadi	65	33.33	460	40.96	+ 395	+ 7.63
3	Tasgaon	113	15.56	46	1.17	- 67	-14.39
4	Miraj	255	24.10	246	13.34	-09	-10.76
5	K. Mahankal	88	21.41	125	18.60	+37	-2.81
6	Jath	96	16.35	1709	44.48	+1613	+28.13
	DZSD	709	20.89	3446	21.49	+2737	+0.60

Source: 1. Socio-economic Abstract of Sangli District 1989-90 & 2009-10
2. Agriculture Dept. of Zila Parishad, Sangli

Table No 5.14 shows the spatial distribution of pomegranate fruit crop. It is uneven due to the variation of environmental condition. The highest area (above 30 % to FCA) is observed in Jath and Atapadi Tahsil. The moderate area (15 to 30 % to FCA) under this crop is observed in Khanapur and K.Mahankal tahsil. The lowest area (below 15 to FCA) is noticed on Tasgaon and Miraj tahsil of DZSD.

Pomegranate is large cash devoting crop in DZSD. After the development of irrigation facilities, it is cultivated firstly on barren and fallow land, after that it replaced by food grain crop like Bajara, Jawar etc.

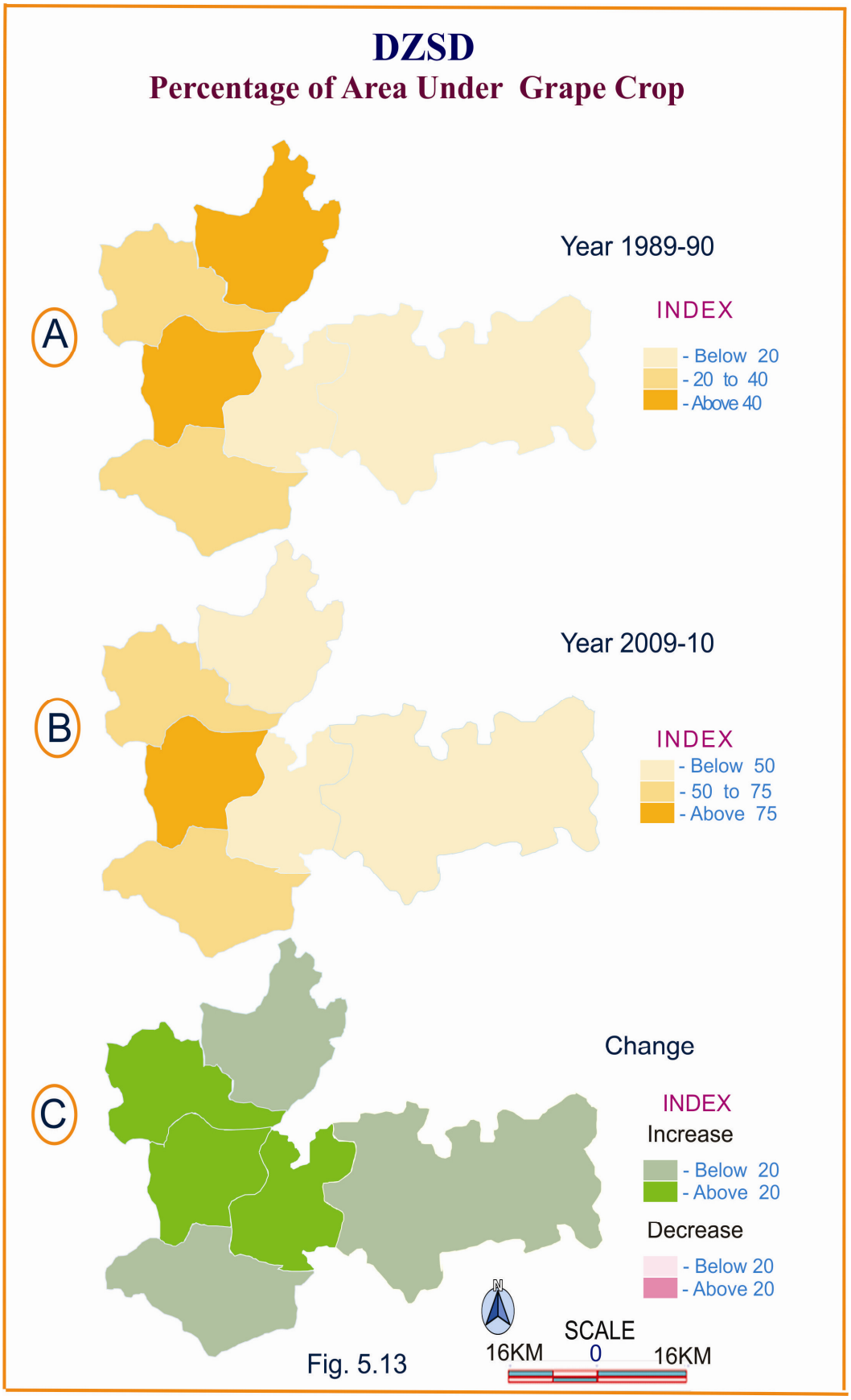

DZSD
Percentage of Area Under Grape Crop
A
Year 1989-90
INDEX
- Below 20
- 20 to 40
- Above 40
B
Year 2009-10
INDEX
- Below 50
- 50 to 75
- Above 75
C
Change
INDEX
Increase
- Below 20
- Above 20
Decrease
- Below 20
- Above 20
N
SCALE
16KM
0
16KM

Fig. 5.13

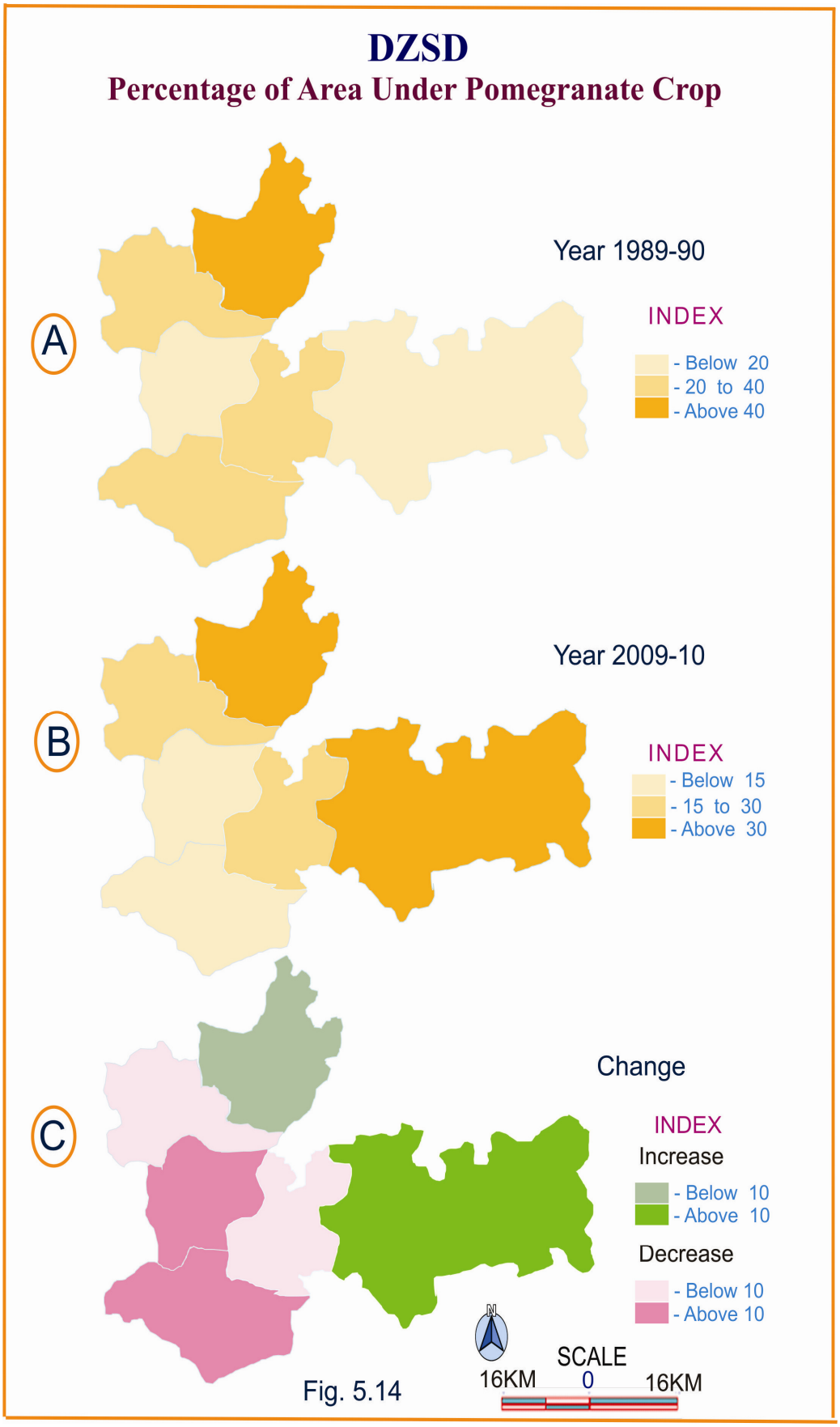

DZSD
Percentage of Area Under Pomegranate Crop
A
Year 1989-90
INDEX
- Below 20
- 20 to 40
- Above 40
B
Year 2009-10
INDEX
- Below 15
- 15 to 30
- Above 30
C
Change
INDEX
Increase
- Below 10
- Above 10
Decrease
- Below 10
- Above 10
N
SCALE
16KM 0 16KM

Fig. 5.14

During the investigation period it is increased 2737 hect. and it's share in FCA is increased only 0.60 percent in study area. The highest growth is observed in 1613 hect. (28.13 % to FCA) in Jath Tahsil and lowest growth is observed in K.Mahankal tahsil but the percentage of this fruit crop to total fruit crop is decreased. The area under pomegranate fruit is decreased in Tasgaon and Miraj tahsil due the attack of '*telya'* disease, they replaced it by grape fruit crop.

3. **Ber**

Ber is one of the ancient suited and sturdy fruit crops. It is often called the poor man's fruit. Many types of popular variety developed in ber crop. It is cultivated in shallow soil with low water requirement. It is cultivated on 482 hect. (14.20% to FCA) in the reference year 1989-90 which is increased 90 hect. in during the study period. However, the share of ber crop in FCA is decreased, it noticed that the trend of fruit farming cultivator divert to other fruit crop like pomegranate and grape crop.

Table - 5.15
DZSD: Tahsilwise area under Ber fruit crop & change

Sr. No.	Tahasils	1989-90	% to FCA	2009-10	% to FCA	Change	%
1	Khanapur	37	8.89	117	2.53	+ 80	-6.36
2	Atpadi	16	8.20	61	5.38	+ 45	-2.82
3	Tasgaon	98	13.49	103	2.62	+05	-11.27
4	Miraj	105	9.92	88	4.77	- 17	-5.15
5	K. Mahankal	59	14.35	26	3.86	- 33	-10.49
6	Jath	167	28.44	177	4.60	+ 10	-23.84
	DZSD	482	14.20	572	3.57	+90	-10.63

Source: 1. Socio-economic Abstract of Sangli District 1989-90 & 2009-10
2. Agriculture Dept. of Zila Parishad, Sangli

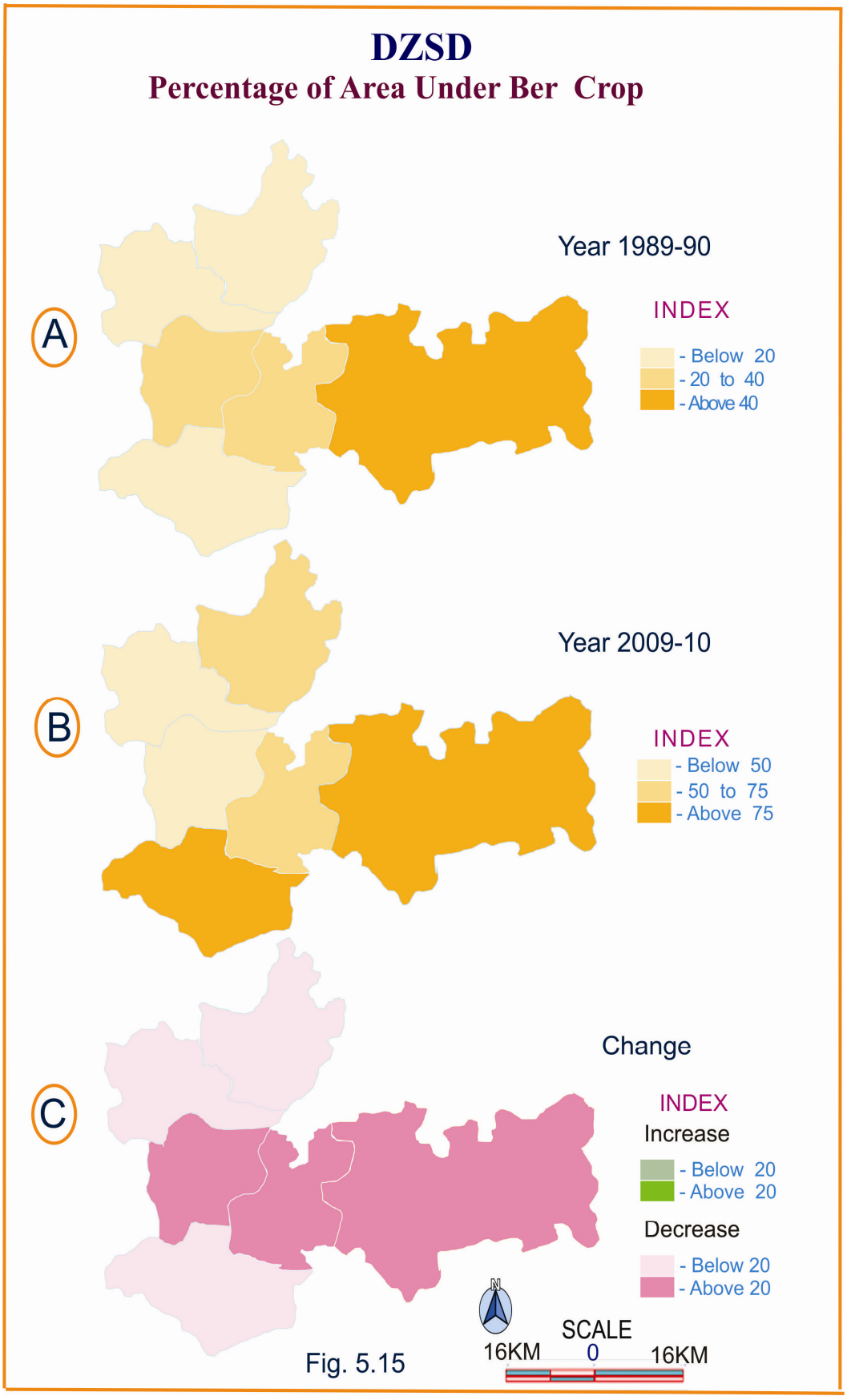

DZSD
Percentage of Area Under Ber Crop
A
Year 1989-90
INDEX
- Below 20
- 20 to 40
- Above 40
B
Year 2009-10
INDEX
- Below 50
- 50 to 75
- Above 75
C
Change
INDEX
Increase
- Below 20
- Above 20
Decrease
- Below 20
- Above 20
N
SCALE
16KM 0 16KM

Fig. 5.15

Table No 5.15 noticed the spatial distribution of ber fruit crop in 2009-10 year. The highest ber area is observed in Jath tahsil but they consist only 4.60 percent area of total fruit crop area. The lowest ber area is recorded in Tasgaon tahsil which share 2.62 percent area of FCA. The temporal analysis reveals that the area under ber crop increased 90 hect. but it's share to total fruit crop area decreased in all tahsil of study. The maximum decrease is lie in Jath (23.84% to FCA) and lowest (2.82 % to FCA) in Atpadi tahsil.

4. Mango

Mango, popularly known as the king of fruit. Mango tree is well adopted to tropical and subtropical environmental conditions. It is cultivated in traditional way by DZSD's farmers in long time. But now a days, it is cultivated on commercial way means it is cultivated on a garden or total peace of land. it is cultivated only 186 hect. (5.48% to FCA) in the reference year 1980-81, however in the year 2009-10, it is cultivated on 670 hect. (4.17% to FCA) in study region. If the area under mango crop is increased (484 hect.), but the share of in total fruit crop is decreased (1.31% to FCA) during the investigation period of 20 years.

Table - 5.16
DZSD: Tahsilwise area under Mango fruit crop & change

Sr. No.	Tahasils	1989-90	% to FCA	2009-10	% to FCA	Change	%
1	Khanapur	45	10.81	259	5.60	+ 214	-5.21
2	Atpadi	09	4.61	96	8.47	+ 87	+ 3.86
3	Tasgaon	16	2.20	80	2.04	+ 64	-0.16
4	Miraj	58	5.48	101	5.48	+ 43	00
5	K. Mahankal	35	8.52	23	3.42	- 12	-5.10
6	Jath	23	3.91	111	2.89	+ 88	-1.02
	Total DZSD	186	5.48	670	4.17	+ 484	- 1.31

Source: 1. Socio-economic Abstract of Sangli District 1989-90 & 2009-10
2. Agriculture Dept. of Zila Parishad, Sangli

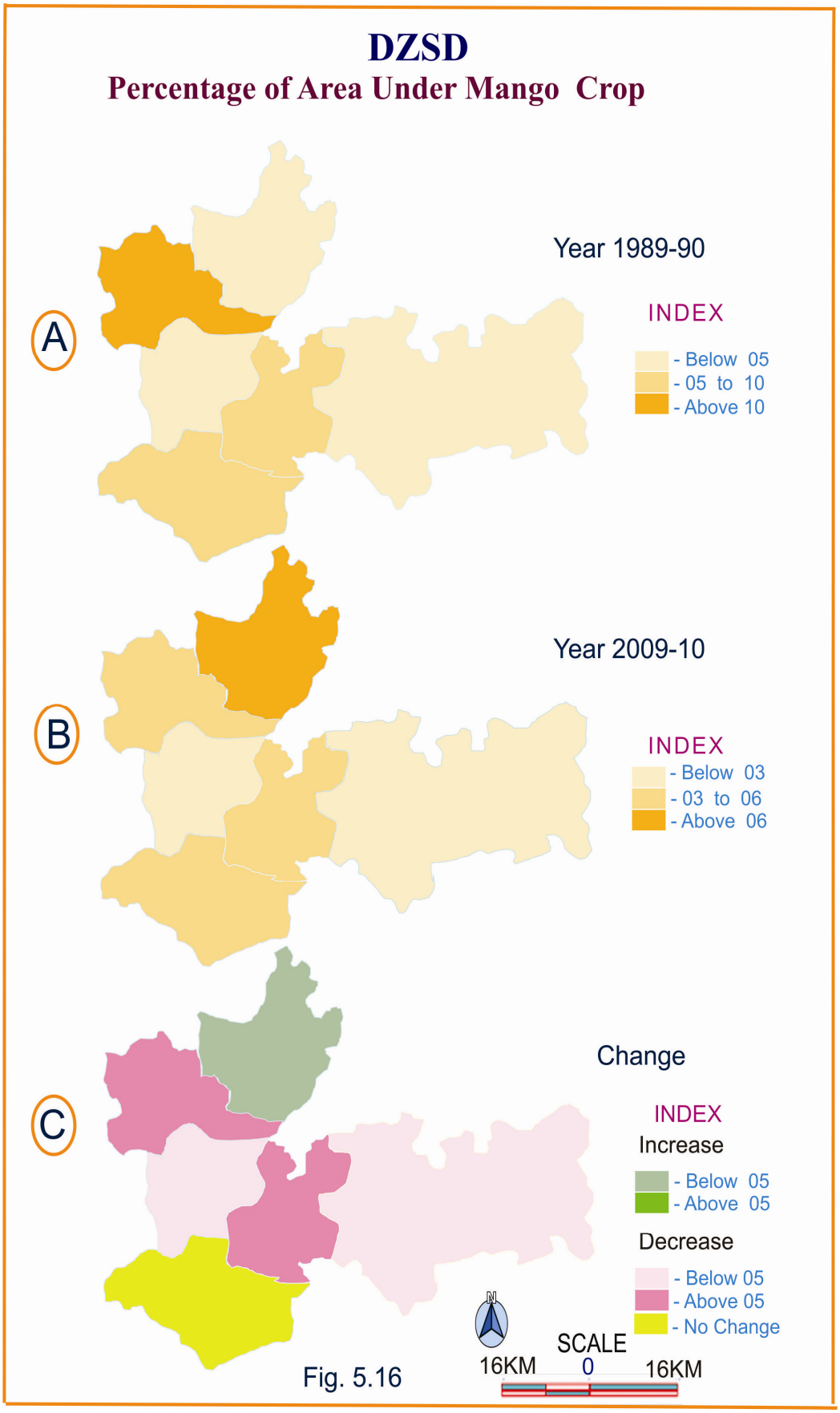

DZSD
Percentage of Area Under Mango Crop
A
Year 1989-90
INDEX
- Below 05
- 05 to 10
- Above 10
B
Year 2009-10
INDEX
- Below 03
- 03 to 06
- Above 06
C
Change
INDEX
Increase
- Below 05
- Above 05
Decrease
- Below 05
- Above 05
- No Change
N
SCALE
16KM 0 16KM

Fig. 5.16

Table No 5.16 reveals that the spatial distribution is uneven in DZSD in reference year 2009-10. It is highly (above 6%) cultivated in only Atpadi tahsil. The moderate (3 to 6 % FCA) area under mango is observed in Khanapur, Miraj and K.Mahankal tahsil. The low area (below % to FCA) is observed in Tasgaon and Jath tahsil of study area.

Temporal analysis of the area under mango crop brings out the either positive or negative change. The positive change is observed in only Atpadi tahsil but the negative change is observed in four tahsil of study area and i.e. Khanapur, Tasgaon, K.Mahankal and Jath tahsil. The mango area and its share in total fruit crop are also decreased in K.Mahankal. It is also observed that the share of mango to total fruit in Miraj tahsil is constant during the investigation period.

5. Crusted apple

Crusted apple is known as a drought fruit crop. It means that it is living long time on very few water. The area under this crop is 4.34 percent to total fruit crop area in 1989-90. After the 20 years of study means in 2009-10, it is cultivated on only 1.91 percent of fruit crop area. This is happen due to low yield and low market price of this crop compare to other fruit crops.

Table - 5.17
DZSD:Tahsilwise area under C.apple fruit crop & change

Sr. No.	Tahasils	1989-90	% to FCA	2009-10	% to FCA	Change	%
1	Khanapur	42	10.10	61	1.32	+ 19	-8.78
2	Atpadi	14	7.17	40	3.53	+ 26	-3.64
3	Tasgaon	06	0.82	54	1.38	+48	+0.56
4	Miraj	09	0.85	32	1.73	+23	+0.88
5	K. Mahankal	34	8.27	26	3.86	-08	-4.41
6	Jath	43	7.32	106	2.75	+63	+4.57
	DZSD	148	4.34	319	1.99	+171	-2.35

Source: 1. Socio-economic Abstract of Sangli District 1989-90 & 2009-10
1.Agriculture Dept. of Zila Parishad, Sangli

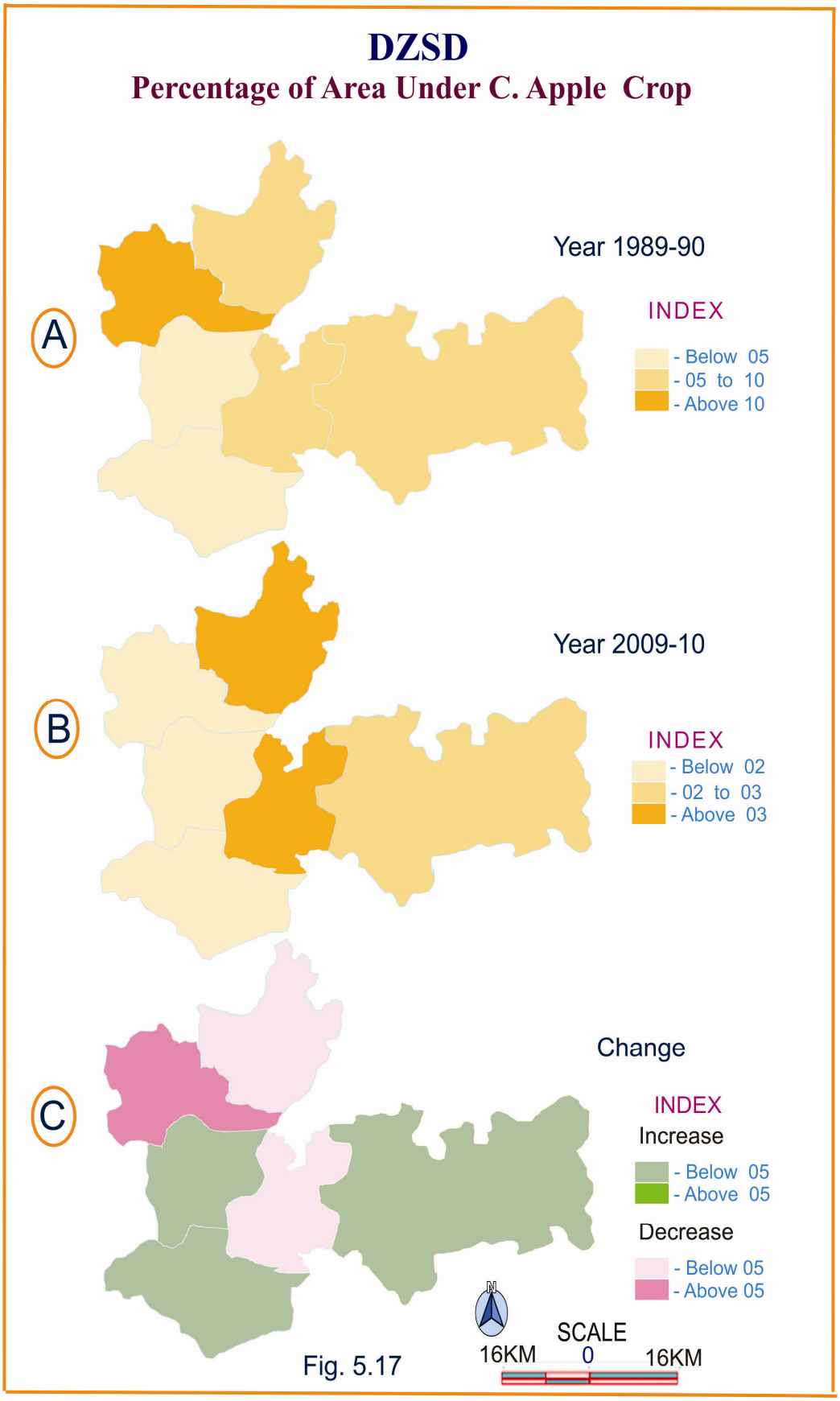

DZSD
Percentage of Area Under C. Apple Crop
A
Year 1989-90
INDEX
- Below 05
- 05 to 10
- Above 10
B
Year 2009-10
INDEX
- Below 02
- 02 to 03
- Above 03
C
Change
INDEX
Increase
- Below 05
- Above 05
Decrease
- Below 05
- Above 05
N
SCALE
16KM 0 16KM

Fig. 5.17

The table No 5.17 reveals that the spatial distribution of Crusted apple is same in all tahsil and it capture very low area approximately below 4 percent to fruit crop area in each tahsil. During the study period, the positive change is observed in five tahsil and i.e. Khanapur, Atpadi, Tasgaon, Miraj and Jath tahsil. It is also observed that if the area under this crop increased, it's share in total fruit crop is decreased. The negative change is observed in K.Mahankal tahsil.

6. Banana

Banana is important fruit crop covering over all 6.48 percent of the total area under fruits. During the investigation of 20 years, the area under this crop decreased 4.82 percent in study region. This decrease happen due to it need more water compare to other fruit crop and get low profit compare to grape and pomegranate.

Table - 5.18
DZSD: Tahsilwise area under Banana fruit crop & change

Sr. No.	Tahasils	1989-90	% to FCA	2009-10	% to FCA	Change	%
1	Khanapur	28	6.73	87	1.88	+ 59	-4.85
2	Atpadi	10	5.12	13	1.14	+ 03	-3.98
3	Tasgaon	47	6.47	62	1.58	+15	-4.89
4	Miraj	76	7.18	90	4.88	+14	-2.30
5	K. Mahankal	24	5.83	11	1.63	-13	-4.20
6	Jath	35	5.96	35	0.91	00	-5.05
	Total DZSD	220	6.48	298	1.86	+78	-4.82

Source: 1. Socio-economic Abstract of Sangli District 1989-90 & 2009-10
2.Agriculture Dept. of Zila Parishad, Sangli

The spatial distribution of banana is uneven in DZSD in the reference year 2009-10. The highest area under banana crop is observed in Miraj tahsil (4.88 %) and lowest is in Jath tahsil (0.91%). The remaining tahsils of study region, the area under banana crop is negligible (below 2%).

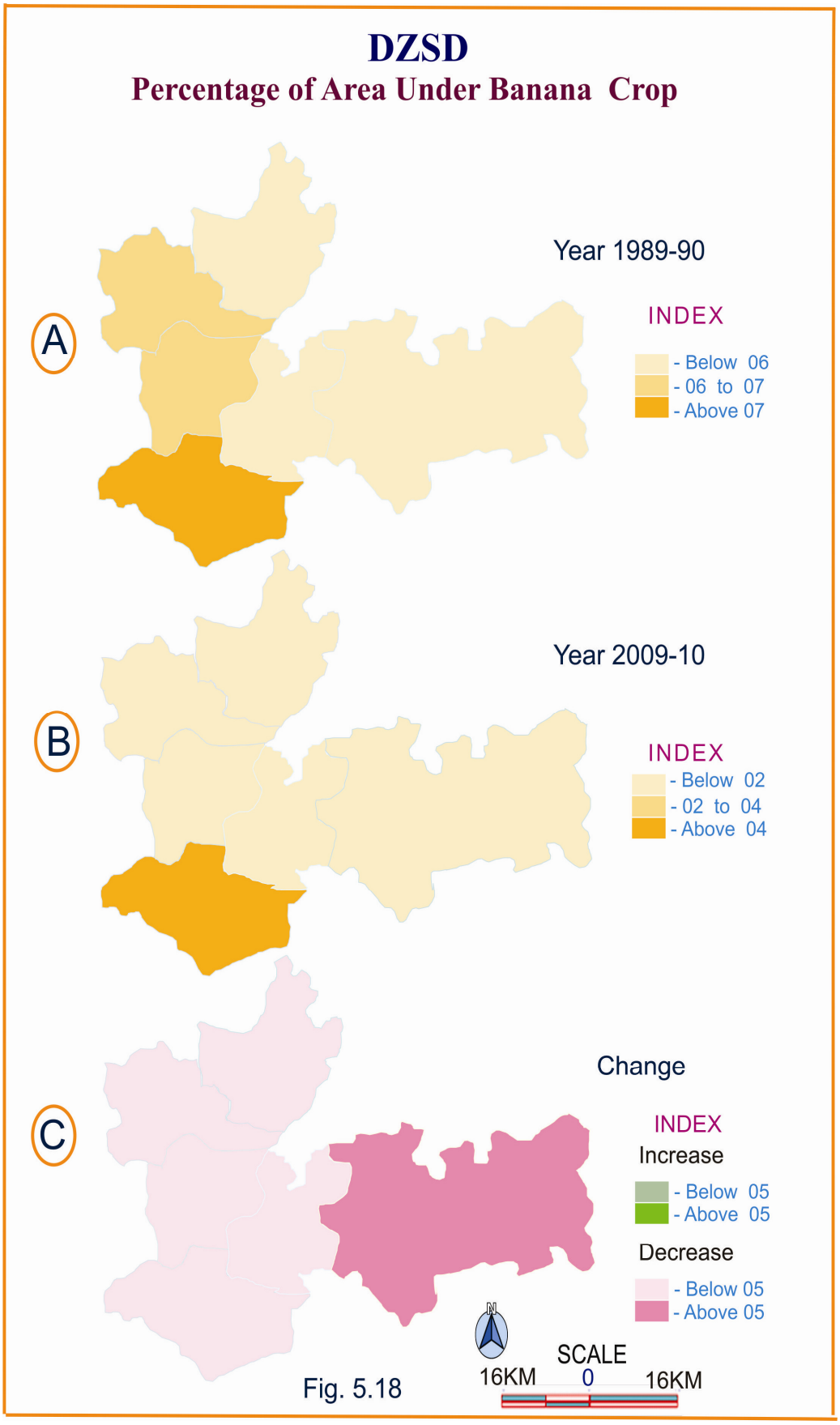

DZSD
Percentage of Area Under Banana Crop
A
Year 1989-90
INDEX
- Below 06
- 06 to 07
- Above 07
B
Year 2009-10
INDEX
- Below 02
- 02 to 04
- Above 04
C
Change
INDEX
Increase
- Below 05
- Above 05
Decrease
- Below 05
- Above 05
N
SCALE
16KM 0 16KM

Fig. 5.18

During the period of 20 years of investigation, the highest banana area is decreased in Jath Tahsil (5.05%) and lowest in Miraj tahsil (2.30%). Remaining part of study region, it is decreased approximately region average.

7. Sapota

Sapota is also important fruit crop in drought prone area. It is cultivated on the 185 hect. in 1989-90 year in DZSD which consist 5.45 percent area to total fruit crop area. It is increased 706 hect. in during the period of 20 years of investigation. But the percentage to total fruit is increased only 0.10 percent, it means that the growth of these crops is low compare to total fruit crop area.

Table - 5.19
DZSD: Tahsilwise area under Sapota fruit crop & change

Sr. No.	Tahasils	1989-90	% to FCA	2009-10	% to FCA	Change	% to FCA
1	Khanapur	35	8.41	240	5.19	+ 205	-3.22
2	Atpadi	06	3.07	56	4.94	+ 50	+1.87
3	Tasgaon	26	3.58	135	3.44	+109	-0.14
4	Miraj	26	2.45	153	8.30	+127	+5.85
5	K. Mahankal	36	8.75	36	5.35	00	-3.40
6	Jath	56	9.54	221	5.75	+165	-3.79
	Total DZSD	185	5.45	891	5.55	+706	+0.10

Source: 1. Socio-economic Abstract of Sangli District 1989-90 & 2009-10
2. Agriculture Dept. of Zila Parishad, Sangli

The spatial distribution sapota is uneven in a region related to the agro-climatic conditions. Spatial analysis of the area of the talukas under this crop for the reference year 2009-10 focuses the pattern of distribution. Miraj taluka lies the highest area (above 7%) under this crop in study region.

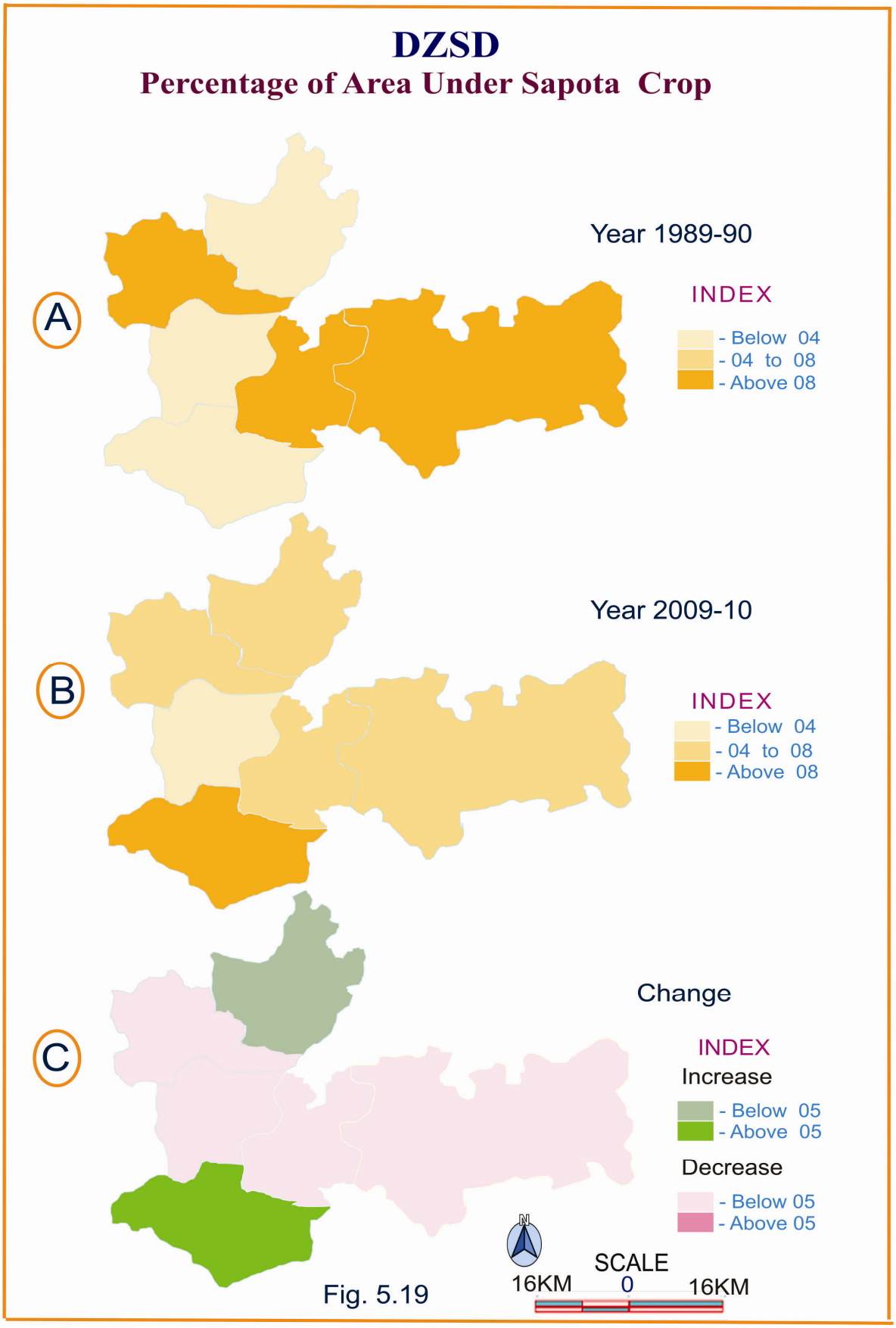

DZSD
Percentage of Area Under Sapota Crop
A
Year 1989-90
INDEX
- Below 04
- 04 to 08
- Above 08
B
Year 2009-10
INDEX
- Below 04
- 04 to 08
- Above 08
C
Change
INDEX
Increase
- Below 05
- Above 05
Decrease
- Below 05
- Above 05
N
SCALE
16KM 0 16KM

Fig. 5.19

The three tahsils (Khanapur, Jath & K.Mahankal) lies medium grade (5 to 7%) in area of this crop. The lowest grade (below 5%) is observed in Atpadi and Tasgaon tahsil.

Temporal analysis reveals that the area of sapota is increased over all tahsil of DZSD, but the growth is uneven. The positive change is observed in Miraj (5.85%) and Atpadi tahsil (1.87 %). The negative change is depicted in remaining all four tahsil. It is approximately above 3 percent expect Tasgaon tahsil.

8. Guava

Guava will thrive on shallow and infertile soil, abundant rainfall but 1000 to 2000 mm rainfall per year and optimum temperature is between 23°c to 28° c. These environmental elements are varied tahsils in DZSD. The area under guava fruit crop was 99 hect. in reference year 1989-90 and it share 2.91 percent area out of total fruit crop area.

Table - 5.20
DZSD: Tahsilwise area under Guava fruit crop & change

Sr. No.	Tahasils	1989-90	% to FCA	2009-10	% to FCA	Change	%
1	Khanapur	14	3.36	33	0.71	+ 19	-2.65
2	Atpadi	09	4.61	32	2.82	+ 23	-1.79
3	Tasgaon	16	2.20	27	0.68	+11	-1.52
4	Miraj	14	1.32	23	1.24	+09	-0.08
5	K. Mahankal	23	5.59	16	2.38	-07	-3.21
6	Jath	23	3.91	83	2.16	+60	-1.75
	Total DZSD	99	2.91	214	1.33	+115	-1.58

Source: 1. Socio-economic Abstract of Sangli District 1989-90 & 2009-10
1. Agriculture Dept. of Zila Parishad, Sangli

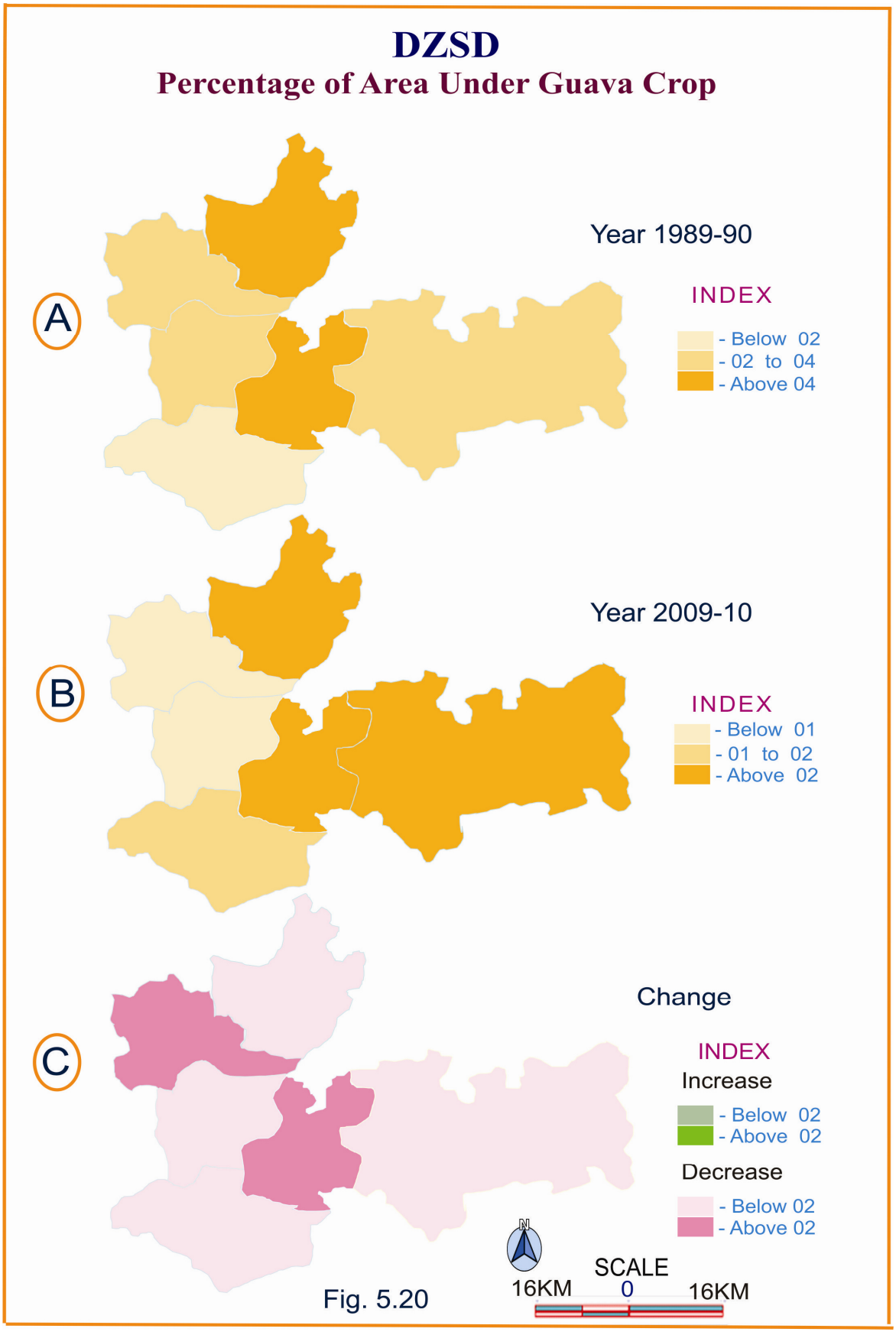

DZSD
Percentage of Area Under Guava Crop
A
Year 1989-90
INDEX
- Below 02
- 02 to 04
- Above 04
B
Year 2009-10
INDEX
- Below 01
- 01 to 02
- Above 02
C
Change
INDEX
Increase
- Below 02
- Above 02
Decrease
- Below 02
- Above 02
N
SCALE
16KM
0
16KM

Fig. 5.20

However, in reference 2009-10, it is cultivated on 214 hect. (1.33 to FCA) in study area. If the area under guava crop is increased (115 hect.), the share in total fruit crop is decreased (1.58%).

The spatial distribution of area under guava crop is uneven in study region in reference year 2009-10. Percentage of area under guava crops varies 0.68 to 2.82 percent. The highest percentage (Above 2 % to FCA) is observed in Atpadi, K.Mahankal and Jath tahsil of DZSD. The moderate area (1 to 2 %) guava crop is captured by in only Miraj. The negligible area (below 1 %) is in Tasgaon and Khanapur tahsil.

Temporal analysis for the period under consideration focuses light change in guava crop. The area under crop is increasing all tahsils expect K.Mahankal tahsil but its share on total fruit crop is decreased all tahsils of study region. The highest (above 2%) negative change is observed in K.Mahankal and Khanapur tahsil. The moderate negative change (1 to 2%) is noticed in Atpadi, Jath and Tasgaon tahsils. Miraj tahsil is involved in lowest (below 1%) negative change in area under guava crop.

5.4. Agriculture transformation

The change in cropping pattern in a particular span of the time clearly indicates the changes that have taken place in the agricultural transformation. These changes are brought by the socio-economic influences. The natural factors of physiography, climate soils and water resources will always continue to exert influences on the agricultural land use. A part from this population pressure the ownership of land size of land holding, availability of markets and the farmers capacity and ability play dominant role in deciding the cropping pattern of a particular region.

The agriculture transformation means the changes or shifts in area under one crops to another over a period of time. The changes occurred in cropping pattern assume special importance in taking to analyse the food grain to fruit crop transformation in drought prone area of Sangli District. Farmers are always trying to get maximum benefit form his farm with low investment in short period. They are cultivated commercial crops on new method which is required low water.

The agriculture transformation in DZSD during the period 1989-90 to 2009-10 is shown in the table no 5.21 For the purpose of the study, the major seven food grain crop and eight fruit crops are selected. During the investigation period, the food grain crops are decreased 2.97 percent to net sown area and food grain crops are increased 2.33 percent to net sown area in DZSD. This figure shows the guaranteed positive change in food grain to fruit crop transportation.

Table 5.21
DZSD; Agriculture Transformation (area in hect.)

Food Grains	Change		Fruit crops	Change	
	Area	%		Area	%
Jawar	+32771	+4.21	Grape	+7227	+1.33
Wheat	-9302	-2.12	Pomegranate	+2737	+0.50
Bajara	-43372	-8.81	Ber	+90	+0.02
Maize	+9430	+1.71	Mango	+484	+0.09
Gram	+9495	+1.63	C. Apple	+171	+0.03
Tur	-2368	-0.54	Banana	+78	+0.01
Moog	+4148	+0.75	Sapota	+706	+0.13
Other	+3145	+0.08	Guava	+115	+0.02
Total	+3947	-2.97	Other	+1079	+0.19
			Total	+12637	+2.33

Source: Compiled by Researcher

Table No5.21 shows that the positive and negative change among the food grain and fruit crops during the investigation period in study area. Among the foodgrain crops, the area under four crops is increased and these crops are Jawar, Maize, Gram, Tur and Moog crop. However, the highest positive change is lie in Jawarcrop (4.21% to NSA) and lowest lie in Moog crop (0.75 % to NSA). However, the negative change in area under food grain crop is recorded in Bajara, Wheat and Tur crop. The maximum negative is observed in Bajara crop (8.81 % to NSA) and lowest in Tur crop (0.54 % to NSA).

The table no 5.21 also reveals the changes in fruit crops during the study period in DZSD. The fruit crop area is increased 12637 hect. which consist 2.33 percent to net sown area. The increase of area under fruit crop is noticed among the all fruit crop on a large or small scale. The highest area (1.33 % to NSA) under fruit crop is increased in Grape fruit crop and followed by Pomegranate (0.50 % to NSA). The lowest growth is recorded in Banana crop (0.01 % to NSA) which needs more water. Among the agriculture transformation, it is reveals that the bajara, wheat and tur crop area is replaced by grape and pomegranate fruit crop. It is also observed that western part of study area attracted to grape cultivation while the eastern part trend is to pomegranate cultivation. This is depend on environment situation.

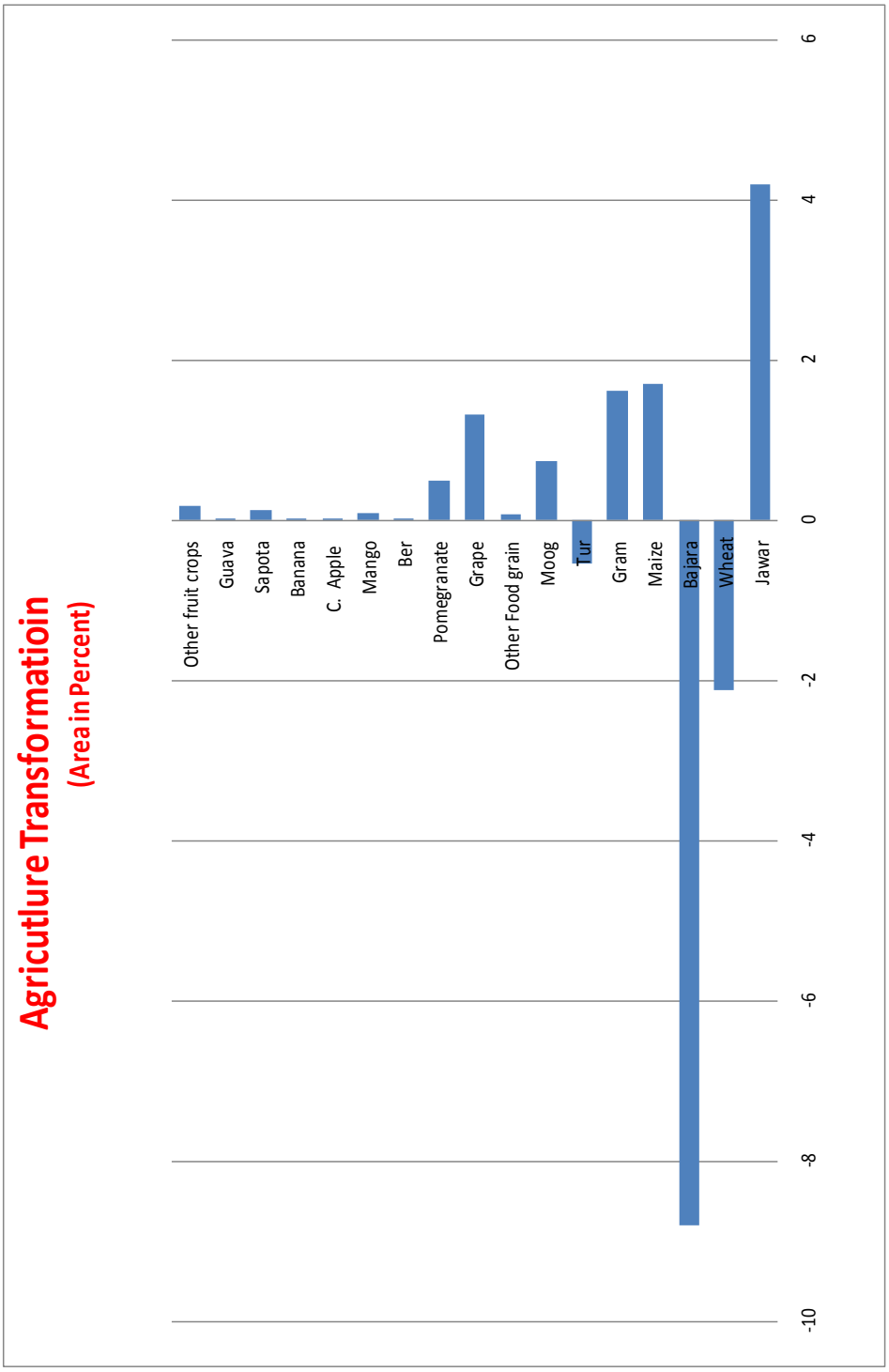

Agricutlure Transformatioin
(Area in Percent)
Other fruit crops
Guava
Sapota
Banana
C. Apple
Mango
Ber
Pomegranate
Grape
Other Food grain
Moog
Tur
Gram
Maize
Bajara
Wheat
Jawar
6
4
2
0
-2
-4
-6
-8
-10

Fig.5.21

5.5 Analysis of Correlation Matrix

The correlation coefficient is computed to establish relationship between variables. These variables are, namely, grape, pomegranate, ber, mango, guava, c.apple, sapota, rice, wheat, jowar, bajara, gram, sugarcane, net sown area, cultivable waste, fallow land, area not available and forest land. In order to understand the agriculture transformation the correlation coefficient has been computed. The twenty-two variables have been carefully selected from the DZSD. These chosen variables are as follow:

X1= Area under Grape

X2= Area under Pomegranate

X3= Area under Ber

X4= Area under Mango

X5= Area under C.apple

X6= Area under Banana

X7= Area under Sapota

X8= Area under Guava

X9= Area under Forest

X10= Area under Non-agriculture land

X11= Area under Potential land

X12= Area under Fallow land

X13= Area under Net sown area

X14= Area under Jawar

X15= Area under Bajara

X16= Area under Wheat

X17= Area under Maize

X18= Area under Gram

X19= Area under Tur

X20= Area under Moog

X21= Area under Sugarcane

X22= Area under Cotton

The co-relationship has been computed between fruit crop to another crop or landuse by applying correlation co-efficient technique for 22x22 data matrix. Pearson Product Movement correlation was applied (Table-5.22). The relationship between variables is summarized as below;

Table 5.22

Correlation matrix of agriculture transformation in DZSD

1	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15	X16	X17	X18	X19	X20	X21	X22
X1	1																					
X2	0.76	1																				
X3	0.7	0.67	1																			
X4	0.93	0.86	0.85	1																		
X5	0.91	0.88	0.60	0.88	1																	
X6	0.86	0.65	0.85	0.91	0.68	1																
X7	0.94	0.88	0.70	0.96	0.94	0.85	1															
X8	0.8	0.97	0.65	0.87	0.95	0.64	0.91	1														
X9	-0.73	-0.91	-0.66	-0.83	-0.86	-0.56	-0.83	-0.91	1													
X10	0.51	0.11	0.38	0.53	0.30	0.64	0.51	0.17	-0.24	1												
X11	0.86	0.58	0.81	0.88	0.61	0.94	0.80	0.55	-0.56	0.70	1											
X12	-0.59	-0.91	-0.32	-0.63	-0.80	-0.35	-0.71	-0.89	0.80	0.08	-0.28	1										
X13	0.16	0.65	-0.05	0.19	0.49	-0.11	0.32	0.62	-0.52	-0.51	-0.20	-0.87	1									
X14	0.78	0.85	0.72	0.91	0.82	0.72	0.89	0.85	-0.93	0.53	0.74	-0.69	0.03	1								
X15	-0.73	-0.91	-0.66	-0.83	-0.86	-0.56	-0.83	-0.91	1.00	-0.24	-0.56	0.80	-0.52	-0.93	1							
X16	-0.86	-0.78	-0.84	-0.96	-0.73	-0.92	-0.89	-0.74	0.75	-0.58	-0.94	0.53	-0.07	-0.88	0.75	1						
X17	0.84	0.96	0.62	0.85	0.93	0.64	0.89	0.96	-0.86	0.07	0.58	-0.89	0.63	0.77	-0.86	-0.75	1					
X18	0.91	0.76	0.53	0.87	0.93	0.72	0.94	0.83	-0.81	0.59	0.72	-0.67	0.28	0.87	-0.81	-0.78	0.80	1				
X19	-0.64	-0.20	-0.10	-0.43	-0.61	-0.44	-0.56	-0.37	0.23	-0.55	-0.38	0.19	0.05	-0.30	0.23	0.28	-0.35	-071	1			
X20	0.86	0.90	0.65	0.92	0.90	0.82	0.97	0.90	-0.79	0.46	0.74	-0.78	0.40	0.87	-0.79	-0.86	0.87	0.89	-0.40	1		
X21	-0.56	-0.19	0.01	-0.38	-0.58	-0.34	-0.54	-0.37	0.25	-0.57	-0.29	0.24	-0.02	-0.34	0.25	0.22	-0.31	-0.71	0.96	-0.49	1	
X22	0.01	0.26	-0.18	-0.06	0.57	-0.06	0.02	0.15	0.11	-0.59	-0.16	-0.43	0.58	-0.23	0.11	0.06	0.31	-0.14	0.17	0.13	0.21	1

Source : Compiled by Researcher

1. Area under Grape

Grape is dominant fruit crop cultivated in study region. Area under grape fruit crop exhibits highly negative correlation with wheat (-0.86), bajara (-0.73), forest (-0.73), tur (-0.64), fallow land (-0.59) and sugarcane (-0.53). This figure shows that the wheat, bajara, forest area are highly transformed to grape fruit crops. Followed by tur, fallow land and sugarcane crops also replaced by grape.

2. Area under Pomegranate

Pomegranate is another important fruit crop in DZSD. The high negative correlation is found with forest (-0.91), fallow land (-0.91) and bajara crop (-0.91), it means these area are converted into pomegranate fruit crops. Followed by moderate negative correlation is observed with wheat crop (-0.78) and low negative correlation with tur (-0.20) and sugarcane (-0.19). It means that the tur and sugarcane area are replaced by pomegranate fruit crop, but it is very few not in significant.

3. Area under Ber

Ber is tropical fruit crop cultivated specially in dry and shallow soil area. Ber crop are shifted on the crop area of wheat, bajara and forest land. So the negative correlation of ber crop observed with wheat (-0.84), bajara (-0.66) and forest land (-0.66) is significant. Followed by the negative correlation of ber crop is exhibits with fallow land, tur and cotton crop. Their area also replaced by ber crop.

4. Area under Mango

Recent some years, mango fruit crop is planted on commercial base. After growing four to five years of crop, the crop routes are go on high depth and they don't need of artificial source of water. So it is cultivated in dry zone area. This crop exhibits the high negative correlation with wheat (-0.96), bajara (-0.83), forest land (-0.83) and fallow land (-0.63). It is also observed that the some area of sugarcane, cotton and tur crop replaced by mango crop.

5. Area under Crusted apple

Crusted apple crop is well known for surviving in drought region. It has needed very few water. The increasing demand of this crop, it is capture dominant area in the study region. The high negative correlation of this crop exhibits with wheat (-0.96), bajara (-0.86), forest land (-0.86), fallow land (-0.80), wheat (-0.73), and tur (-0.61). The negative correlation of sugarcane and cotton crop also observed in study region, but it is not significant.

6. Area under Banana

Banana fruit crops need more water, however it is cultivated in deep soil or water available area. So the high negative correlation of banana crop is exhibits with wheat (-0.92). Wheat crop would be cultivated in deep soil with available of irrigation facilities. The negative correlation of banana fruit crop is also observed with forest (-0.56), bajara (-0.55), tur (-0.44), fallow land (-0.35) and sugarcane crop (-0.34).

7. Area under Sapota

Sapota is specially known as '*chikku*' in study region. This crop is another option to fruit farmers in DZSD. Recently some years, the farmers are turned towards the sapota crop. The correlation of sapota is observed with wheat (-0.92), forest (-0.83), fallow land (-0.71), bajara (-0.56), and tur (-0.44). The areas of sugarcane, tur, cotton are also replaced by sapota fruit in small scale.

8. Area under Guava

Guava is planted on small area on the DZSD. The correlation of guava is observed with bajara (-0.91), forest (-0.91), fallow land (-0.89), wheat (-0.74), tur (-0.37) and sugarcane (-0.37). It means that the area of these crop replaced by guava fruit crop in study region.

Among the observation, it is clear that the areas under wheat, bajara, tur are tremendously replaced by fruit crops in all fruit crops in study region. Followed by fruit crops are planted on forest and fallow land area. The small scale sugarcane and cotton area are changed by the fruit crops in study region.

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CHAPTER – VI
ANALYSIS OF SURVEY WORK

6.1 Introduction:

In the preceding chapters, an aggressive picture on the DZSD tahsils of the spatial pattern, food grain crops, fruit crops and changes there in during the period under review is presented. The aim of this chapter is two fold. Firstly, it attempts to provide a picture of spatial pattern of sample farmers in selected villages and secondly, to measure the agriculture transformation especially food grain to fruit crop transformation in sample farmers.

According to Mac Master, this acts as an important supplement to checkup on the board picture outlined in the preceding discussion. (Kashid- 2009) Field work or survey work is a universally respected approach to study of geography, as it is a primary source of data. In the preceding Chapters an attempt has been made to highlight the various aspects of agriculture transformation in the study area. In this Chapter survey work is attempted, to observe personally the situation in the region regarding the food grain to fruit crop transformation. This Chapter mainly deals with the following aspects: -

1. Data base and methodology
2. Sample selection
3. General status of Sample Farmers
4. Agriculture Landuse Pattern
5. Agriculture transformation
6. Causes of agriculture transformation
7. Problem of agriculture in drought prone area

6.2 Data Base and Methodology:

To study the food grain to fruit crop transformation in drought prone area of Sangli District, the two stages stratified selected sampling technique is adopted for the selection of villages and farmers of the study area. There are 449 villages in six tahsils

in drought prone area of Sangli District. It is not possible to study the landuse and transformation from food grain to fruit crops in respect of all tahsils. Therefore sampling technique seems to be best for obtaining factual information in regard to food grain to fruit crop transformation. The villages are selected by using random sample tables. Fig No.6.1 shows the location of the villages in the DZSD. For this investigation 180 sample farmers from 45 villages are selected by purposive sampling method, but they are carefully chosen in the study area.

6.3 Selection of Sample Villages:

The study area consist six tahsils of Sangli District which located in Drought prone area. Then all villages arranged alphabetically in each tahsil of study area. Then the 10 percent villages are selected as a sample in each tahsil of study area. In this way, the total 45 villages are selected form total villages (449) of study area. After that the four farmers are selected purposive sample in each selected village and the total 180 farmers are selected to study food grain to fruit crops transformation. These are following.

Table- 6.1

DZSD: Tahsilwise Sample Villages .

SR No	Taluka	Total villages	Selected villages	Sample selected
1	Khanapur	67	Bhalwani, Dhondewadi, Kurli Jadhavnagar, , Panchalingnagar Tadachiwadi, Wazar	28
2	Atpadi	60	Deshmukhwadi , Kalewadi , Madgule , Palsekhel, Shrewadi Wakasewadi	24
3	Tasgaon	69	Chikhal Gothan, Gotewadi, Kindarwadi, Nagaon Nimani Rajapur , Vanjarwadi, Yogewade	28
4	Miraj	68	Budhgao CT, Kadamwadi, Salgare Khanderajuri, Mhaisal(S), Siddhewadi,Wajegaon (NV)	28
5	K.Mahankal	60	Deshing ,Hingangaon ,Kerewadi Malangaon, Raywadi,Zurewadi	24
6	Jath	125	Avandhi , Bhivargi ,Dhulkarwadi Halli , Karajanigi, Konbagi, Lanvanga, Motewadi, Rajobawadi Shelkewadi, Tilyal, Waifal	48
	Total	449	45	180

Source: Compiled by Researcher

A. Identification Code to sample villages

The selected villages are arranged alphabetically in each tahsil. The total 45 villages are investigated in this study. So it is difficult to write it's name on it's location on the map. For this all the sample villages get the code numbers. They are numerical 1 to 45 and shows in Fig. - 6.1 .

Table - 6.2
DZSD: Identification code to sample villages

Name of village	Code No	Name of village	Code No	Name of village	Code No
Bhalwani	1	Kindarwadi	16	Malangaon	31
Dhondewadi	2	Nagaon Nimani	17	Raywadi	32
Jadhavnagar	3	Rajapur	18	Zurewadi	33
Kurli	4	Vanjarwadi	19	Avandhi	34
Panchalingnagar	5	Yogewade	20	Bhivargi	35
Tadachiwadi	6	Budhgao CT	21	Dhulkarwadi	36
Wazar	7	Kadamwadi	22	Halli	37
Deshmukhwadi	8	Khanderajuri	23	Karajanigi	38
Kalewadi	9	Mhaisal(S)	24	Konbagi	39
Madgule	10	Salgare	25	Lanvanga	40
Palsekhel	11	Siddhewadi	26	Motewadi	41
Shrewadi	12	Wajegaon(NV)	27	Rajobawadi	42
Wakasewad	13	Deshing	28	Shelkewadi	43
Chikhal Gothan	14	Hingangaon	29	Tilyal	44
Gotewadi	15	Kerewadi	30	Waifal	45

Source: Compiled by Researcher

DZSD

Location of Sample Villages

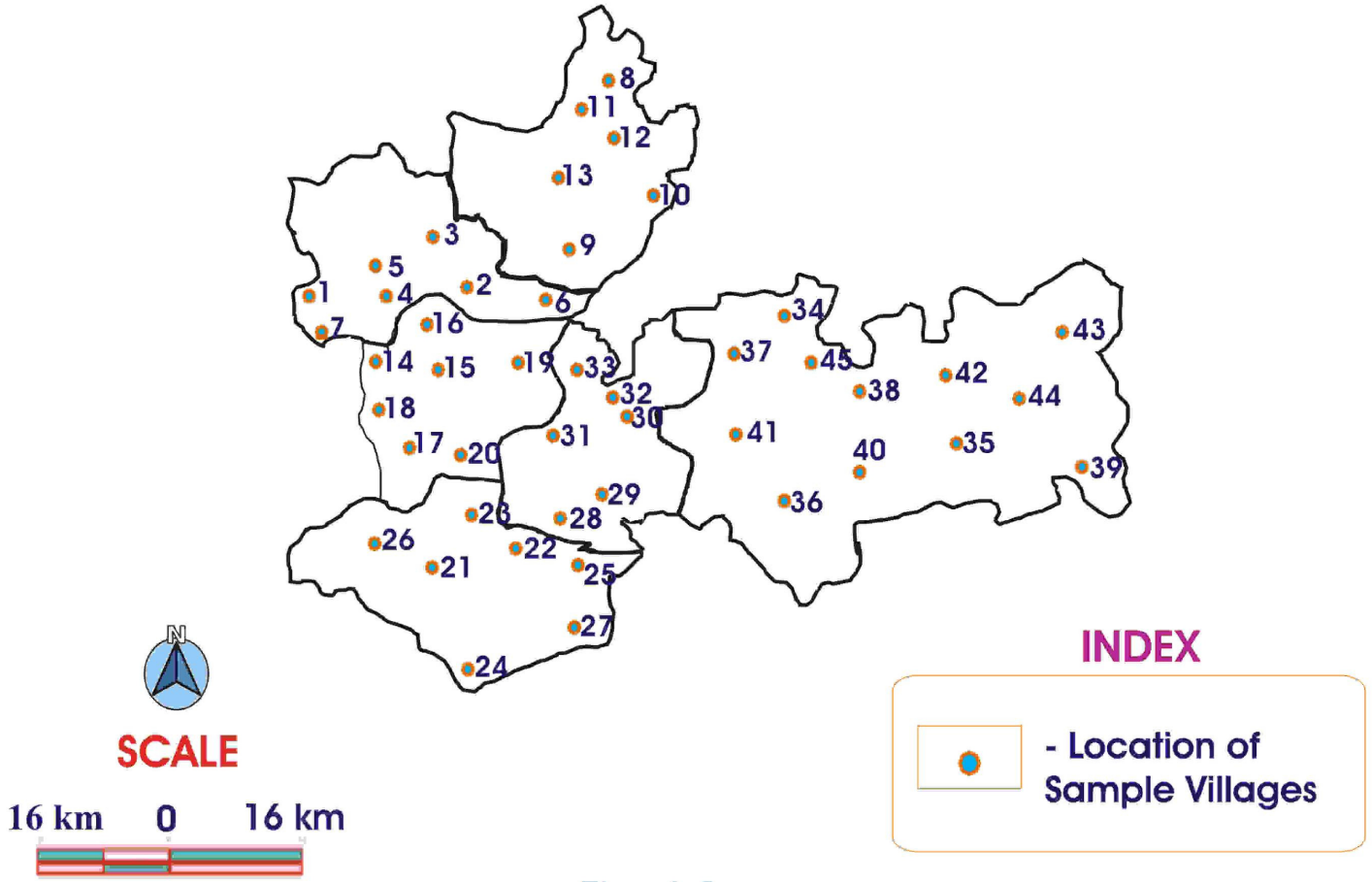


Fig. 6.1

B. Tahsilwise sample farmers

The six tahsils of Sangli District are studied which consisted drought zone of Sangli District. Among the all tahsils, the villages are selected on the basis of 10 percent sample village in each tahsil. The total 45 villages are selected in all six tahsils of DZSD. The four farmers are selected in each village. Moreover, the villages are uneven in each tahsil, so the number of sample villages are different each tahsil and so sample farmers are also different in each tahsil. These are following.

Table-6.3
DZSD: Area captured by sample farmers

Sr. No.	Taluka	No of Farmers	%	Area captured (acre)	%
1	Khanapur	28	15.55	220	14.39
2	Atpadi	24	13.33	190	12.43
3	Tasgaon	28	15.55	140	9.16
4	Miraj	28	15.55	139	9.09
5	K.Mahankal	24	13.33	123	8.04
6	Jath	48	26.70	716	46.85
	Total	180	100	1528	100

Source: Based on field work and Compiled by Researcher

The table no 6.3 noticed that the highest number of villages are selected from Jath tahsil i.e. 48 villages (26.70 %) and they capture highest area 716 acre (46.85 %) compare to other investigated tahsils in DZSD. The lowest villages (24-villages) are selected in Atpadi and K.Mahankal tahsil. However,the lowest area captured by K. Mahankal tahsil i.e. 123 acre. And 8.04 percent to total observed area of study region.

6.4. General information of Sample Farmers

The general information of farmers include the physio- cultural condition. The physical elements consist the soil, topography, slope etc. The socio-economic elements such as farmer's age, literacy of farmers, working family members and land holding size of farmers etc. are affects on agriculture land use and method of cultivation. The development of agriculture and nature of agriculture are also depend on farmers socio-economic status. Among all the socio-economic factors major factors are discussed here, which is affected on agriculture transformation in drought prone area of Sangli District.

1. Age group of sample farmers

The quality and productivity of agricultural crops are affected by the physical and environmental factors, as well as the age of farmers. The young farmers easily accept new technology, new variety of crops, modern and scientific method of cultivation, so among them cost of crop production is low compared to older farmers. They can cultivated crops on the quality of soil and other components and use fertilizers on requirement of crops type and growing stage. But Farmers experience in farm is more important for improvement of agriculture quality and productivity. Experienced farmers can use their experience in farm which is not used by the new farmers. They can easily understand and decide the peak period, time of spraying, management of fertilizers, harvesting period, etc.

Table - 6.4 Solapur District: Farmer Age

Sr No	Farmer age	No of Farmers	%	Agri. Transformed by farmers	% to no of farmers
1	Below 30	22	12.22	20	90.90
2	30 to 45	56	31.11	53	94.64
3	45 to 60	97	53.88	82	84.53
4	Above 60	05	2.77	03	60.00
5	Total	180	100	158	87.77

DZSD: Age group of selected farmers
Source: Based on field work and Compiled by Researcher

It is noticed from table 6.4 that 53.88 percent sample farmers belong to 45 to 60 age group, 31 percent sample fruit growers belong to below 30 to 45 age group, 12 percent sample fruit growers belong to below 30 age group and 2.77 percent sample farmers belong to above 60 age group. It is observed in the field work that farmers belong to younger age group are more prone to adopt modern techniques and practices in their farms and they are ahead to changing the agriculture cropping pattern.

Table no 6.4 also reveals that the farmer's age group largely affect on agriculture transformation. The farmer's age group of 30 to 45 is more aggressive to food grain to fruit crop transformation. Among the survey, 94.64 percent (53 farmers) farmers of this group transformed their crops followed by the farmer's age group of below 30 years are consisted in transformation. It is also observed that the aged farmers (above 60 years) are low (60 percent to total farmers) take decision to agriculture transformation from food grain to fruit crops.

2. Education of Sample Farmers

Education is essential to farmers which can give more benefit directly and indirectly. The educated farmers can contribute more towards the process of mechanization and use of bio-chemical fertilizers in their farms. Education farmers can take some decision by reading books, newspapers, market reports and others instructions provided by the Govt. and internet website. These farmers are more prone to adopt modern technology in their fields. The illiterate and averagely-educated farmers can face the difficulties in understanding the rotation of cropping pattern, agriculture transformation and the services provided by Extension Service Centers in the propagation of agriculture technology among them.

Table - 6.5
DZSD: Literacy of Sample farmers

Sr No	Farmer Literacy	No of Farmers	%	Agri. Transformed by farmers	% to no of farmers
1	Illiterate	13	07	02	15.38
2	Below 10^{th} Std	62	34	57	91.93
3	11^{th} to 15^{th} Std	88	49	85	96.59
4	Above Graduation	17	10	14	82.35
5	Total	180	100	158	87.77

Source: Based on field work and Compiled by Researcher

The table no 6.5 reveals that out of the total sample fruit growers 8 percent are illiterate, 34 percent are below 10^{th} std., 49 percent are 11^{th} to 15^{th} std. and 10 percent are above graduated. Education is a deciding factor in the food grain to fruit crop transformation.

The education play as a key role in food grain to fruit crop transformation in study region. The illiterate 15.38 percent farmers has transformed their crops to fruit crops, however the 11^{th} to 15^{th} std learned 96.59 percent farmers changed crops to fruit crops. This shows that the educated farmers accepted or used new farm technology as well as they took risk of changing cropping pattern.

3. Working Family of Selected farmers

Labor force or workers are essential in agriculture for plantation, harvesting, inter cultivation, etc. A farmer or workers can work on the field with great interest and make all efforts to increase crop production. Therefore all work depends on hired labours and their interest in obtaining maximum output with minimum input, due to which the fertility of the land goes down year after year and consequently the farmer's income also goes down.

Table –6.6
DZSD: Working Family member in sample farmers

Sr No	Working family member	No of Farmers	%	Agri. Transformed by farmers	% to no of farmers
1	No Member	18	10	02	11.11
2	Below 2	116	65	113	97.41
3	2 to 5	33	18	31	93.93
	Above 5	13	07	12	92.30
5	Total	180	100	158	87.77

Source: Based on field work and Compiled by Researcher

Table No 6.6 shows that the most of population is engaged in farming either as cultivators in the DZSD. Approximately 10 percent of farmers in DZSD are observed which cannot work in their farm and their total farm implement is depend on labour force. The maximum 65 percent farmers observed whose family is small and farmers and his wife working in farm. It is also noticed that 33 farmers farm, 2 to 5 members of family working in agriculture farm and 7 percent farmers above 5 members working in agriculture.

It is proved from this table that food grain to fruit crop transformation is influenced by working family members. Those farmers working family member is more, they can turned towards the fruit farming compare to famers those family member is not work in farm. It also reflects that the fruit crops have sensitive crops, so it has need deftness labours and need of small observation during harvesting period. The agriculture labour can't work carefully and labour charges also more.

4. Land holding size of Sample growers

The size of land holding is an important factor in determining the efficient use of the agriculture land available to a farmer. For the size of farms decides the degree of risk taking and may affect the proportion of specialization possible, the quantity and size of equipment and power. Moreover, the farm size is large, irrigation facilities are available and working family member is few these farmers can decide to plantation of sugarcane. If the farm size is small, these farmers trend towards the more and quality production and produce high marginable crops like grape and pomegranate.

Table - 6.7
DZSD: Farm size of sample farmers

Sr No	Farm size	No of Farmers	%	Agri. Transformed by farmers	% to no of farmers
1	Below 5 acres	73	41	56	76.71
2	5 to 10 acres	61	34	58	95.08
3	Above 10 acres	46	25	44	95.65
	Total	180	100	158	87.77

Source: Based on field work and Compiled by Researcher

It is observed in Table 6.7 that the size of farms in sample farmers are found to be below 5 acres 41 percent farmers of the region especially in Tasgaon, Miraj and K. Mahankal tahsil. While the farm size among the 5 to 10 acres is captured by 34 percent of sample farmers those are located dominantly located Atpadi and Khanapur Tahsil. It is also observed that 46 percent sample farmers in DPSD acquired above 10 acre farm size abundantly in Jath tahsil where the fallow land and uncultivated land is more.

Farm size is dominant factor affect on agriculture transformation to fruit crops. The large farm size farmers more turned towards the fruit farming. The big farmers take chance to changing cropping pattern towards the fruit farming and another reason is small farmers can not be take risk fruit farming because high investment and fruit crop has more sensitive.

5. Irrigation

Water is the most important single requirement for the growth of plants. Crops can be raised successfully only if water is available in adequate quantity. Irrigation is one of the important inputs and socio-economic basis of agriculture. The success of agriculture depends to a large extent on how successfully water requirement of various crops can be met. Irrigation helps to augment yield per unit area, increase the crop land and affect on agriculture transformation.

Table -6.8
DZSD: Source of irrigation used by Selected farmers

Sr No	Source of irrigation	No of Farmers	%	Agri. Transformed by farmers	% to no of farmers
1	Well	15	8.33	05	33.33
2	Well + bore well	86	47.77	84	97.67
3	Well + canal	42	23.33	36	85.71
4	Bore well + canal	21	11.66	20	95.23
5	Bore-well	16	8.88	13	81.25
	Total	180	100	158	87.77

Source: Based on field work and Compiled by Researcher

It is observed that largely (above 47.47 percent) farmers depend on well and Bore well. The 23.33 percent sample farmers used well and canal and the 11.66 percent farmers providing water from bore-well and canal for irrigation. Only 8.33 percent farmers are seen depending on well and 8.88 percent on bore-well irrigation because there is no guarantee of water in bore well at summer time. It is also observed that the maximum farmers of study region depend on two or more sources for irritation.

Irrigation has dominantly impact on agriculture transformation in study region. The above 90 percent farmers turned towards the fruits farming who used irrigation source of well and bore-well as well as bore-well and canal. The well irrigation source using farmers are lowest (33.33 percent) in food grain to fruit crop transformation because of in summer season wells are become dry.

6. Mode of irrigation

Irrigation is artificial supply of water for growing crops. The choice of method of irrigation is very important element in cultivation of crops and requirement of water. Selection of method of irrigation by sample farmers is shown in the Table No-6.9.

Table –6.9
DZSD: Mode of irrigation used by sample farmers

Sr No	Mode of irrigation	No of Farmers (Out of 180)	%	Agri. Transformed by farmers	% to no of farmers
1	Surface irrigation	60	33	02	3.33
2	Drip irrigation	173	96	154	89.01
3	Sprinkler irrigation	05	03	00	00
4	Total			158	87.77

Source: Based on field work and Compiled by Researcher

Table 6.9 shows the irrigation mode used by selected farmers in study region. Drip irrigation is very popular mode of irrigation. The 96 percent sample farmers used this mode in their farms. It is water saving and equal water supplying mode in especially slope area. This is mostly used for fruit cultivation in study region. Now a days, it is used for all crops in dry zone area. Although the 33 percent sample are also used the surface irrigation method that plated mango crop and their economical condition is low. The sprinkler is new mode of irrigation also used by only 3 percent of farmers in study area.

Among the sample survey, the only 2 farmers (3.33 percent) transformed crops to fruit crops that use surface irrigation method. These farmers are planted mango fruit crop which has need amount of water. Drip irrigation system more useful for fruit crops, so the drip irrigation using 154 farmers (89.01 percent) are transformed towards the fruit crops. Sprinkler irrigation is not used for fruit cultivation in study region.

7. Soil

Soil constitutes the physical basis of an agriculture enterprise and plays a very important role in agriculture pattern in DZSD. Agriculture productivity is the result of interrelationship among the different type of soil and variety of crops. Every type of crops need a different type of soil viz. Cotton needs black soil and fruits needs shallow soils.

Table 6.10
DZSD: Type of Soil used by sample farmers

Sr No	Soil type	No of Farmers	%	Agri. Transformed by farmers	% to no of farmers
1	Shallow soil	122	67.77	91	74.59
2	Medium soil	87	48.33	63	72.41
3	Deep soil	38	21.11	04	10.52
4	Total			158	87.77

Source: Based on field work and Compiled by Researcher

The most sample farmers are used shallow soil for agriculture especially for fruit cultivation. The shallow soil is more useful for cultivation. The 48 percent farmers are cultivated agriculture on medium soil and only 21 percent farmers used deep soil for agriculture. It is clearly shows that the most soil is shallow and medium soil is available for agriculture in study region.

It is also observed form this table that the soil type are influenced on the fruit crop transformation in study region. Among the survey, the shallow soil holding 91 farmers (74.59 percent), 63 farmers (72.41 percent) of medium soil captured and very low 4 farmers (10.52 percent) deep soil holding are transformed their food grain crops to fruit crops. It is clearly shows that the sallow soil as well as medium soil is favorable for fruit crops and deep soil is avoided for fruit plantation in study region.

6.5 Landuse of Sample Farmers

For the study of agricultural land use 180 sample farmers are selected from 45 villages in all tahsils of DZSD. Total agricultural land of the sample fruit growers is 1528 acres. Cropping pattern of the sample farmers: -

Table 6.11
DZSD: Landuse by Sample Farmers

Sr. No.	Landuse	Area in acre	%
1	Fallow land	115	7.52
2	Jawar	352	23.83
3	Maize	142	9.29
4	Bajara	120	7.85
5	Wheat	40	2.61
6	Soyabin	48	3.14
7	Sugarcane	72	4.71
8	Cotton	04	0.26
9	Turmeric	35	2.29
10	Grape	267	17.47
11	Pomegranate	195	12.76
12	Mango	32	2.09
13	Ber	09	0.59
14	Custard apple	07	0.46
15	Coconut	03	0.19
16	Banana	02	0.13
17	Rose	03	0.19
18	other	82	5.36
	Total	1528	100

Source: Based on field work and Compiled by Researcher

Table No. 6.11 reveals that out of the total land 115 acre (7.52%) land is fallow land. The area under jawar crop is highest (23.83 %) in sample farmers total captured land. Followed by grape (17.47 %), pomegranate (12.76 %) and Maize (9.29 %) are also largely cultivated crops by sample farmers in DPSD. The area under bajara and sugarcane are range between 4 to 7 percent in investigated land. Among the remaining crops wheat, soyabin, turmeric, mango are captured in range between 1 to 2 percent by sample farmers total land. However, the crops like ber, c. apple, coconut, banana and rose are cultivated on very small scale (below 1%). It is also observed that the other crops like mataki, hulaga, tur, udid etc. are also cultivated in DZSD which acquire 5.36 percent land of total sample farmers land.

A. Tahsilwise Landuse of Sample Farmers

The tahsilwise distribution landuse pattern is uneven which reflect multiple consideration among them are domestic needs, food for human being and fodder for livestock but net return of crops remains the first and foremost consideration. Farmers take into consideration the available water energy and land quality while allocating their land to crops. The cropping pattern are varied in tahsils of DPSD analyzed by sample farmers.

Table 6.12
DZSD: Landuse by Sample Farmers (area in acre)

Sr	Landuse	Khanapur		Atpadi		Tasgaon		Miraj		K.Mahankal		Jath		Total	
		Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%
1	Fallow land	22	10	21	11	03	02	07	05	05	04	57	08	115	7.52
2	Jawar	96	44	85	45	08	06	07	05	07	06	99	28	352	23.83
3	Maize	24	11	19	10	13	09	18	13	11	09	57	08	142	9.29
4	Bajara	13	06	11	06	-	-	-	-	09	07	87	12	120	7.85
5	Wheat	05	02	-		04	03	04	03	06	05	21	03	40	2.61
6	Soyabin	-	-	-		18	13	18	13	12	10	-		48	3.14
7	Sugarcane	-	-	04	02	08	06	15	11	16	13	29	04	72	4.71
8	Cotton	-	-	04	02	-	-	-	-	-	-	-	-	04	0.26
9	Turmeric	-	-	-		-	--	06	04	-	-	-	-	85	2.29
10	Grape	20	09	02	01	59	42	38	28	32	26	116	16	267	17.47
11	Pomegranate	15	07	34	18	11	08	06	04	15	12	114	16	195	12.76
12	Mango	-		-		03	02	04	03	04	03	21	-	32	2.09
13	Ber	07	03	02	01	-	-	-	-	-	-	-	-	09	0.59
14	C. apple	07	03	-		-	-	-	-	-	-	-	-	07	0.46
15	Coconut	-		-		-	-	03	02	-	-	-	-	03	0.19
16	Banana	02	01	-		-	-	-	-	-	-	-	-	02	0.13
17	Rose	-		-		03	02	-	-	-	-	-	-	03	0.19
18	other	09	04	08	04	10	07	13	09	06	05	36	05	82	5.36
19	Total	220	100	190	100	140	100	139	100	123	100	716	100	1528	100
	%	14.39		12.43		9.16		9.09		8.05		46.85		100	

Source: Based on field work and Compiled by Researcher

The tahsilwise landuse pattern is uneven shows in Table No 6.12 and These are following.

a) Khanapur Tahsil: In Khanapur tahsil, the total 7 villages are selected for sampling and among them 28 farmers are selected. They capture 220 acre land (14.39 %) out of total 1528 acre land studied. In between the fallowed land is 10 percent which is dominantly hilly and barren land due to rainfall and irrigation. Jawar crop is dominantly (44 %) cultivated Khanapur tahsil which represents the traditional way of agriculture in this tahsil. Followed by maize (11 %) and bajara (6 %) are cultivated

by selected farmers. Among the fruit crops, grape (9%) and pomegranate (7%) are captured where the irrigation is available. The ber, mango and c. apple fruit crops are also cultivated in this tahsil by sample growers. Due to lack of irrigation facilities and low quality of soil, the wheat crops are observed in only 2 percent area. The other crops like tur, moog, udid, potato, guava and vegetables are also cultivated by sample farmers in Khanapur tahsil.

b) Atpadi Tahsil: Atpadi tahsil is well known drought tahsil of Maharashtra state however the fallow land is 11 percent to total area captured by sample farmers in the tahsil. The jawar crop is tremendously 85 acres (45 %) by sample growers. The pomegranate is another important fruit crop this tahsil which cover 18 percent land of total investigated land. The rain water recharging soil are affected on quality and production of pomegranate and it requires demand on foreign countries. The maize crop also important fodder crop. It provide the food to milk cows who become backbone economy source of farmers. The sugarcane, cotton, ber and grape are also cultivated by sample growers in this tahsil.

c) Tasgaon Tahsil: In Tasgaon, the seven villages are selected and 28 farmers selected for studied. They captured 140 acre area which share 9.16 percent area of total observed area. Among them, only 2 percent area are observed in fallow land which means that the well developed agriculture tahsil in DZSD due to canal irrigation. It is also noticed that the jawar, maize, soyabin, sugarcane and wheat are cultivated in this tahsil but it's share is below 15 percent to total observed area in this tahsil. The grape is cultivated most of the sample farmers, it covered 42 percent area to observed area. The pomegranate (8 %), mango (2 %) and rose flower (2 %) are cultivated by sample growers. It reflects that the farmers diverts from traditional crops to fruit crops or commercial crops.

d) Miraj Tahsil: The 28 farmers are selected from 7 villages in Miraj tahsil. They capture 139 acre area. Among the capture area, five percent area are fallow land. The grape is principal fruit crop cultivated by sample growers which share 28 percent area to total observed area. The maize (13 %), sugarcane (13 %) and soyabin (11 %) are major crops cultivated by sample farmers. The jawar (5 %), wheat (03 %), turmeric (04 %), pomegranate (04 %), mango (03 %) and coconut (o3%) are also cultivated on small scale by sample growers.

e) K.Mahankal Tahsil: The six villages are selected out of 60 villages of tahsil and 24 farmers in these villages. These 24 farmers have captured only 123 acre area which

represents that the land holding size is low. Among the observed area, the 4 percent land is fallow land. On the agriculture landuse, grape is observed highest stage which 26 percent area of total observed area in tahsil. Followed by sugarcane (13 %), pomegranate (12 %), soyabin (10 %) and maize (09 %) are cultivated by selected farmers. However, the bajara (07 %), jawar (06 %), wheat (05 %) and mango (03 %) are also covered small area by sample farmers.

f) Jath Tahsil: Jath is big tahsil of Sangli district which consist 125 villages. Among them 12 villages are selected for investigation and 48 farmers are select in these villages. These 48 farmers captured 716 acre area. It shows that the land holding size is huge but the fallows land also more in this tahsil. Among the observed farmers area 8 percent area are fallow land. Among the agriculture landuse pattern, the jawar (28 %), grape (16 %), pomegranate (16 %) and bajara (12 %) are the principal crops cultivated by sample growers. It is also observed that the maize, sugarcane and wheat crops are cultivated by small scale by sample growers in Jath tahsil.

6.5 Agriculture transformation

The change in cropping pattern in a particular span of the time clearly indicates the changes that have taken place in the agricultural transformation. These changes are brought by the socio-economic influences. The natural factors of physiography, climate soils and water resources will always continue to exert influences on the agricultural land use. For this investigation, the question of food grain to fruit crop transformation is asked to all 180 farmers.

Table 6.13
DZSD: Food grain to fruit crops transformation

Sr. No.	Food grain to fruit crops transform	No of Farmers	%
1	Yes	158	88
2	No	26	12
	Total	180	100

Source: Based on field work and Compiled by Researcher

Table No 6.13 represents that the food grain to fruit crop transform by sample growers in DZSD. Among them, 158 farmers (88 %) out of 180 farmer are transform their cropping pattern from food grain to fruit crop. Remaining 26 farmers are agreeing to transformation landuse pattern. But they face many problems, that why they can't be transform their landuse pattern.

A. Food grain to fruit crops transformation period

The spatio-temporal physical and socio-economic situation is different in all tahsils of DZSD. However, the landuse pattern, farmer's attitude, cultivation of method, etc. are varied tahsil to tahsil. That why the starting agriculture transformation in every tahsil should be different. In DPSD, the agriculture transformation especially food grain to fruit crop is as following.

Table – 6.14
DZSD: Food grain to fruit crops transformation period

Sr. No.	Period of transformation	No of Farmers	%
1	Below 5 year	71	45
2	5 to 10 year	58	37
3	10 to 15 year	21	13
4	Above 15 year	08	05
	Total	158	100

Source: Based on field work and Compiled by Researcher

It is observed from the Table No 6.14 that the agriculture transformation process dominantly started in last ten year in DZSD. The last five years, 71 farmers (45 % to total farmers) transformed food grain to fruit crops in study area. Followed by 58 farmers (37 %) are transformed their crops in the period between 5 to 10 years of from present year. It is also noticed on the table that the last 10 to 15 years, the 21 farmers out of 180 (13 %) are transformed towards the fruit crops but above 15 years, only 8 farmers (05 %) trends towards the transformation. It is suggested, the recently some years farmers know about the fruit crops, their demand, best situation of farm for fruit crop, huge benefit, guarantee of production, new technology of irrigation, modern agriculture method, etc. These factors pull farmers to fruit cultivation in DZSD.

B. Transformation of crops

The development of socio-economic factors which determine the possibility of the enterprise the farmer chosen and the input intensity with which forms with an assured supply of water and availability of modern inputs specially high yielding varieties of seeds and commercial fertilizers, it becomes possible for the farmer to replace less profitable crop of enterprises with more profitable ones also enhance the intensity of the use of the available land.

Table 6.15
DZSD: Transformation of crops by Sample Farmers

Sr. No.	Land Transformed to fruit crops	Name of fruit crops	No. of Farmers (out of 180)	%
1	Fallow land	Grape, Pomegranate, Ber, Mango, Custard Apple,	137	76
2	Jawar	Grape, Pomegranate	101	56
3	Bajara	Pomegranate, Ber,	153	85
4	Maize	Grape, Pomegranate	77	43
5	Wheat	Grape, Banana	112	62
6	Sugarcane	Grape,	52	29
7	Soyabin	Grape,	32	18
8	Fruit crop (Ber, Pomegranate)	Grape	07	04
9	Other crops	Ber, Mango, Custard Apple	117	65

Source: Based on field work and Compiled by Researcher

Table No 6.15 reveals that the agriculture transformation trends towards the fruit crops from the different crops. The food grain to fruit crops transformation are influenced by the net profit from food grain crops and fruit crops, required climatic conditions, availability of water, soil fertility, economic status of farmers, Govt. Facility, etc. The food grains to fruit crops transformation of sample farmers are following.

1. **Fallow land:** Fallow land is largely found due to inadequate water supply or excess of moisture supply, hilly area, extensive holding and shallow soil, heavy clayey soils difficult for tilling at proper time. Now a day, population pressure on agriculture land increased and farmers want to cultivate maximum area of his captured land. However, the fallow soil fertility, water availability, famers economic status, climatic conditions, are affected on the choice of fruit crops. The 76 percent farmers are converted their fallow land to fruit farming. They converted their fallow land to grape, pomegranate, ber, mango, c. apple, etc. Grape fruit crops are cultivated in where the fertile soil, fix source of water available. Pomegranate crops are cultivated in shallow soil on slope area with available of source of irrigation. Ber, Mango and C.apple are planted in the shallow and medium soil with scarcity of water region.

2. **Jawar Crop**: Jawar is principal staple food crop which is cultivated in medium and deep soil with supply of irrigation facilitates. However, the market cost of jawar is low compare to cash crop and fruit crops and no any agro-processing industries developed in this region. Because of this jawar crop is transformed to fruit crops by the 56 percent sample farmers. This fruit crops are grape and pomegranate. Grape is planted on medium and deep soil while pomegranate is planted on shallow and medium deep soil.
3. **Bajara Crop:** Bajara crop is cultivated in shallow soil with help of rainfall water. The productivity of bajara crop is very low (4 to 5 quintal per acre) and market price and demand of bajara crop is so low, that's why the 85 percent sample farmers of the region replaced by ber, crusted apple fruit crops. These crops have low requirement of water. Drip irrigation and mulching system have support it to survive during the scarcity period of water. The subsidy on farm storage water tank have also pull to farmers towards the fruit farming.
4. **Maize Crop:** Maize is best fodder to milk cows and livestock animals. Now a day, milk price are remaining constant for the last ten to twelve years. Due to this reason, the 43 percent sample farmers are replaced maize to fruit crops (Grape, Pomegranate). The another reason is grape and pomegranate net profit per acre is more compare to maize crop.
5. **Wheat Crop:** The wheat crop is very sensitive crop according to climatic condition. Many times it has been fail due to the climatic change and absence of water. But in last 10 to 15 years, the farmers specially educated and young farmers replaced this crop by grape and banana fruit crops. Banana fruit crop have been cultivated by the more water availability farmer, however the banana crop farm size is very limited (0.5 acre to 1 acre).
6. **Sugarcane Crop:** Sugarcane is principal cash crop in western Maharashtra as well as in Sangli District. But it is 12 to 14 months crop and having large amount of water. Farmers change their attitude towards the sugarcane crop and replaced by grape fruit crop. Grape fruit crops net profit is double or more compare to sugarcane crop and water requirement is fifty percent or less than the sugarcane crop. Among the sample survey, the 29 percent sample farmers transformed sugarcane to fruit crops in DZSD.
7. **Soyabin Crop:** Soyabin is oil seed crop cultivated in medium as well as in deep soil with help of the water source of irrigation. The 18 percent sample farmers are

transformed this crop to grape fruit crop. The main reason is the net profit in per are is as high as compare to soyabin crop.

8. **Fruit Crops:** In DZSD, pomegranate fruit crops have been destroyed by '*telya'* disease and net profit of ber crop is low compare to grape fruit crop. However, these fruit crops also replaced by grape fruit crops. The climatic condition of DZSD is favorable for grape plantation. Another reason, the raisin, wine, jelly, etc. agro-processing industries on grape fruit crop are developed, so the demand of grape increased. Among the sample survey, the 04 percent sample farmers transformed their fruit crops (pomegranate, ber) towards the grape fruit crop.
9. **Other Crops:**Out of total sample farmers, the 65 percent farmers are attracted towards the fruit crops from other crops like tur, udid, moog, mataki, etc. These crops are cultivated in shallow soil and on rainfall water. After the development agriculture technology, farm water storage tank, drip irrigation system, new variety of fruit crops, etc. are transformed towards the fruit crops. These fruit crops are Ber, Mango and Custard Apple.

14.6 Causes of Agriculture Transformation

Agriculture is dominant primary activity which has provided food for man and animals. After the huge growing of population, the pressure of population increased and farmers are always try to every fallow convert to agriculture and get maximum crop production. For these, farmers are cultivated crop on the availability of water, soil fertility, climate, working family member, slope of farm, etc. In DZSD, the farmers are transformed their crops from food grain to fruit crops. The following causes are told by sample farmers for the present transformation.

1. High Net Profit: The sample farmers of DZSD told that the average net profit from food grain crops is very low compare to fruit crops. The net profit of food grain crops per acre is in range from 10,000 to 50,000 Rs and these from jawar (40,000 Rs), Bajara (15,000 Rs), maize (45,000) and wheat (35,000 Rs). While the average net profit of fruit crop in per acre is in range of 50,000 to 2, 00,000 Rs and these from grape (2, 00,000), pomegranate (1,55,000 Rs), ber (65,000 Rs) and mango (50,000 Rs). Due to the difference of average net profit farmers are turned to fruit farming from food grain farming.

2. Suitable Climate: The climate characteristics of DZSD is dry, high temperature, low rainfall, low moisture availability, cleanness sky etc. These climatic situations are best for fruit farming which affects on fruit quality, quantity, size, test,

colour, etc. On the other hand, the food grain crops always face problem of irrigation due to this food grain crops burn.

3. Requirement of water: The water is provided to food grain crops by flood system. This system need huge water and the amount of water is waste by this method. In the shallow soil slope field, the water requirement of crops is more and need of water in short distance of time. On the other side, drip irrigation system is used for fruit cultivation. It is very popular, beneficial and water saving system of irrigation. Govt. also gives subsidy on it and it helps to proving fertilizers to fruit plants. DZSD is water shortage region, so the fruit farming is increased in last tow decades.

4. Suitable soil: The quantity and availability of plats' nutrient elements in the soil change as a result of removal by the growing or harvested crop, leaching, erosion or the addition of fertilizer, manure or compost. In DZSD, the shallow soil is large and deep soil very low. The large share of discharging shallow soil is favorable for fruit cultivation, however the fertile deep soil is best for food grain crops which share is very low in study region. The fallow land share is more which transformed by fruit crops.

5. Market demand: Importance of fruits in the human diet is universally recognized. Fruits are the chief source of vitamins, nutritious without which the human body cannot maintain proper health & resistance to diseases. The fruit crops are used in medicines, jelly, juice, jam, wine, fresh eating, etc. So the demand of fruit crops increased in over all worlds. But the food grain crops demand is limited domestic or regional people. Demand of fruit crop is high, the market price also high and demand of food grain crop is low, the market price is also low.

6. Market availability: The food grain crops are sold in domestic or local market, the market demand is limited. Many times traders create a monopoly in domestic or local market due tom this farmers get low price. But in fruit crops are available market of national as well as international where the market is open, farmers get maximum price of fruits. Even farmers sold their fruits on road side of state and national highway.

7. Investment: The fruit crops have needed one time investment in the time of plantation. The minimum age of fruit crop is 15 years or more. After that it has need harvesting investment of only 20 percent of production cost, so it net profit is more. On the side, the food grain crop needs more investment compare to its production cost

because of every year need of plugging, plowing, harvesting, weed control etc. and among them many activities related to bullock or human labour, so production cost increased and net profit decreased.

8. Government policy: The Government policy always tries to increasing the fruit crop area. So Govt. of state and nation, N.H.B, NABARD, and many other organization always give subsidy for plantation of fruit crops like fruit plant, drip irrigation, digging of trenches, water storage tank, fruit conference, crop insurance, help in disease and environmental hazards etc. On the other side, the Govt. should give only crop insurance, and help in natural hazard in way of very few for food grain crops.

9. Agro-processing industries: No any agro-processing industries can not be developed or created in Sangli district as well as in state. But the jam, jelly, medicine, juice, wine, raisin, etc. are many agro-processing industries on fruit crops developed in region and other region. Due to this, the demand and market price of fruit crops are increased. However, the net profit of fruit crops tremendously increased.

10. Requirement of labour: The large share of labours needs in food grain crops like owing, weed control, harvesting, etc. The study region is dry zone, the many people or labour migrated towards the big city for employment. So the problem of labour shortage creates and labour cost increased. But in the fruit crops many activities complete by machines like tractor, HTP spray, and weed control of chemical fertilizers, so the need of labor is low. Another reason is food grain crops come at a time in region, so the demand of labours increased, so labour cost become high.

11. New technology: The food grain crops are cultivated in traditional way, while the productivity and quality is low. But in fruit crops, every stage of fruit crops use new technology like inter cultivation by tractors, HTP spray, chemical fertilizers by weed control, drip irrigation for providing water and fertilizers, mulching for survive in dry period, water storage tank, etc. Due to this production cost decreased and production quality and quantity will be increased.

12. Inter cultivation: The long distance is available among the two pants and row of fruit plants. The vegetables and flowers inter cultivated in fruit farm yard in the absence of fruit harvesting period. If the fruit crops net profit decreased, the farmers will be supported by inter cultivated crops. So the fruit growing farmer's economic condition remain stable or good.

13. **New variety** : The new variety of fruit crops are developed which need low water, high quality, huge productivity, attractive size and colour. The grape new varieties of Thomson seedless, Tas-A- Ganesh, Sonaka and Sharad seedless, pomegranate varieties of Bhagwa, Mrudula, Arakta, Ganesh, Rubi, ber varieties of Umran, Chameli, Kadka and Gola and Mango new varieties of Kesar, Alfanso, Badam, Rawal are developed which is live low water and get best qaultiy. On the another side, the new varieties of food grains crops like jawar, bajara, maize and wheat are developed according to dry zone area. So the food grain area decreased and fruit crop area are increased.

14.7 Problems of famers in DZSD

The total 180 farmers are interviewed during the period of field survey in this present study. Among them most of the farmers told several farmers to the researcher at the time of interview. Among the various problems, major problems are below.

1. **Drought** :

The entire selected village's falls in drought prone area hence there is a problem of scanty water in these village, except in Tasgaon tahsil villages. There is no assuring rainfall in all villages. Distribution of rainfall is uneven in study region. The rainfall is decreased from west to east. The problem of drought especially in Jath, Atpadi, K.Mahankal and some part of Miraj & Khanapur tahsil are very serious where the canal facilities are not provided.

2. Decline of Groundwater

The quantity of ground water is decreased almost in all villages selected for study. The groundwater level is lowest in summer season i.e. near above 400feet depth. The problem is very serious in Jath, Atpadi, K.Mahankal and some part of Miraj & Khanapur tahsil. This is due to mainly scanty rainfall and poor surface irrigation.

3. Low quality of Soil

The major area of study area are open and slope covered by shallow soil. These soil do not support to the rabbi crops at all. Soil erosion is the main problem of DZSD. Soil erosion in its midst senses includes not only control cover erosion but all those measures like conservation of soil defects, proper crop rotation, etc.

4. Traditional cultivator

The majority of farmers of DZSD are poor and ignorant, they are adopting very old cultivation method. Unless this traditional which support backwardness and

stagnation is changed, there is no possibility of agricultural progress, but the important thing that the conditions are changing fast. We should change these conditions through television, radio programmers and Govt. efforts.

5. Lack of irrigation

This is the major barrier of agriculture development. The percentage of irrigation to total net sown area is very low in study area especially in Jath, Atpadi and K.Mahankal tahsil. Particularly in winter and summer season it is very necessary to provide water to crops. The most of study area are totally depending on wells for irrigation and water table of wells depend on erratic monsoon rainfall due to this there is no assure perennial irrigation.

6. Poor techniques of production

The tahsil like Jath, Atpadi and K.Mahankal are use very low modern agriculture techniques like drip irrigation, sprinkler irrigation, harvesting machines, new variety of seeds or High yield varieties etc. above facts indicates that due to poorness the farmers of such village they are unable to use high techniques of farming.

7. High population pressure on land

The population depend on agriculture is more in study area. The tahsil like Khanapur, Atpadi, Tasgaon and Jath, the population pressure on agriculture land is more that why they can use their land for food grain and can't take risk of commercial agriculture crops. They only depend on agriculture which is depending on uncertain and irregular irrigation. That why the poorness of farmers continuously increasing in dry zone area.

8. Supply of capital on low interest rate

The study region farmers told the low interest rate capital .The main problem of agriculture development are capital. Govt. should provide more facilities to farmers but their rules and officer's harassment, farmers can get capital from rich person in village on the high interest rate.

9. Labour problem

Agricultural labour is provided mostly by economically and socially backward sections and poor sections. The majority labours are not working skilled and their labour charges are huge. Especially in food grain farming the time of all farmers are one time, the labour are either not available or labour cost is huge.

10. Less knowledge of Agriculture

In the study region farmers have less knowledge about agriculture and agriculture related income sources. They have no idea about the cropping pattern, crop rotation, soil testing, use of fertilizer on requirement of crops, etc. The tendency of farmers are also observed that they can not accept new changes in agriculture.

11. Lack of electricity

The electricity is major problem dry zone area of Sangli district. Especially in Jath and some part of Khanapur tahsil the connectivity of electricity is absence. The electricity is totally absent of 15 to 20 hours of day. That why the available water problem from electricity is very serious in study region.

12. Problem of training centers

The farmers of the study region are poor illiterate, ignorant, superstitions, conservative and found by out model customs and institutions such as the caste system and the joint family, superstitions and belief in fate are the causes which keep the farmers satisfied with their primitive system of cultivation.

13. Markets

The agricultural production of a crop increases in particular region automatically the costs of sale decrease but if such commodities are purchased by the government or it can be solid in good market more profit will be received to the farmers so good markets should be developed in DZSD.

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CHAPTER - VII
CONCLUSIONS AND SUGGESTIONS

The present research work is attempted to study the grain farming to fruit farming a geographical study of Dry zone area of Sangli District. The study is aimed at proving some guidelines and base for planning of agriculture development of dry zone area of Sangli District. Therefore, the objectives of the study include the identification of dry zone area and to analyse the agriculture transformation from grain farming to fruit farming in dry zone area of Sangli District. Examination of association of grain farming to fruit farming with physical and socioeconomic condition, the study of physical and socioeconomic status of region are understood in this study. In order to understand the land utilization, the five categories of landuse are studied. The agriculture landuse and their change in area has been analysed. The index number, annual variation and spatiotemporal variation of grain crops and fruit crops has been attempted which clear the grain farming to fruit farming transformation. The agriculture planning for assessment of agriculture development, policy of agriculture, problem of dry zone farmers, trend of transformation, a micro level study in respect of selected villages has also been carried out. The following finding from the study of DZSD have emerged.

Findings

1. Sangli district is one of the southern most districts of Maharashtra state where droughts occur frequently. For the study of dry zone area of Sangli District it is essential to identify the area that is dry zone. There are many definition of drought, therefore the methods of study of the drought are also many. The selection of method is depend on rainfall and irrigation based method. For the purpose of the study these factors are analysed during the study period. Sangli District roughly 80 percent rainfall is received from the south west monsoon. Rainfall starts sometime in the last week of June and lasts till end of September because Sangli District is located in rain shadow area of Western Ghats. This scanty and uneven rainfall drastically affecting agriculture of the region. But Shirala tahsil records heavy amount of rainfall with average of 1005 mm. This perhaps, is due to close vicinity of this tahsil with Western ghats. The rage of 450

to 620 mm are observed in Palus, Khanapur, Atpadi, Tasgao, Miraj, Kadegao, Jath and K. Mahakal tahasils of Sangli district. Secondly irrigation is selected to identify dry zone area. The intensity of irrigation is the proportion of net irrigated area to net shown area of the aerial unit. The average irrigation intensity district is 24.76. The low and moderate irrigation intensity is observed in six tahsil of Sangli district. On the observation of rainfall and irrigation base the Jat, Atpadi, Khanapur, K.Mahankal and Tasgaon are consisted in dry zone area.

2. The physical and socio-economic conditions of the area have a great bearing on the agriculture landuse and agriculture transformation. DZSD is a part of the larger Deccan Peninsula of India. The average height of the area is about 600 meters. There are not prominent hilly ranges but little Central and north-western part of the study region is covered by Mahadev ranges respectively. Central part of the district comes under the Man river basin. The Krishna , Agrani, Yerala rivers flows in study area. Soils vary from deep black in river valley to shallow gray in dry area of DZSD.
3. The agro climatic conditions of the region are uneven. December is coldest month and average minimum temperature is about 12.8^0c. In April and May maximum temperature goes up to about 38.5^0c. Rain fall is the dominant single weather parameter, and climatic hazards which affects plant growth. The variability of rainfall is high in the western part than the eastern part of study region. The average rain fall is ranging from 500 to 600 mm. The variation in the annual rainfall from year to year is large.
4. The population of DZSD is 688521 persons according to 2001 census. The highest population is observed in Miraj (35.3%) and followed by Tasgaon tahsil (24.9%). The lowest population is located in Atpadi tahsil (5.8%). During the investigation period it is increased 47.4 percent. The density of population in the region is 325 persons per km. The agriculture density of study region 58 persons per square km. That is high Miraj and Tasgaon and low in Atpadi and Jath tahsil. The relative co-efficient of over population is 1.15 in the study region. The high over population is observed in Khanapur and Jath tahsil.
5. The study area acute need of irrigation. Wells, canals and rivers are used for irrigation and drip irrigation system plays a very vital role as a source of irrigation for fruit farming. There is one major project (Tembu) in the study region and other sources of irrigation played a vital role in transforming the cropping

pattern of the area. So far as the land holding size is concerned the district is an area of small and medium sized farmers. The farm implements include ploughs, carts and tractors.

6. The study of general landuse pattern reveals that out of the total geographical area 75.22 area percent area belong to the cultivated area. There is positive change (3.61 percent) observed over a period of twenty five years in cultivated area. The land under fallow is 3.66 percent to geographical area. It is highly (7.76 %) decreased due to the development of irrigation facility, growing population and farmers economic condition. The land under potential category is 7.59 percent to geographical area in DZSD. There is slight increase (2.99%) in potential land during the investigation period. Area under non agriculture is more (9.55 %) compare to the other part of the district. There is a little positive change (1.10%) over a period of twenty five years of investigation.
7. Analysis of the cropping pattern indicates that area under food crop is 75.22 percent to total agriculture area. This area tremendously (7.81 %) decreased over a period of investigation. Among the food crops, share of food grain is more (75.98%), however it is also slightly decreased. Non-food grain crops capture 7.63 percent area. This area also decreased in amount of 4.86 percent. It is important to note that area under non food crops is 16.57 percent and it is 7.58 percent increased with a fast rate during the period of investigation.
8. Annual area variation of food grain and fruit crops area ups and downs during the period of investigation. During the investigation period of 20 years, the food grain area is increase in 16 years and decreased in 8 years which period is 1990 to 1995. The highest increase (72708Hect.) is observed in 1986-87 and lowest increase (3987 Hect.) is in 2004-05. The rate of growth continuously decreasing after 1997-98. It strongly present that it is replaced by other cash crops or fruit crops.
9. The total area under fruit crop is low compared to foodgrain because of the climatic conditions. Area under fruit crop has continuously increasing during the investigation period. The growth rate was below 1300 hect. in first decade (1989-90 to 1999-2000) compare with base year of 1989-90. During the second decade (1999 to 2009) the growth rate was between 3000 to 11000 hect. After the 2004-05, the fruit crop area has increasing tremendously because of the development of irrigation type and mode, new variety of fruit crops, traditional way of fruit cultivation and increasing demand of fruit crops in over all world.

10. The total food grain crops indices are remaining over 100 % during the period of 1991 to 1995 and 2001 to 2009. Remaining period of study, it is decreased and reached below 100 %. Moog is highest in the year 2004-05 and it is 760.41 %. Followed by Maize is second leading crop in index number 389.79 % in 1995-96 in all food grain crops in DZSD. The indices of Bajara and Tur crop shows us ups and downs through out the period of under study. A wheat crop index is always remaining below 100 during the investigation period in study area. In the table no 6.14 also observed that all food grains crops are remaining below 100 % in during between 1996-97 to 1999-2000.
11. The index of area under total fruit crops are continuously increased and growth rate are also increased during the study region. The highest indices are observed in grape fruit crop in 2009-10 and it is 743.54 %. Followed by pomegranate, Sapota fruit crops are also high indices. Grape fruit crop indices are continuously extent. But pomegranate indices are becoming low after 2005-06. Ber fruit crops index remaining below 100 % in only two years out of 20 years. However the rage of increasing of ber fruit crop area is below 130 %.
12. Among the food grain, Jawar is most importance as a staple crop in the DZSD. During the period of study under consideration, the area has increased by 3.39 percent. It has become 43.58 percent in reference year 2009-10. Bajara is the second rank crop in the district accounting for a major proportion (16.67 percent in 1989-90 and 7.86 percent in 2009-10) to the net sown area. Maize covered 0.74 percent of the net sown area in 1989-90 and 2.45 percent in 2009-10, it increased by 1.71 percent of the net sown area.
13. Among the pulses gram, tur, Moog etc. are the major pulses in study area. Gram was 2.70 percent in 1989-90, which has been increased 1.63 percent and reach 4.33 percent in 2009-10. The area under tur crop has been decreased by 0.54 percent in DZSD during the period under study. The area under gram was 821 hectors (0.16 %) in 1989-90, which increased in 2009-10 i.e. 0.92 percent of the net sown area.
14. Fruits comprise a large range of crops which differ in their perishability, seasonality value and also their soil and climatic requirements. The percentage fruit crop has increased by 2.31 percent during the period of 20 years. Grape is cultivated only 1123 hect. in the reference year 1989-90, but it is tremendously growing during the investigation period. It is capture 8350 hect.in 2009-10.

Pomegranate is cultivated only 709 hect. On DZSD in the reference year 1989-90, however it is increasing 3446 hect. in the reference year 2009-10. Ber is cultivated on 482 hect. (14.20% to FCA) in the reference year 1989-90 which is increased 90 hect. in during the study period. The mango, crusted apple, banana, guava, sapota fruit crops are cultivated on small scale in study region.

15. The agriculture transformation in DZSD during the period 1989-90 to 2009-10 studied. During the investigation period, the food grain crops are decreased to 2.97 percent to net sown area and food grain crops are increased 2.33 percent to net sown area in study area. Among the foodgrain crops, the area under four crops is increased and these crops are Jawar, Maize, Gram, Tur and Moog crop. However, the highest positive change is lie in Jawarcrop(4.21% to NSA) and lowest lie in Moog crop (0.75 % to NSA). However, the negative change in area under food grain crop is recorded in Bajara, Wheat and Tur crop. The maximum negative is observed in Bajara crop (8.81 % to NSA) and lowest in Tur crop (0.54 % to NSA).
16. During the study period the fruit crop area is increased 12637 hect. The highest area (1.33 % to NSA) under fruit crop is increased in Grape fruit crop and followed by Pomegranate (0.50 % to NSA). The lowest growth is recorded in Banana crop (0.01 % to NSA) which needs more water.
17. Among the agriculture transformation, it is reveals that the bajara, wheat and tur crop area is replaced by grape and pomegranate fruit crop. It is also observed that western part of study area attracted to grape cultivation while the eastern part trend is to pomegranate cultivation. This is depend on environment situation.
18. The area under forest and fallow land are replaced by fruit crops in study region and the area under sugarcane and cotton crop are also replaced by fruit crops in small scale in DZSD.
19. This micro level study the 45 villages are selected on random sampling. The four farmers are selected in each village. In this way the 180 farmers are selected for micro level study. The education, land holding size, age group, working family member, irrigation, soil, etc. elements are analysed in this study.
20. The total sample farmers have captured 1528 acres area. The area under jawar crop is highest (23.83 %) in sample farmers total captured land. Followed by grape (17.47 %), pomegranate (12.76 %) and Maize (9.29 %) are also largely cultivated crops by sample farmers in DPSD. The area under bajara and sugarcane

are range between 4 to 7 percent in investigated land. Among the remaining crops wheat, soyabin, turmeric, mango are captured in range between 1 to 2 percent by sample farmers total land. However, the crops like ber, c. apple, coconut, banana and rose are cultivated on very small scale (below 1%). It is also observed that the other crops like mataki, hulaga, tur, udid etc. are also cultivated in DPSD which acquire 5.36 percent land of total sample farmers land.

21. Among 180 farmers, 158 farmers (88 %) are transform their cropping pattern from food grain to fruit crop. Remaining 26 farmers are agreeing to transformation landuse pattern. But they face many problems, that why they can't be transform their landuse pattern. The last five years, 81 farmers (45 % to total farmers) transformed food grain to fruit crops in study area. Followed by 67 farmers (37 %) are transformed their crops in the period between 5 to 10 years of from present year. It is also noticed on the table that the last 10 to 15 years, the 23 farmers out of 180 (13 %) are transformed towards the fruit crops but above 15 years, only 9 farmers (05 %) trends towards the transformation.
22. The sample farmers of the study region face many problem of agriculture. Among them scarcity of water, lack of irrigation facilities, traditional cultivator, poor techniques of production, high population pressure on agriculture land, supply of capital on low interest rate, less knowledge of agriculture etc. are major problem of farmers in dry zone area of Sangli District.

Major suggestion to solve the problem

1. Sangli District is located in drought prone area. Water scarcity is a serious problem in agriculture. The farmers should use the mulching techniques for maximum use of available water. Drip irrigation system is most useful in getting good yield during the water scarcity period.
2. Many of the wells have insufficient water facilities during late summer and early monsoon, hence efficient utilization of water is needed minimal irrigation for field crops need to be adopted.
3. There is a need to establish training and research center at every tahsil. The farmers should be given training about water conservation, water management, crop production, modern implements, new production technology, etc.

4. For the development of agriculture in DZSD to select the best cropping pattern system on the ecological consideration, it is necessary to identify the best cropping pattern for DZSD under the prevailing rainfall and temperature pattern.
5. Farmers of the region face the problem of capital. To solve this problem, it is suggested that Credit Societies, N.H.B., DCC Banks and Agriculture Departments can release more capital on subsidy basis for increasing fruit cultivation area in the study area.
6. The problem of daily shortage of electricity is very serious. Therefore, it is suggested that to overcome this difficulty the use of fuel engines, solar plant etc. may be made as an alternative to the electricity.
7. The co-operative marketing channel is quite safe to avoid the cheating by the middlemen. Hence, the Farmer should come together and form a Federation of Co-operative Societies by taking financial assistance from the Government Organizations viz, the National Board of Agriculture Research & Development (NABARD) and National Horticulture Board (NHB).

8.It is noticed from the field study that there are technological differences among the farmers regarding the application of chemical fertilizer, application of irrigation, plant protection from diseases and pests, knowledge of improved varieties and application of compost. Hence, it is suggested that special extension efforts are essential in terms of organization of demonstration, meetings, discussion, film shows on farmer's field and campus training programmes should be organized.

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Appendix I

DZSD : Annual variation in food grain crops

Year	Jowar	Wheat	Bajara	Maize	Gram	Tur	Moog	Other	Total
1980-81	202878	32637	85898	3811	13938	11753	821	52208	406944
	Base Year								
1981-82	+17513	-12438	+13906	-1457	-3531	-1817	+304	+2043	+11523
1982-83	+17513	-12438	+13906	-1457	-3531	-1817	+304	+2043	+11523
1983-84	+16626	-14981	+14709	-1470	-2776	+4885	+306	+209	+14527
1984-85	+11946	-15568	+18008	-1184	-3368	+1024	+260	-12150	-4032
1985-86	+16217	-16392	+22137	+5448	-2930	-2592	+867	+3936	+23691
1986-87	+59505	-14022	+35536	-625	+9317	+2512	+1066	-17581	+72708
1987-88	+25821	-18798	+7511	-364	+9672	+1488	+1032	-2359	+21003
1988-89	+25906	-12225	+29709	+11044	+927	+1828	+1120	-4372	+50937
1989-90	-169259	-14797	-78976	-1403	-10598	-10733	+1165	-18993	-308561
1990-91	-189019	-20491	-83255	-2769	-10325	-10859	-31	-15753	-335772
1991-92	-179715	-24039	-80364	-2207	-10279	-11017	-167	-49428	-360116
1992-93	-175124	-19398	-80480	-1354	-10894	-10821	-107	-48888	-350066
1993-94	+8989	-16105	-14728	+3185	+1467	-762	+1576	+49067	-68445
1994-95	-3488	-18916	-81761	-904	-7920	-10786	+739	-47622	-173658
1995-96	+51043	-16115	-5955	+179	+6095	-3193	+3123	+24933	+57130
1996-97	+105852	-13662	-80869	-1512	-6103	-2432	+4552	+33649	+36475
1997-98	+36835	-19123	+24003	+3216	+3114	-2175	+3755	+12402	+59027
1998-99	+35242	-10341	+13502	+4643	+13453	+52	+5175	-1170	+57656
1999-00	+42998	-10824	-36365	+7887	+12202	+357	+5422	+12964	+32461
2000-01	+46818	-11273	-83221	-810	+12599	+3558	+3148	+4504	-17677
2001-02	+25821	-18798	+7511	-364	+9672	+1488	+1032	-2359	+21003
2002-03	+43867	-8798	-42489	+9636	+9672	+1488	+4032	-2359	+12049
2003-04	+50771	-9302	-43372	+9430	+9495	-2368	+5061	-9978	+6847
2004-05	+32771	-9302	-43372	+9430	+9495	-2368	+4148	+6525	+3947

Appendix II

DZSD; Annual variation of fruit crops

Year	Grape	Pomegranate	Ber	Mango	Crusted Apple	Banana	Sapota	Guava	Other	Total
1980-81	1123	709	482	186	148	220	185	99	241	3393
	Base Year									
1981-82	+3	+46	-2	0	0	+5	+14	+46	+269	+380
1982-83	+3	+46	-2	0	0	+5	+14	+46	+269	+380
1983-84	+137	+147	+8	+2	+3	-2	+26	+47	-36	+332
1984-85	+155	+278	+9	+9	+5	-5	+35	+53	-51	+488
1985-86	+233	+436	+8	+10	+1	+91	+38	+75	-15	+882
1986-87	+275	+488	0	+10	+2	+85	+54	+77	-27	+962
1987-88	+299	+636	+10	+17	+3	+78	+54	+72	-27	+1142
1988-89	+345	+701	+17	+19	+3	+87	+69	+73	-33	+1281
1989-90	+467	+1680	+20	+28	+4	+147	+171	+80	+672	+3269
1990-91	+581	+1831	+37	+46	+16	+145	+181	+91	+679	+3605
1991-92	+1052	+2447	+52	+51	+28	+135	+197	+86	+413	+4479
1992-93	+1511	+3077	+47	+57	+31	+124	+202	+76	+282	+5405
1993-94	+1733	+3523	+45	+57	+35	+119	+120	+53	+229	+5914
1994-95	+2198	+4711	+80	+70	+50	+113	+247	+57	+271	+7795
1995-96	+2617	+4789	+76	+78	+68	+107	+247	+53	+129	+8162
1996-97	+2897	+4914	+81	+84	+81	+5	+300	+51	+57	+8570
1997-98	+3118	+4981	+88	+95	+88	+5	+331	+54	+13	+8873
1998-99	+3248	+4990	+86	+94	+93	-1	+352	+60	+5	+9027
1999-00	+4292	+5316	+88	+100	+140	-7	+428	+64	+2	+10523
2000-01	+5110	+5203	+135	+75	+141	-8	+468	+66	+4	+11294
2001-02	+6156	+4491	+105	+137	+147	+87	+530	+72	+11	+11736
2002-03	+6550	+4423	+98	+224	+157	+87	+563	+85	+19	+12176
2003-04	+7167	+3756	+94	+370	+162	+83	+621	+91	+13	+12357
2004-05	+7227	+2737	+90	+484	+171	+78	+706	+115	+1029	+12637

Appendix III

DZSD; Index number of food grain crops

Years / Crops	Jowar	Wheat	Bajara	Maize	Gram	Tur	Moog	Other	Total
1980-81	202878	32637	85898	3811	13938	11753	821	52208	406944
	100	100	100	100	100	100	100	100	100
1981-82	108.63	61.88	116.18	61.76	74.66	84.54	137.02	103.91	102.83
1982-83	108.63	61.88	116.18	61.76	74.66	84.54	137.02	103.91	102.83
1983-84	108.19	54.15	117.12	61.42	80.08	141.56	137.27	100.40	103.56
1984-85	105.88	52.29	120.96	68.93	75.83	108.71	131.66	76.72	99.01
1985-86	107.99	49.77	125.77	242.95	78.97	77.94	205.60	107.53	105.82
1986-87	129.33	57.03	141.36	83.60	166.84	121.37	229.84	66.32	117.86
1987-88	112.72	42.40	108.74	90.44	169.39	112.66	225.70	95.48	105.16
1988-89	112.77	62.54	134.58	389.79	106.65	115.55	236.41	91.62	112.51
1989-90	16.57	54.66	8.05	63.18	23.96	8.67	241.90	63.62	24.17
1990-91	6.83	37.21	3.07	27.34	25.92	7.60	96.22	69.82	17.48
1991-92	11.41	26.34	6.55	19.29	26.25	6.26	79.65	5.32	11.50
1992-93	13.68	40.56	6.30	64.47	21.83	7.92	86.96	6.35	13.97
1993-94	104.43	50.65	79.16	183.57	110.52	93.51	291.96	6.01	83.18
1994-95	9.82	42.04	4.81	76.27	43.17	8.22	190.01	8.78	13.22
1995-96	125.15	50.62	93.06	104.69	143.72	73.00	480.38	147.75	114.03
1996-97	152.17	58.13	5.85	60.32	56.21	79.30	654.44	164.45	108.96
1997-98	118.15	41.40	127.94	184.38	122.34	81.49	557.36	123.75	114.50
1998-99	117.37	68.31	115.71	221.83	196.52	100.44	730.32	97.75	114.16
1999-00	121.19	69.28	57.68	306.95	187.54	103.83	760.41	124.83	107.97
2000-01	123.07	65.45	3.11	78.74	190.39	130.27	483.43	108.62	95.65
2001-02	112.72	42.40	108.74	90.44	169.39	112.66	225.70	95.48	105.16
2002-03	121.62	73.04	50.53	352.84	169.39	112.66	591.18	95.48	102.96
2003-04	125.02	71.49	49.50	347.44	168.12	79.85	716.44	81.08	101.68
2004-05	116.15	71.49	49.50	347.44	168.12	79.85	605.23	111.77	100.96

Appendix IV

DZSD; Index number of fruit crops

Year / Crops	Grape	Pomegranate	Ber	Mango	Crusted Apple	Banana	Sapota	Guava	Other	Total
1980-81	1123	709	482	186	148	220	185	99	241	3393
	100	100	100	100	100	100	100	100	100	100
1981-82	100.26	106.34	99.58	100	100	102.27	107.56	146.46	211.61	111.19
1982-83	100.26	106.34	99.58	100	100	102.27	107.56	146.46	211.61	111.19
1983-84	112.19	120.73	101.65	101.07	102.02	99.09	114.05	147.47	85.05	109.78
1984-85	113.80	139.21	101.66	104.83	103.37	97.72	118.91	153.53	78.83	114.38
1985-86	120.74	161.49	101.65	105.37	100.67	143.63	120.54	175.75	93.77	125.99
1986-87	124.48	168.82	99.58	105.37	101.35	138.63	129.18	177.77	88.79	128.35
1987-88	126.62	189.70	102.07	109.13	102.02	135.45	129.18	172.72	88.79	133.65
1988-89	130.72	198.87	103.52	110.21	102.02	139.54	137.29	173.73	86.30	137.75
1989-90	141.58	336.95	104.14	115.05	102.70	166.81	192.43	180.80	378.83	196.34
1990-91	151.73	358.25	107.26	124.73	110.81	165.90	197.83	191.91	381.74	206.24
1991-92	193.67	445.13	110.37	127.41	118.91	161.36	206.48	186.86	271.36	232.00
1992-93	234.55	533.99	109.33	130.64	120.94	156.36	209.18	176.76	217.01	259.29
1993-94	254.31	596.89	108.92	130.64	123.64	154.09	164.86	153.53	195.02	274.30
1994-95	295.72	764.45	116.18	137.63	133.78	151.36	233.51	157.57	212.44	329.73
1995-96	333.03	775.45	115.35	141.93	145.94	148.63	233.51	153.53	153.52	340.55
1996-97	357.96	793.08	116.80	145.16	154.72	147.72	262.16	151.51	123.65	352.57
1997-98	377.64	802.53	118.25	151.07	159.45	147.72	278.91	154.54	105.39	361.50
1998-99	389.22	803.80	117.84	150.53	162.83	144.99	290.27	160.60	102.07	366.04
1999-00	482.19	849.78	118.25	153.76	194.59	142.27	331.35	164.64	100.82	410.13
2000-01	555.03	833.85	128.00	140.32	195.27	141.81	352.97	166.66	101.65	432.86
2001-02	648.17	733.42	121.78	173.65	199.32	139.54	386.48	172.72	104.56	445.88
2002-03	680.58	723.83	120.33	220.43	206.08	139.54	404.32	185.85	107.88	458.85
2003-04	738.20	629.76	119.50	298.92	209.45	137.72	435.67	191.91	105.39	464.19
2004-05	743.54	486.03	118.67	360.21	215.54	135.45	481.62	216.16	526.97	472.44

Glossary

Food grain and Fruit Crops Common & Botanical Names

Sr. No	Local Name	English Name	Botanical Name
1	Jwari	Sourgham	Sourgham vulgare
2	Gahu	Wheat	Triticum Satuvum
3	Bajari	Peal Millet	Pennisetum Typhoides S & H
4	Maka	Maize	
5	Bhat	Rice	Oriza Satva
6	Tur	Red Gram/Pigeon pea	Cajanus Canon millsp
7	Chan/ harbara	Bengalgram / Chick pea	Cicer arietinum
8	Moog	Green gram	Phaseolus aureus Roxb
9	Oas	Sugarcane	Saccharum officinarum Linn
10	Bhuimug / Moongphali	Groundnut	
11	Kusum	Safflower	
12	Kapasi	Cotton	Gossypium atborium L
13	Drakshe	Grape	
14	Amba	Mango	Mangifera indica L
15	Peru	Guava	Psidium guajava L
16	Dalimb/Anar	Pomegranate	Punica granatum
17	Bor	Ber/ Jujabe	Ziziphus mauitiana Lam
18	Cicku	Sapota	A chras zapota