

**ECONOMIC APPRAISAL OF
AGRICULTURAL DEVELOPMENT OF
SANGLI DISTRICT IN MAHARASHTRA**

By

MISS DHOLE SONAM GAJANAN

(Reg. No. R/013/131)

A Thesis submitted to the

**MAHATMA PHULE KRISHI VIDYAPEETH,
RAHURI-413 722, DIST. AHMEDNAGAR
MAHARASHTRA STATE (INDIA)**

In partial fulfilment of the requirements for the degree

of

MASTER OF SCIENCE (AGRICULTURE)

in

AGRICULTURAL ECONOMICS

**DEPARTMENT OF AGRICULTURAL ECONOMICS,
POST GRADUATE INSTITUTE,
MAHATMA PHULE KRISHI VIDYAPEETH,
RAHURI-413 722. DIST. AHMEDNAGAR, M.S., INDIA.**

2015

**Economic Appraisal of Agricultural
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2015

CANDIDATE'S DECLARATION

I hereby declare that this thesis or part
there of has not been submitted by
me or other person to any other
University or Institute
for a Degree or
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This is to certify that the thesis entitled, “**Economic Appraisal of Agricultural Development of Sangli District in Maharashtra**”, submitted to the Faculty of Agriculture, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar, Maharashtra State in partial fulfilment of the requirements for the degree of **MASTER OF SCIENCE (AGRICULTURE)** in **AGRICULTURAL ECONOMICS** embodies the results of a *bonafide* research work carried out by *Ms. Dhole Sonam Gajanan*, under my guidance and supervision and that no part of the thesis has been submitted for any other degree, diploma or publication.

The assistance and help received during the course of this investigation have been acknowledged.

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ABSTRACT

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Research Guide	:	Dr. G.G. Joshi
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The present investigation was undertaken to evaluate the process of agricultural development by way of studying the changes in the land use and crop pattern, growth rates in area, production and productivity of major crops and to identify the factors influencing agricultural production during the period from 1980-81 to 2012-13 in Sangli district. The time series data covering the above period relating to the aspect of the study were collected from the published literature as well as from relevant sources. The data were analyzed by adopting suitable analytical tools to arrive at the following results.

Abstract contd ...**Dhole S.G.**

The study revealed that, the irrigated area increased by 129.65 per cent while the un-irrigated area declined by 21.72 per cent during the entire period under study. The net sown area showed decreasing trend by 4.79 per cent and gross cropped area also decreased by 1.19 per cent to the total geographical area. The land under cultivable waste and cultivable fallows showed increasing trend. The land under non- agricultural use increased by, 79.06 per cent. The cropping pattern showed the predominance of foodgrains crop in district. The commercial crop sugarcane showed continuous increasing trend in area. A contrary was the trends noted in area in case of foodgrains crop in district.

The study brought an important fact that, the new technology available during post green revolution period help to improve the productivity of crops *viz.*, wheat, jowar, maize, gram and red gram. As a result, the rate of increase in the production of foodgrain was more in post green revolution (1997-98 to 2005-06) period as compare to that in pre green revolution period (1950-51 to 1967-68). It is concludes that, from the study the factors *viz.*, consumption of total fertilizer (NPK) per hectare of gross irrigated area in kg (X_2), per cent of area under commercial crops to gross sown area (X_5), percentage of area of HYV seeds to gross sown area (X_4), area under fruits crops in hectares (X_8) and number of milch animals (X_9) have shown a significant positive association with the increase in the value of aggregate crop output in Sangli district.

Abstract contd ...**Dhole S.G.**

The important policy implications made on the basis of the present investigation are maintaining forest area, expansion of irrigated facilities, supply of fertilizers and proper supervision on the use of credit, the area expansion of HYV's may be properly supervised for its best utilization in agriculture. The use of agronomical and mechanical measures for harvesting rainwater for development of agriculture in Sangli district.

Pages 1 to 112

1. INTRODUCTION

1.1 General

In developing countries, the agriculture is the backbone of the economy. In India, agriculture contributed 13.7 per cent to the Gross Domestic Product (GDP) during the year 2012-13. Agriculture sector provides employment to more than 52 per cent of country's workforce and is the single largest private sector occupation. Any developing economy dependent primarily on agriculture has to undergo the process of agricultural development for accelerating the economic growth. The process of economic development of a country mainly depends upon as to how the agricultural sector is advancing. The performance of agricultural sector is therefore crucial in the process of economic development of a country. This is especially true in case of a predominantly agricultural and over- populated country like ours.

The development of agriculture has significant effects on the growth of other sectors of the economy. It helps the process of industrialization by providing raw material to the leading agro-based industries as well as small scale and cottage industries.

In India, half of the income generated in industrial sector is based on raw material obtained from agriculture. The trade both international and interstate in our country highly depends on agricultural products. The surpluses form agricultural sector, because of increased productivity due to

modernization of agriculture, serve as the basis for starting several economic activities and finally contribute substantially to an overall economic growth of the country. This is the reason why agricultural development has been given priority in the economic planning during post-independence period in our country.

1.2 Agricultural development

The development of agriculture is a process through which the shift takes place from the stage of traditional agriculture to the stage of modernized agriculture resulting in increased productivity and production per unit of resource due to use of modern technology. During the process of transformation, the position of original equilibrium changes and production function shifts to a higher level and occupies a new equilibrium position where the profits are maximum. The process of agricultural development includes the use of high yielding varieties, adoption of package of practices including the use of fertilizers, plant protection measures, irrigation, modern machinery, etc., for increasing productivity of farm enterprises. The process aims at getting the maximum advantage of the available resources vis., land, labour, capital, etc., on the farm and finally depicts the prominent changes in resource use and allocation, productivity of crops over a period of time in the region. The process of agricultural development is thus important from the viewpoint of increasing agricultural production in the country.

1.3 Agricultural development in India

Recognizing the important role of agriculture in the economic development of country, five-year plans assign high priority to agricultural development. Agriculture has been the major source of livelihood in India since the primordial age. Invention of Moghals followed by British did not change the situation to the desired level. Agriculture remained totally primitive, deteriorative and turbulent. The deficiency of foodgrains had led to witnessing of a number of horrible famines. The agriculture sector in many developing countries could not move ahead because of large number of physical, natural, economical, social, political and human factors.

Since, the post-independence period, several measures have been taken to swing-up agricultural sector. The first five year plan allotted 31 per cent of its total investment on agriculture and allied activities. As a result, the trend of agricultural production has been reversed partly because of increase in the area under cultivation and partly because of adoption of the intensive method of cultivation. The Green Revolution was started in our country in around 1965-66 onwards. The development of new high yielding varieties of foodgrains *viz.*, wheat, rice, maize, jowar and bajra was the spectacular achievement of agricultural research. The new strategy concentrated not only on high yields per unit of land but also on higher intensity of cropping. The conditions did not remain the same and since 1966-67 with the onset of the process of agricultural development involving technological

changes with the introduction of high yielding varieties of seeds during mid sixties and increase in availability of chemical fertilizers and irrigation facilities, Indian agriculture no longer continued to be traditional one as it was during the fifties. The increased agricultural production enabled India to become self sufficient in foodgrains. The production of other crops such as cotton, sugarcane, oilseeds, fruits and vegetables as well increased during the seventies and eighties.

In recent past, Government of India has been focusing on agricultural development by giving special efforts on policies, strategies and framework such as General Agreement On Tariffs Trade Agreement (1994), National Agriculture Policy (2000), National Seeds Policy (2002), Cooperative Policy, Agriculture Price Policy, Agricultural Extension Framework (2001), National Rural Employment Guarantee programme (2005), National Horticultural Mission (2005-06), National Food Security Mission (2007), Rashtriya Krishi Vikas Yojana (2007-08) etc.

Overall, the total foodgrain production in the country has increased from 123.7 million tonnes in 1980-81 to 255.36 million tonnes in 2012-13. The country has already reached a stage of self-sufficiency in foodgrain production. The total irrigated area in 1980-81 was 49.78 million hectares, which rose to 91.53 million hectares in 2012-13 i.e. by 83.87 per cent. The fertilizer consumption was 55.16 lakh tonnes in 1980-81, which rose to 255.36 lakh tones in 2012-13. It is thus clear that the agriculture in the country is marching on the path of development aimed at socio-economic prosperity of the people.

Cropping intensity of India in 1980-81 was 123.3 per cent, which rose to 133.14 per cent.

Many efforts were taken in improving the agricultural situation in India, the growth in agricultural output was however, not smooth over all the years as well as over different states and regions in India. It is seen that technological changes was specific to the crops such as wheat, cotton, paddy, groundnut all of which were grown under irrigated conditions in Haryana, western Uttar Pradesh (Uttarakhand), Punjab, few pockets of Gujarat, Maharashtra, Tamil Nadu and Andhra Pradesh. Many of the pulses and oilseed crops as well as commercially important crops such as sugarcane, tobacco and chilly remained outside the phenomenon of technological change for a long time.

1.4 Agricultural development in Maharashtra

In Maharashtra, all possible efforts have been made for increasing agricultural production and thereby to involve in the national campaign of development of agriculture, which commenced during post-independence period. The development scheme *viz.*, CADA (Command Area Development Authority, DPAP (Drought Prone Areas Programme), SFDA (Small Farmers Development Agency), and MFAL (Marginal Farmers and Agricultural Labourers) are also in operation in Maharashtra. Maharashtra is fore runner in respect of many new schemes like SFDA (Small Farmers Development Agency), pioneer in cooperatives such as Sugar factories, dairies, water user association etc. First, state to adopt Dry Land Farming

Technology. The implementation of the pilot project scheme involving the action co-ordination of development agencies for boosting the productivity of wheat in 1975-76 and of sugarcane in 1976-77 was also the unique attempt for increasing production of these crops in the state.

Due to development of agriculture higher levels of production of food and other farm products, higher income and better standard of living for farm families have been achieved. When an agricultural sector grows, the impact of its development is felt in other sectors of the economy and it accelerates the overall economic development of the region. Maharashtra could be considered to be one of the heterogeneous states in the Indian Union as far as the varying agro-climatic conditions are concerned. The state comprises four regions *viz.* Konkan, Western Maharashtra, Marathwada and Vidarbha region which represent varying types of natural, physical, social and economical conditions, quite distinct from each other. The variability in topography, soil and climatic factors bear significant impact on crop and land use patterns, use of production inputs and adoption of technological innovations of crop production among the region. The inter-regional comparison of the performance of agriculture has revealed that the technological advances in agriculture could not make much progress in their contribution to increase production and productivities of various crops in different regions. Because of this variability, there existed significant imbalance and disparities in income levels of families in these regions.

The development of agriculture in Maharashtra did not prove to be much satisfactory during the plan periods. As a matter of fact, the state government was quite progressive with regard to planning and implementation of a variety of agricultural development programmes with a view to gear up natural resources conservation and development activities, supply of farm inputs including credit, development of other infrastructural facilities, strengthening of research and extension education, efforts to evolve and disseminate new agricultural technologies and expansion of adequate institutional base conducive for transformation of agriculture in the state. However, because of the limitations of irrigation facilities, regional variations in natural resource endowments and excessive dependence of agricultural sectors could not make much headway throughout the entire planned period. In effect there existed great disparities in the spread of biochemical and mechanical innovation among different regions and among individual crops within the regions of Maharashtra.

The total foodgrain production in the state was 94.72 lakh tones in 1980-81, which increased to 104.39 lakh tones in 2012-13. The agricultural production in the state is highly subjected to the regularity of monsoon. The area under sugarcane, which is a prominent cash crop, has increased from 3.19 lakh hectares in 1980-81 to 10.22 lakh hectares in 2012-13. It has been noted that the gross area irrigated showed an increase from 24.15 lakh hectares to 40.89 lakh hectares during the period from 1980-81 to 2012-13.

1.5 The problem

A breakthrough in India agriculture due to introduction of green revolution during the mid-sixties has helped farmers to come out of their traditional agriculture. They have now realized the importance of the use of crucial inputs *viz.*, irrigation, credit, fertilizer, high yielding varieties seed, plant protection measures, etc., for increasing agricultural production. It appears that the above said inputs along-with the new technology in agriculture have profound effects in influencing the productivity and the resulting production in agriculture. The agriculture in Maharashtra underwent several changes on account of the national campaigns for agriculture development since mid-sixties.

The need was felt to undertake a scientific assessment of the process of agricultural development in a well defined area over a period of time. A study of this kind may have a detailed probe in examining the trend of changes in the land use, crop pattern, and growth rates of important crops and identification of major variables influencing the agricultural production. The examination of changes in growth rates of area, production and yield of major crops due to introduction of green revolution would also be useful. The studies on the above said aspects evaluating the agricultural development in a well defined area, say a district are relatively scarce. It is observed that Sangli district in Western Maharashtra is one of the developed districts in agricultural development activities. In view of this it was therefore decided to undertake a study *viz.* "Economic Appraisal

of Agricultural Development of Sangli District in Maharashtra” covering a period from 1980-81 to 2012-13 in Western Maharashtra region.

1.6 Objectives of the study

The study was undertaken with the following specific objectives;

- a) To study the changes in land use and cropping pattern,
- b) To study the growth rates in area, production and productivity of major crops,
- c) To study infrastructural development for agriculture of Sangli district,
- d) To identify the important factors responsible for agricultural development of Sangli district,
- e) To identify strengths, weaknesses, opportunities and threats (SWOT) and suggest measures.

1.7 Hypotheses of the study

In the light of foregoing theoretical propositions and the review of literature presented in the next chapter, the following hypotheses were proposed to be tested for fulfilling requirements of the objectives of study.

1. There is an expansion in cultivated and irrigated area biased towards commercialization of agriculture due to agricultural development in Sangli district.
2. The introduction of green revolution in agriculture has helped in increasing the production and productivity of major crops in Sangli district.

3. Expansion of irrigated area, credit flow, consumption of fertilizers, annual rainfalls etc. are the major factors influencing the agricultural production in Sangli district.

1.8 Scope and utility of the study

The scope of the study is restricted to the above said objectives only. However, the finding of the study can be projected to wider areas having similar agro-climatic conditions. The study will focus light on important parameters of agricultural development in a district which can be further studied under varied situations in the state for knowing their significance.

It is hoped that the study will arrive at important conclusions which could be useful for planning and execution of agricultural development programmes in the district. The weaknesses in the resource allocation can be noted with the help of the changes in crop pattern of the district over a time as well as growth rates in important crops and finally can be removed by suggesting suitable measures for the balanced agricultural growth in the district.

1.9 Limitations of the problem

The present study is based on the secondary data obtained from published sources as well as from development agencies in Sangli district. The analysis is limited to the available stock of the data on the aspects of the study. The validity of the result of study is therefore, based on the degree of reliability of the secondary data. However, the attempt is made to have an in-

depth analysis of the data by adopting suitable analytical techniques to arrive at the meaningful conclusions.

2. REVIEW OF LITERATURE

2.1 General

While carrying out any scientific research, it is necessary to have knowledge of the similar previous research carried out by other researchers. It gives an insight into the manner in which the problem has been tackled, the nature of results obtained and the conclusions drawn. It may be true that the previous research work might have been carried out in different regions, under different set of conditions. Nevertheless, the knowledge of such research is helpful in designing the research problem under study, adopting suitable methodology and interpretation of the result properly. The review of the past literature relevant to the topic under research, therefore, forms an integral part of any scientific research work.

This chapter is organized to explain briefly the reviews drawn on the problem under study. The reviews have been chronologically arranged under the points mentioned below keeping in mind the objectives of the present study.

- a) To study the changes in land use and cropping pattern,
- b) To study the growth rates in area, production and productivity of major crops,
- c) To study infrastructural development for agriculture of Sangli district,
- d) To identify the important factors responsible for agricultural development of Sangli district,

- e) To identify strengths, weaknesses, opportunities and threats (SWOT) and suggest measures.

2.2 Changes in the land use and cropping Pattern

Agricultural production is influenced by physical, socio-economic, technological and organizational factors an endeavour is made to study the crop combination in regions for different years.

Over a period of time, the structural change of land use and cropping pattern have undergone several changes in response to a large number of factors, such as development in resource endowments, adaptability of crop varieties to new environmental setup, relative economics of production activities, changes in relative prices of output and input- mix, technological advancement, etc. The shifts in land use and cropping patterns are therefore of significant importance in the process of agricultural development.

Naikawadi (1980) examined the agricultural development in Sangli district of Maharashtra and concluded that the area under forest remains more or less stable over a period. The area of barren and uncultivable land showed some decline while the land put under non agricultural use showed significant increase during the period under study. The net sown area declined by 8.88 per cent during the entire period under study. Irrigated area increased by 133.44 per cent during the study period. The gross cropped area also showed decline by 3.18 per cent in the district.

Rath (1980) reported that the compound growth rates of area, production and productivity of the major crops in India for the period 1949-50 to 1977-78. He found that the agricultural production of India grew at an average rate of 2.48 per cent per annum. With the advent of new HYV's the pattern changed only for wheat during the period of post 1965.

Anonymous (1998) studied economic appraisal of agricultural development in Jalgaon district. It was concluded that the cereals predominated cropping pattern. The area under total pulses and total oilseeds declined and increased under cash crops such as cotton, banana and sugarcane. The net irrigated and gross irrigated area increased significantly over a period of time. Except rice almost all the cereal crops indicated significant increase in production. The productivity of sugarcane and cotton increased significantly. There was an increase in total livestock, poultry, HYV use and fertilizer use. However, the infrastructure facilities for agriculture and agro-based industries based on banana production need to be developed on priority basis in the district.

Anonymous (1999) studied economic appraisal of agricultural development in Pune district and reported that, land put to agricultural use increased to 91.61 per cent and cropping intensity of crop decreased to 9 per cent. The area under paddy, Rabi jowar, wheat, sugarcane, ground nut, fruits, and vegetables increased. The area *kharif* jowar, Bajara and cotton decreased. Improvement in productivity of paddy and *kharif* jowar was recorded. During the period of study livestock position increased

substantially. Strengthening of infrastructural facilities for agricultural development in the district was also suggested.

Rupkumar (2001) studied regional disparities in agricultural development in Maharashtra and concluded that land use patterns and area shares of major crops in the gross cropped area remained more or less stable in all the regions of Maharashtra. Rate of adoption of HYV's has been accelerated after mid seventies. The performance of cereal crops improved after mid seventies. There was an increase in the productivity of pulse crops after mid seventies. Technological changes in agriculture had to improvement in productivities of conventional form of inputs after 1972.

Bobade (2003) appraised the agricultural development in Satara district in Maharashtra and concluded that the area under forests had declined by 4.09 per cent during the period under study in Satara district. The area under barren and uncultivable land and land under cultivable waste showed increasing trend in the district. The net sown area decreased over a period of time mainly due to increase in barren and uncultivable land and land under cultivable waste. The cropping pattern of the district dominated by cereals has been tilted towards commercial crops.

Chauhan (2005) studied the agricultural development of Pune in Maharashtra and concluded that the area under forest had declined by 9.19 per cent during the period under study in Pune district. The area under barren and uncultivable land use showed increasing trend over a given period of time.

Land under non-agricultural use showed increasing trend in district. The area under *kharif* jowar and bajra declined. The area under wheat and rabi jowar has predominance in cropping pattern in Pune district. Under pulses, the area of gram and green gram increased during 1960-61 to 2000-01.

Jabir (2007) studied livestock sector development and implications for rural poverty alleviation in India and reported that livestock sector in India experienced remarkable growth during the last two decades in terms of production, value of output from livestock and trade. It contributes nearly 25 per cent to the gross value of agricultural output at the national level and more towards poverty reduction.

Wani *et al.* (2009) studied the land use dynamics in Jammu and Kashmir. The dynamics of shift among different land use classes has been studied in the state. A significant decline has been observed in the total reported area, area under forest. The unfavorable increasing trends in the area to non-agricultural uses and barren and uncultivable area.

Bhatt (2012) studied the agricultural development in Himachal Pradesh and concluded that the land utilization pattern over the years showed that most of the geographical area of the state was under forest and pastures. The area under forests increased from about 21.71 per cent in 1975-76 to 24.67 per cent during 2007-08. The area under pastures declined marginally from 40.62 per cent to 32.67 per cent during the period of 32 years.

Shaikh (2013) studied the agricultural development in Andhra Pradesh and concluded that the land utilization pattern over the years showed that most of the geographical area of the state was under forests and cultivated. The area under forests was slightly decreased from 22.64 per cent in 1980-81 to 22.58 per cent in 2009-10. The area under barren land decreased.

2.3 Growth rates in area, production and productivity of major crops

Rath (1980) estimated the compound growth rates of area, production and productivity of the major crops in India for the period 1949-50 to 1977-78. He found that the total agricultural production of India grew at an average rate of 2.48 per cent per annum. With the advent of the new HYV's the pattern changed only for wheat during the period of post 1965.

Hanumantha (1989) studied the state wise production growth rates for rice and foodgrain for the periods 1961-62 to 1977-78 and 1977-78 to 1988-89. There was improvement in the growth rate of production of foodgrains in second period when compared to the first period. Crops such as paddy and pulses, showed higher growth rates. There were clear indications that the major inter crop imbalances in growth witnessed in the early years of green revolution were getting redressed to some extent in the recent period.

Pawar *et al.* (1991) examined the regional variations in the performance of major cereals, pulses, oilseeds, fruits and vegetables in Maharashtra during the period 1956-57 to 1987-88 on the basis of the estimated - compound growth rates in area,

production and productivity of individual crops. Based on the empirical evidences, it was concluded that the performance of almost all the cereals was unsatisfactory during the pre-green revolution period. However, the situation improved a lot with the great strides of green revolution. The increase in the production of total cereals was contributed largely by significant improvement in the productivity of most of the cereal crops. The performance of all the pulses together was satisfactory during the period 1956-57 to 1987-88. The increase in production of pulses was primarily attributed to the significant increase in area under pulses. The performance of pulses, however, varied greatly among the regions and during different time periods. Similar picture was depicted in the case of the oilseeds. The gains of productivity improvement of some of the vegetable crops have been outweighed by the acreage contraction effect during recent years. The overall performance of the fruit crops was satisfactory among the regions in Maharashtra. The performance of sugarcane was of mixed type. There existed regional variabilities in acreage expansion and production increase in sugarcane. The production increase of sugarcane was contributed exclusively by area expansion, as there was continuous decline in its productivity.

Rahane and Joshi (1993) had estimated compound growth rates in area, production and productivity of some important oilseed and pulse crops in Maharashtra. The study was based on secondary data for groundnut (1966-67 to 1991-92), sesamum (1966-67 to 1988-89), safflower (1968-69 to 1989-

90), gram and tur (1966-67 to 1990-91). The study revealed that, the area, production and productivity of sesamum, safflower, gram and tur has increased significantly. But in case of groundnut, there was an increase in its production and productivity only. Among the various oilseeds and pulse crops, the highest growth rates in area was observed for sesamum 2.97 per cent, while the growth rates in production 8.26 per cent and productivity 5.74 per cent were higher in case of safflower. The area under groundnut has declined significantly throughout the period while there was increase in production mainly due to increase in productivity. The production of sesamum also increased significantly due to increase in area and a slight increase in its productivity. There was a tremendous increase in the production of safflower mainly due to the increase in productivity and due to a slight increase in area. The production of tur has increased significantly but the major contribution was on account of a significant increase in area 2.05 per cent as compared to productivity. The production of gram has increased significantly at the rate of 4.18 per cent per annum, while it was equally contributed by a significant increase in area and productivity, mainly due to the introduction of irrigation facilities, improved technology and high yielding varieties.

Sharma and Jacob (1997) studied livestock growth, employment and rural poverty in India and viewed the available of empirical evidence regarding the high potential of livestock in rural transformation and employment. It is essential that this sector receives greater focus in the coming years.

Jagannathan (1998) reported the trends and patterns of agricultural growth of different crops in India. The study revealed that there was an increase in yield and thereby production of all crops at an increasing rate in the early phase of green revolution. The study concluded that the public investment had to play a major role in the technological and infrastructural development for agricultural growth. Moreover, sustained and accelerated growth in agricultural production would not only contain reducing rural urban income disparities but also help in achieving higher reduction in rural poverty.

Tadakhe (1999) studied the district wise growth rate of agriculture in the Konkan region and concluded that the positive growth rates were observed in terms of area under irrigation, consumption of nitrogenous and phosphatic fertilizers, production and productivity of important crops grown in the Konkan region. The study concluded that the agricultural development was taking place in the desired direction.

Anonymous (1999) studied the growth in agricultural production in India. The growth in agriculture production was about 3.9 per cent in 1998-99 as against a drop of 6 per cent in preceding year. Food grain production increased annually by 3.22 per cent during fifties mainly because of expansion in food grain area Sixties recorded a low annual growth of 1.72 per cent necessitating large-scale imports of food grains. Annual growth of 2.08 per cent was recorded during seventies. This decade was the turning point in the India's food grain economy and the path to self-sufficiency was marked by the revolutionary changes in

the seed technology that pushed up productivity levels first in wheat and later rice in the eighties. An annual growth of 3.5 per cent in foodgrains in eighties was hallmark of the green revolution that enabled India to become self-sufficiency in food grains and even an exporter.

Bobade (2003) studied agricultural development of Satara district of Maharashtra. He examined that there existed a wide variability in the performance of individual crops in terms of changes in their in acreages, production and productivities in the district over a period of time. Period I (1960-61 to 1973-74) was by and large characterized by stagnant productivities of most of the crops in the district. The production of crops showed an increase during period II (1974-75 to 1987-88), period III (1988-89 to 2001-02).

Chauhan (2005) studied the agricultural development in Pune district of Maharashtra and he concluded that there exist the changes of crops in area, production and productivity in the district over a period of time. The productivities of all other crops increased over base year. The critical observation showed that the productivity of crops declined during period II (1970-71 to 1979-80). The major reason for this may be occurrence of three subsequent drought years viz., 1970-71, 1971-72 and 1972-73. The remaining periods I (1960-61 to 1969-70), III (1979-80 to 1989-90) and IV (1989-90 to 2000-01) indicate improved productivity of different crops.

Basnet (2006) studied the agricultural development in Nepal and concluded that in livestock, the growth rates of

population of milking cow and buffalo, pigs, fowl, and lay hen were positive while sheep population had negative growth rate during study period. The growth rates of production of cow milk, pig meat, hen egg, and fishes were quite satisfactory.

Srivastava *et al.* (2010) studied the pulses performance of India, compared to cereals like Wheat and paddy, the growth rate of area and production of pulses negligible and there exists wide variability in their yield in different states of country.

In most of the studies relative to the growth rates, the researchers have attempted to understand the pattern of growth of agricultural production and possible reasons for variations there in. Some of the researchers had made use of the study results for prediction purpose. Studies on growth trends of area, production and productivity in specific crops and for groups of crops such as foodgrains, oilseeds and for the overall agriculture of production have been attempted to show the likely crop pattern in the future and its implications.

2.4 Infrastructural development for agriculture

Naikwadi (1980) studied the economic appraisal of development of agriculture in Sangli district. He studied the factors influencing agricultural production in sangli district and concluded that the agricultural production was positively and significantly influenced by the net irrigated area, quantity of fertilizer disbursed and average annual rainfall, whereas amount of credit disbursed showed negative association with the agricultural production in the district. Hence, he suggested

expansion of irrigation facilities and supply of fertilizers in the dry areas of the district.

Anonymous (1982) reported that fertilizer consumption in India increased at an annual compound growth rate of 9.3 per cent per annum during the year 1971- 81. The violent fluctuations in fertilizer consumption from year to year as well as amongst regions and district were noted. Punjab, Haryana and Uttar Pradesh recorded a highest growth rate of fertilizer consumption. Bihar and Gujarat indicated lower rates of growth.

Alshi *et al.* (1992) studied trends in area, production and yield of fruit crops in Maharashtra and concluded that there was an increase in the total fruit production by 6.98 per cent per annum. Provision of quality sampling of fruit crops, irrigation facilities, and transport facilities for quick marketing, co-operative marketing and establishment of fruit processing units are some of the issues which call for an immediate attention for development of horticulture crops.

Satpute *et al.* (1997) undertook a study on district wise development in Marathwada region and concluded that during 1982-83, net irrigated area was the highest in Osmanabad district. However, during 1983-84 Nanded district ranked first in net irrigated area. The cooperative movement was prominent in Aurangabad and Nanded districts. It was suggested that the balanced development, mobilization of resources to the underdeveloped districts was essential.

Rahane and Kasar (1999) had studied the trends not only in the growth of irrigation but also in allocation of irrigated area among different crops during the last 36 years in the State of Maharashtra, i.e. from 1961-62 to 1995-96 have been used for this study. Both simple method of analysis and regression analysis were used to arrive at the results explained. The study revealed that both net and gross irrigated area have been significantly increased by the linear growth rate of 4.5 and 6.06 per cent per annum, respectively during the period 1960-61 to 1995-96 in Maharashtra. The rate of growth in irrigation was significantly higher in period I (1960-61 to 1977-78) than period II (1978-79 to 1995-96). The wells have appeared to be the major source of irrigation. The development of irrigation is quite conspicuous in Western Maharashtra followed by Marathwada and Vidarbha while it was poor in Konkan region. Of the total irrigable area during the year 1995-96, the share of these regions is 51.27, 26.05, 21.08 and 1.50 per cent respectively in the state. The significant increase in allocation of irrigated area was noted in the case of wheat, pulses, sugarcane, groundnut, fruits and vegetables, while the proportionate decline in allocation of irrigated area was noted in case of paddy, jowar (rabi), jowar (*kharif*) bajra, maize and cotton in the state of Maharashtra during the period under study.

Kumar *et al.* (2003) studied the changing consumption patten in South Asia and reported that agricultural diversification is one of the several pathways of agricultural development. The demand for high value food products such as

fruits, vegetables, milk, meat and fish has been increasing rapidly in the domestic as well as global markets.

Bobade (2003) studied agricultural development in Satara district and showed that the length of national highways, main district roads has increased subsequently over the entire period. The total road length had increased by three times over the base year 1960-61. The credit disbursed through SDDCB's in Satara district had increased continuously from Rs 671.50 lakhs in 1960-61 to Rs 10800 lakhs in 2001-02. The loan disbursed, both short term and medium term by SDDCB was conspicuous during last two periods.

Chauhan (2005) studied agricultural development in Pune district and showed the length of national highways, main district roads has increased subsequently over the entire period. The total road length had increased by four times over the base year 1960-61. The credit disbursed through PDDCB's in Pune district had increased continuously from Rs 5150.97 lakhs in 1960-61 to Rs 160366 lakhs in 2000-01. The loan disbursed, both short term and medium term by PDDCB was conspicuous during last two periods.

Prabha *et al.* (2009) studied the impact of infrastructural and technology on agricultural productivity in Uttar Pradesh. The impact of composite infrastructure index, rural roads, fertilizer and HYV's on agricultural productivity has been found positive and significant.

Bhatt (2012) reported that the use of tractors, wheat threshers, rice threshers and maize shellers was increased

considerably over the period under study. At the state level, the annual consumption of total fertilizer increased. This shows that the farmers in the state have become aware of the use of chemical fertilizers for improving productivity of crops.

Shaikh (2013) reported that the use of machinery increased during the study period in the state. There is higher increase in the use of tractors which are increased by 185.71 per cent over the base year. The total number of sugarcane crusher and pump sets has been increased during the entire period. Also, number of sugar factories in the state increased from 25 in 1980-81 to 2009-10.

2.5 Important factors responsible for agricultural development

Naikwadi (1980) studied the development of agriculture in Sangli district of Maharashtra and concluded that the agricultural production was positively and significantly influenced by the net irrigated area, quantity of fertilizer disbursed and average annual rainfall, whereas amount of credit disbursed showed negative association with the agricultural production in the district. He suggested the need of expansion of irrigation facilities and supply of fertilizer in the dry areas of the district for agriculture development.

Potekar *et al.* (1996) undertook a study to see the position of storage of agricultural produce in different locations of warehouses in Parbhani district of Marathwada region of Maharashtra by using four years secondary data from 1992 to 1993. The study concluded that the capacity of warehouses was

increased considerably. Out of total foodgrain production in the district, 7.59 per cent could be stored at warehouses. The study suggested that the transport facility should be introduced.

Pokharkar *et al.* (2002) carried out an investigation to know the impact of technology on agricultural development in Maharashtra. By the use of exponential type of production function, they computed the compound growth rates of area, production and productivity of major crops and important inputs over a period of time from 1960-61 to 1997- 98. The study revealed that a growth in production due to improvement in the productivity in all crops, except sugarcane and *kharif*. Jowar was due to the use of modern technology in agriculture, use of high yielding and hybrid seeds, increase in irrigation facilities, increase in per hectare use of chemical fertilizers etc. The production of sugarcane and *kharif* jowar was increased by increase in both area and productivity during overall period of time. Thus, growth in total agricultural production and increase in use of major inputs indicated the impact of technology on agricultural development in the district, which was a good sign for agricultural development.

Mamatzakis (2003) assessed the effect of public infrastructure on economic performance in Greek agriculture. The result showed that over the period 1960-95, the impact of public infrastructure on productivity growth in livestock and crop production was found to be positive, although it had been declining since the late 1970s. Thus a decline in public infrastructure investment could partly explain the observed

decline in the productivity growth of Greek agriculture during 1980s.

Kumar *et al.* (2003) studied the changing consumption pattern in South Asia and reported that agricultural diversification is one of the several pathways of agricultural development. The demand for high value food products such as fruits, vegetables, milk, meat and fish has been increasing rapidly in the domestic as well as global markets.

Bobade (2003) studied agricultural development in Satara district of Maharashtra and indicated that the factors viz., fertilizer per hectore of irrigated area, credit disbursed through SDDB and average annual rainfall in the district showed a significant positive association in increasing value of aggregate crop output in Satara district.

Chauhan (2005) studied agricultural development in Pune district of Maharashtra and indicated that the factors viz., per cent of gross sown area to net sown area, per cent of area of high yielding variety seeds to gross sown area, average annual rainfall in the district in mm showed a significant positive association in increasing value of aggregate crop output in Pune district.

Jabir (2007) reported livestock sector development and implications for rural poverty alleviation in India and reported that livestock sector in India experienced remarkable growth during the last two decades in terms of production, value of output from livestock and trade. It contributes nearly 25 per

cent to the gross value of agricultural output at the national level and more towards poverty reduction.

Shaikh (2013) studied agricultural development in Andhra Pradesh and reported that percentage of gross irrigated to gross sown area, percentage of area under commercial crops to gross sown area, amount of loan disbursed to through state cooperative bank showed a significant positive association in increasing value of aggregate crop output in Andhra Pradesh.

2.6 Studies on the strengths, weaknesses, opportunities and threats (SWOT)

SWOT analysis techniques used in economic appraisal of agricultural development of district.

Jungho and Emtage (2005) Studied on survey was undertaken during a workshop to identify the strengths, weaknesses, opportunities and threats (SWOT) of Community-based Forest Management in Leyte Province, the Philippines. A form with open-ended questions, rather than oral discussion sessions traditionally associated with the SWOT analysis, was presented to each member of the group simultaneously. The survey method with a questionnaire was aimed at minimizing the time requirement, preventing the data from being biased by a few dominant players, and obtaining relative frequencies. The greatest strength of the forestry program is seen to be the empowerment given to rural communities to plant and manage trees on publicly controlled lands. Other strengths include the resources and training provided to support the program, and fostering cooperation

between community members. Lack of foreign and local funding to support the program was viewed as the most important weakness. The possible withdrawal or depletion of foreign funding was seen as a major potential threat. Respondents are also concerned about whether communities can find markets for their timber and non-timber forest products. Other challenges include the lack of timber processing facilities in Leyte and instability and complexity of government regulations. With regard to opportunities, respondents tended to report what they would like to see done to improve performance of the program, rather than program innovations probably because as yet little timber harvesting has taken place.

Lakshmi *et al.* (2004) reported (SWOT) analysis of andhra pradesh agriculture is presented in the context of agriculture export potential. Indicate that farmer should concentrate more on profitability rather than on productivity.

Renuka, and Kumari (2003) reported Indian agricultures strengths, weakness, opportunities, threats or analyzed in the context of government. Dismantling of the system of quantitative restriction on export and it is announcement of strategy to promote the agricultural export as a step towards achieving 1% share in global threats.

Anonymous (2003) reported diagnostic report of cashew and fruit processing cluster Sindhudurg district, Maharashtra by United Nations Industrial Development Organization, Cluster Development Programme. Studied and analyse the strengths, weaknesses, opportunities and threats

(SWOT) of production, processing and marketing of cashew and cashew products and other fruit production, processing and marketing.

NCIPM Perspective Plan- VISION 2025 (2007) by National Center For Integrated Pest Management (NCIPM). Carried out SWOT analysis on the status of IPM technologies adopted in the country and suggested the strategies.

Anonymous (2003) Studied the strengths, weaknesses, opportunities and threats for the sector of sugarcane productivity and sugar recovery. Report of the working group on sugarcane productivity and sugar recovery in the country by Government of India, Department of Food and Public Distribution, Directorate of Sugar, Krishi Bhavan.

3. METHODOLOGY

This chapter deals with the plan of investigation and source of data. It is intended to describe clearly the methodology adopted to accomplish the objectives under study. The chapter has been therefore, designed to explain source of data, method of data collection and techniques of analysis adopted to accomplish each of the objectives defined for the present study.

3.1 Basic approach of the study

The main objective of the present investigation is to evaluate the agricultural development that has achieved so far during the last thirty-three years in Sangli district. This is done by studying the important aspects of the process of agricultural development. It is believed that agricultural development in a specific region cause significant changes in the land use and cropping pattern due to rational aptitude of the farmers to make investment in land development and to allocate their resources for high rewarding enterprises. The adoption of new techniques of production results in improving productivity of crops. The new techniques of production involve the use of crucial inputs having significant effect on the agricultural production. The study aimed at evaluation of agricultural development has therefore to examine the changes in the land use and cropping pattern, area, production and productivity of major crops grown, infrastructural development in terms of provision of crucial inputs, markets, value addition system and to identify the factors influencing agricultural production to a greater extent.

Specifically, the present study attempts to analyse the changes in the land use and cropping pattern for thirty-three years starting from 1980-81 to 2012-13 for knowing the trend of farmers in resource allocation and product mix as a result of agricultural development in Sangli district. The changes are measured by estimating proportions to the respective totals at the selected points of time.

The attempt is also made to identify the factors influencing agricultural production by the way of multiple regression analysis. This is done by taking total agricultural production of Sangli district in monetary terms as a dependent variable and the independent factors *viz.*, percentage of gross irrigated area to gross sown area (X_1), Consumption of total fertilizer (NPK) per hectare of gross irrigated area (kg) (X_2), Percentage of gross sown area to net sown area (X_3), Percentage of area of HYV seeds to gross sown area (X_4), Percentage of area under commercial crops to gross sown area (X_5), Amount of loan (short-term and medium-term) disbursed through PACCS per year (₹ in lakhs)(X_6), Average annual rain fall in the Sangli (mm) (X_7), Area under fruits crops (ha) (X_8), Number of milch animals (No) (X_9). The research procedure adopted to study the above aspects has been explained in the discussion that follows

3.2 Location of the study

The Sangli district, which seems to be Agro-climatically representative of western Maharashtra, has purposively selected for present study. The Agriculture along the bank of Krishna river is benefitted by irrigation and is, therefore,

progressive. The eastern part of the district is drought prone area where the agriculture is still developing. It is hoped that the finding of the study may, by and large, indicate the overall trend of agriculture in western Maharashtra. Therefore, the Sangli district has specifically selected for present study.

The famers in the district agriculturally conscious and have made sincere efforts for agricultural development since the inception of green revolution in the country.

3.3 Sources of data

The study is based on the time series data obtained from various sources *viz.*, published statistical literature and by contacting zilla parishad, co-operative and district statistical office, Post Graduate Institute, M.P.K.V. Rahuri library. The data on the land use and cropping pattern for the selected thirty three years, area, production and productivity of selected crops covering the period from 1980-81 to 2012-13 in respect of Sangli district were obtained by referring the socio-economic review District Statistical Abstract of Sangli district published by Directorate of Economics and Statistics, Planning Department Government of Maharashtra India. And also website of Department of Agriculture Government of Maharashtra.

This information became useful for studying the land use and cropping pattern as well as estimation of growth rates of area, production and productivity of selected crops under study in Sangli district. The information on disbursement of credit through co-operatives, distribution of fertilizer, improved seeds, average annual rainfall, agricultural production, etc; in Sangli

district during period from 1980-81 to 2012-13 was obtained by contacting co-operative banks, district co-operative sales and purchase union, Zilla Parishad and District Statistical office, Sangli. This information became useful for identifying the important variables influencing agricultural production in Sangli district.

3.4 Method of analysis

The method of analysis adopted in the present investigation has explained below by keeping in view the objectives of the study.

3.4.1 Structural changes in the land use, cropping pattern and input use

The data obtained on the land use and cropping pattern of Sangli district for the thirty-three years divided into two periods and overall period 1980-81 to 1994-95, 1995-96 to 2012-13 and 1980-81 to 2012-13 were analysed by simple tabular method. The proportions were estimated for each of the above years to know the changes in the land use, cropping pattern and input use of district over the period under study. The changes in the land use, cropping pattern and input use are also depicted graphically.

3.4.2 The growth rates in area, production and productivity of major crops

The data obtained on area, production and productivity of major crops *viz.*, Paddy, *kharif* jowar, rabi jowar, wheat, gram, red gram, groundnut, cotton, bajra, green gram, black gram, sugarcane for the period from 1980-81 to 2012-13

in respect of Sangli district were used for estimation of compound growth rates. The data was analysed to have compound growth rates in area, production and productivity of the above said crops for two different period's *viz.*, Period I 1980-81 to 1994-95, Period II 1995-96 to 2012-13 and for overall period 1980-81 to 2012-13. This became useful for studying the changes in the performance of the selected crops during the above periods in Sangli district.

Compound growth rate

The compound growth rates were worked out by fitting exponential function of the following type to the data for three periods explained above

$$Y = ab^t$$

Where,

Y = Area in hectares, production in quintals and yield in quintals per hectare

a = Intercept

b = Regression coefficient

t = Time period in year

Finally, the annual rate of compound growth in area, production and productivity of the crops was worked out by using the formula.

$$r = (\text{Antilog } b - 1) \times 100$$

The significance of the estimated compound growth rates were tested with the help of students't test.

3.4.3 Factors influencing agricultural production in Sangli district

The information regarding total agricultural production, percentage of gross irrigated area to gross sown area, consumption of total fertilizer (NPK) per hectare of gross irrigated area, percentage of gross sown area to net sown area, percentage area under high yielding variety seeds to gross cropped area, percentage area under commercial crop to gross sown area, loan (short term and medium term) disbursed through PACCS per year in lakhs of rupees and average annual rainfall in the district during the Period i.e. period-I 1980-81 to 1995-96, period-II 1995-96 to 2012-13 and for overall period 1980-81 to 2012-2013 were used for fitting a multiple regression equation of the following type.

This was done for identifying the important variables and their role in influencing agricultural production in the district.

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + b_9X_9 + ut$$

Where,

- Y** = Total agricultural production of food grain + non-food grains in Sangli (₹ in crores).
- a** = Intercept
- b_i's** = Regression coefficients
- X₁** = Percentage of gross irrigated area to gross sown area.
- X₂** = Consumption of total fertilizer (NPK) per hectare of gross irrigated area (kg).
- X₃** = Percentage of gross sown area to net sown area.

- X₄** = Percentage of area of HYV seeds to gross sown area.
- X₅** = Percentage of area under commercial crops to gross sown area.
- X₆** = Amount of loan (short-term and medium-term) disbursed through PACCS per year (₹ in lakhs).
- X₇** = Average annual rainfall in the Sangli (mm).
- X₈** = Area under fruits crops (ha)
- X₉** = Number of milch animals (No).
- ut** = error term.

Dependent variable

Total agricultural production in Sangli district(Y). The total agricultural production obtained from foodgrain and non-foodgrain crops in Sangli district during the period 1980-81 to 2012-13 has been obtained and converted into monetary form by multiplying the physical output of each of the crop with their farm harvest prices for a specific year. The aggregate value of total agricultural production for a specific year was then worked out by adding the values of physical output of various crops.

Independent variables

1. Percentage of gross irrigated area to gross sown area (X1)

The percentage of gross irrigated area to gross sown area was worked out for each of the year under study and thus the variable was constructed. It was expected that the increase in this percentage of gross irrigated area to gross sown area would boost the agricultural output of the district.

2. Consumption of total fertilizer (NPK) per hectare of gross irrigated area in kilograms (X2). This variable was constructed in order to know the effects of fertilizer use on aggregate crop output.
3. Percentage of gross sown area to net sown area (X3). It was expected that the increase in percentage of gross sown area to net sown area would have a positive effect on farm output of the district and therefore this variable was considered.
4. Percentage of area under HYV seeds to gross sown area (X4) This variable was developed in order to assess the effects of HYV seeds on the aggregate farm output of the district.
5. Percentage of area under commercial crops to gross sown area (X5)
6. Amount of loan (short term and medium term) disbursed through PACCS in Sangli district in lakhs of rupees (X6). This variable was developed in order to assess the relationship of credit, particularly the short term and medium term, disbursed through PACCS in Sangli district with the aggregate crop output in the Sangli district.
7. Average annual rainfall in mm, in the Sangli district (X6). The data available on annual average rainfall in the district were used to develop this variable. The purpose was to examine the effect of average annual rainfall on aggregate farm output in the district. From the usual statistical

procedure was adopted for testing the significance of the estimates of parameters.

8. Area under fruits and vegetables (ha) (X8).
9. Number of milch animals (X9).

4. SALIENT FEATURES OF SANGLI DISTRICT

4.1 General

Agricultural production is primarily dependent upon soil and climatic conditions of the area, such as soil type, temperature, rainfall, etc. As these factors are beyond the control of farmer, he has to adjust his crops and farming practices to fight these natural factors. In addition to these factors, the economic factors like marketing arrangements, transports facilities and the availability of sufficient and timely credit at cheaper rate also determine the crops to be grown and affect the farmers' economy. This is true particularly in the case of cash crops, which require large amount of credit and also bring highly perishable, require quick transport facilities and readily available markets. For a better understanding of the conditions of the tract under study, the general information is described below.

The land of milk, fruits, temples, wrestlers and warriors, Sangli district is among the most advanced in India. Asia's largest cooperative sugar factory established by Maharashtra's undisputed leader Vasant Dada Patil is a social and political magnet. Battis-Shirala is famous around the world for Nagpanchmi celebrations when thousands of cobras are worshipped freely by people. Grapes produced in this district have invaded foreign markets, especially in the West. Progressive steps taken for adopting the latest technology by this district for modernizing agricultural and farm research are remarkable.

Wine production will soon begin on a large scale, adding to India's foreign exchange earnings.

4.2 Geographical features of Sangli district

4.2.1 Location

Sangli District is a part of the famous Deccan Plateau. It lies between 16°45' and 17°22' North latitude and 73°42' and 75°40' East longitude. It is bound on the East by the district of Bijapur in Karnataka state, on the West by the Ratnagiri District, on the south by the Districts of Kolhapur and Belgaum and on the north it's the districts of Satara and Solapur.

4.2.2 Topography

4.2.2.1 Soils

The Sangli district has variety of soils on account of its geographical situation. The western part covering Shirala tahsil has red laterite soils mixed with hard murum due to hilly area. The central portion of the district including Walwa, part of Tasgaon and Miraj tahsils has deep black soils and forms a good agricultural tract of the district. The eastern zone of the district is characterized by poor grey soils.

4.2.2.2 Rivers

Krishna and Warana are the principal rivers of the district. The agricultural along the banks of these rivers is well developed due to availability of irrigation water and fertile soils. Yearly, Morna, Manganga, Nanni, Agrani, and Bor are the other small rivers flowing through this district. These small rivers go dry in summer season.

4.2.2.3 Hill ranges

There are two main systems of hills. The Sahyadri range and its offshoots and the offshoots of Mahadeo range. The Sahyadri system includes the main range of the Sahyadri, which forms the western boundary of the district. One of the spurs of the Mahadeo range known as Mahimgad Panala spurs stretches up to Khanapur.

4.3 Climate and Rainfall

The rainfall and temperature have pronounced effects on climate. The western portion of the district *viz.*, The central part of the district receives an annual rainfall of 750 mm. The eastern part of the districts gets the lowest rainfall i.e., less than 500mm in a year. The average annual rainfall in the district is 613.2 mm in 2013. The maximum average temperature in the district is 37.5°C and minimum temperature is 14.9 °C.

The eastern region of the district comprising the area of six tahsils *viz.*, Atpadi, Khanapur, Tasgaon, Jath, Kavathe mahankal and Miraj as the drought prone area. The physical settings of Sangli district shows a contrast of immense dimensions and reveals a variety of landscapes influenced by relief, climate and vegetation. The climate ranges from the rainiest in the Chandoli (Shirala) region, which has an average annual all of over 2000 mm to the driest in Atpadi and Jath tahsils where the average annual rainfall is about 500 mm. The vegetal cover too varies from the typical monsoon forest in the western parts to scrub and poor grass in the eastern parts.

4.4 Area and Demography

The information about area and demography according to census 2011 is presented in the table 4.1

It can be seen from the table that, the district has an area of 861000 ha and population is 28,22,143 as per the census of 2011. The density of population is 329 persons per sq.km. Of the total population 13,86,415 are females and 14,35,728 are males. The sex ratio was 965 females per 1000 males. Out of the total population 2102786(73.44%) was in rural area and 719357(26.56%) population was in urban area. Agricultural labours in the district were 245826 and farmers were 432025.

4.1 Area and Demography of Sangli district according to Population census 2011

Sr. No.	Particular	Number
1	Total Area(ha)	861000
2	Total Population	2822143
3	Female	1386415
4	Male	1435728
5	Sex ratio	965
6	Population density (persons/sq.km.)	329
7	Rural population	2102786
8	Urban population	719357
9	Farmers	432058
10	Agricultural labours	245826

Source: Socio-economic review and statistical abstract of Sangli district, 2012-13.

4.5 Agriculture

4.5.1 Land use pattern of Sangli district

The land use and crop pattern in respect of Sangli district for the latest year i.e. 2011-2012 is explained below to have the brief idea of the mode of agriculture in the district.

Table 4.2 Land Use Pattern of Sangli District (2012-2013)

(Area in '00' hectares)

Sr. no.	Particulars	Area	Percentage to the total
1	Total geographical area	8610.00	100.00
2	Area under the forest	434.00	5.04
3	Barren and uncultivated lands	368.00	4.27
4	Land put to non-agricultural use	496.00	5.76
5	Permanent pastures and grazing land	148.00	1.72
6	Area under orchard and miscellaneous trees	153.00	1.78
7	Cultivable waste	150.00	1.74
8	Other fallow land	425.00	4.94
9	Current fallow	579.00	6.72
10	Net sown area	5857.00	68.03
	a) Irrigated area	1580.00	18.35
	b) Un-irrigated area	4277.00	49.68
11	Area sown more than once	797.00	9.26
12	Gross cropped area	6654.00	77.28
13	Intensity of cropping (%)	113.61	

Source: Socio-economic review and statistical abstract of Sangli district, 2012-13.

It is noted that only 9.25 percent of the total geographical area had been sown more once in Sangli district. The gross cropped area of district was 77.28 percent of the total geographical area. The cropping intensity for the district worked

out 113.61 percent. The net sown area for the year 2012-2013 was 585700 hectares which formed 68.02 percent of the total geographical area. The irrigated area was only 26.98 percent of the net sown area.

The area covered by forests was 5.04 percent. The gross cropped area was 665400 hectares. Net sown area was 585700 hectares, in which only 26.98 percent area was irrigated and 73.02 percent area was unirrigated.

4.5.2 Irrigation resources

Irrigation is the most important input in agriculture. A significant change in cropping pattern could be brought with the help of adequate irrigation facilities. The cultivators of Sangli district have recognized the importance natural gift of Krishna, Warana and other small rivers. Since the proportion of dry area is predominant i.e. 49.67 percent of the total geographical area, it is obvious that the performance of the agriculture is dependent upon the prospects of the monsoon. As mentioned above eastern part of the district is dry and lagging behind in agricultural development. During last few years many major and minor irrigation projects like Warna major irrigation project Krishna Koyna Lift Irrigation Project etc. have come into existence. The major irrigation project is Chandoli dam on Warna river in Shirala Tahsil haing ultimate irrigation potential 121.92 Th. Ha, it will provide irrigation to Sangli, Satara and Kolhapur district. Also 5 medium and 54 Minor irrigation projects have come in to existance.

The details regarding the sources of irrigation and area irrigated in the district during the year 2012-13 are presented in Table 4.3

Table 4.3 Area irrigated by various sources in Sangli district (2012-2013) (Area in '00' ha)

Sr. No	Particulars	Area
1	Surface irrigation other than wells	446 (28.23)
2	Well irrigation	1134 (71.77)
3	Net area irrigated	1580 (100)

(Figures in parentheses indicate percentage to the net irrigated area)

Source: Socio-economic review and statistical abstract of Sangli district, 2012-13.

It can be seen from the table that the total net irrigated area of Sangli district is about 158000 hectares in 2012-13. Of the net area irrigated 71.77 percent area was under well irrigation and 28.23percent area was irrigated by surface irrigation other than wells.

4.5.3 Cropping pattern of Sangli district

The data on cropping pattern revealed that the crops grown and their spread from year to year association with economic and technological development in the tract. The cropping pattern of the Sangli district for the year 2012-13 is presented in the Table 4.4.

It can be seen from the table that, the cereals are important crops and occupied about 42.09percent of the total cropped area during 2012-2013.

Table 4.4 Cropping pattern of Sangli district (2012-13)
(Area in '00' ha)

Sr. No	Crop	2012-13	Percentage to the total
1	Rice	162.00	2.43
2	Wheat	120.00	1.80
3	<i>Kharif</i> Jowar	438.00	6.58
4	Rabi Jowar	1657.00	24.90
5	Bajra	163.00	2.45
6	Maize	244.00	3.67
7	Other cereals	17.00	0.26
8	Total Cereals	2801.00	42.09
9	Gram	110.00	1.65
10	Red Gram	30.00	0.45
11	Green Gram	36.00	0.54
12	Black Gram	40.00	0.60
13	Other pulses	35.00	0.53
14	Total Pulses	251.00	3.77
15	Total foodgrains	3052.00	45.86
16	Groundnut	194.00	2.91
17	Sunflower	16.00	0.24
18	Safflower	7.00	0.11
19	Soybean	408.00	6.13
20	Other oilseeds	9.00	0.14
21	Total Oilseeds	634.00	9.53
22	Grapes	241.24	3.63
23	Other fruits	268.36	4.03
24	Total Fruits	509.60	7.66
25	Sugarcane	612.00	9.21
26	Cotton	2.00	0.03
27	Other Crops	1844.40	27.71
26	Gross cropped Area	6654.00	100.00

Source: Socio-economic review and statistical abstract of Sangli district, 2012-13.

Amongst the different cereals, Jowar and Maize occupied 35.15 per cent area, whereas, pulses occupied about 3.77 percent for both *kharif and rabi* also sugarcane crop shared about 9.21percent. The other important crops of the district are wheat, groundnut and paddy. Paddy occupied 2.43percent, wheat occupied 1.80 percent, and total oilseeds occupied 9.53

percent of the gross cropped area in the district. Fruits crops occupied 7.66 percent of total cropped area. It noticeable that only grapes occupied 3.63 percent of total cropped area. Fiber crops, fodder crops occupied less area in the district.

4.5.4 Animal husbandry

The information about livestock in Sangli district is presented in the table 4.5

It can be seen from the table that, the main purpose of cattle in the district is for draft and milch purpose. Under Indian condition the livestock constitutes a sizable part of investment in agricultural, the reason being that the livestock still continues to be the main source of power required for various farm operations.

Table 4.5 Livestock in Sangli district according to 2007 census

Sr. No.	Particulars	Number
1.	Indigenous Cattle : Bullocks Cows Calf	69411 62726 44699
2.	Exotic Cattle : Bullocks Cows Calf	3760 57734 34624
3.	Buffaloes : He buffaloes Buffaloes Calf	4888 296967 193268
4.	Total Sheep	193960
5.	Total Goat	373000
6.	Other Livestock	156963
7.	Total Livestock	1492000
8.	Total Poultry	402100

Source: Socio-economic review and statistical abstract of Sangli district, 2012-13.

It can be seen from the table that, the main purpose of cattle in the district is for draft and milch purpose. Under Indian condition the livestock constitutes a sizable part of investment in agricultural, the reason being that the livestock still continues to be the main source of power required for various farm operations. Generally, the livestock of cultivator consists of one or two bullock pairs, few cows one or two buffaloes and in few cases some poultry birds and goats. The table 4.5 gives an idea about the position of livestock in Sangli district during the year 2007. It can be observed from table 4.5 that, the total livestock population in Sangli district was 1492000. In the total livestock population, the cattle and buffaloes were 272954 and 495123 ,respectively in the district. Other livestock in the district was 156963 which includes hores, ponies, mules, donkeys, camels and pigs. Total poultry, total sheep and total goats were 402100, 193960 and 373000 respectively.

4.5.5 Agricultural machinery and implements

The type of implements and machinery used influence production efficiency. The adoption of improved implements and machinery also throws light on the change in technology. The positon of implements and machinery in the district for the year 2012-13 is given in Table 4.6.

It seems from the table 4.6 that the cultivators in the district are enthusiastic about the use of modern implements and machineries. The number of oil engines and electric pumps for irrigation was 5000 and 30000, respectively according to

2013 census. This is due to the irrigation facilities available in the district. There are 6524 tractors in the district, which shows mechanization of agricultural in the district.

Table 4.6 Use of implements and machineries in the Sangli district (2012-2013) (Number)

Sr. No	Items	Number
1	Wooden Plough	13000
2	Iron Plough	21000
3	Oil Engine	5000
4	Electric Motors	30000
5	Bullock Cart	19000
6	Tractors	6524
7	Sugarcane crusher	1297

Source: Socio-economic review and statistical abstract of Sangli district, 2012-13.

4.6 Agro Industries

The information about agro industries in Sangli district during 2012-13 is presented in the table 4.7

4.7 Agro industries in Sangli district (2012-13)

(Number)

Sr. No.	Particular	Number
1	Sugar factories	17
2	Textile Industries	130
3	Spinning mills	10
4	Milk processing Plants	29
5	Meat processing industries	25
6	Fruits and vegetables processing	3
7	Rice flour and dal mills	16

Source: Socio-economic review and statistical abstract of Sangli district, 2012-13.

It can be seen from the table 4.7 that, in Sangli district there are number of agro-based industries. Out of which 25 meat processing industries, 3 fruit and vegetable processing industry, 29 milk and milk product producing industry 16 rice,

flour and dal mills. There were 17 sugar factories in Sangli district. There were number of oil mills. There were about 130 registered textile industries in Sangli district and 10 co-operative spinning mills.

4.7 **Infrastructural facilities**

4.7.1 **Markets**

In Sangli district, there are six APMCs, which are engaged in marketing of Jowar, Maize, soybean, paddy, onion, jaggary and turmeric. Marketing centres, development of markets and marketing facilities help the agricultural business in two ways. Firstly, in easy purchase of inputs such as seeds, fertilizers, insecticides, pesticides and other inputs. Secondly, by easy disposal of agricultural surplus produce of farmer. Sangli turmeric market is India's biggest turmeric market. About 80% of the turmeric trade in India takes place in Sangli. In Sangli district, there are small markets at each tahsil.

4.7.2 **Banking**

At the end of 2012, 573 branches of Nationalized Scheduled Banks and 218 branches of Sangli district Credit Co-operative bank with 4319 members, it has deposits of about 2744 crore rupees, it disburse loan of about 2805 crore rupee. There are 760 PACCS, with 5.58 lakhs members.

4.7.3 **Transport and Communication**

Transport and Communication is plays an important role in the development of any country. The transport facilities are well developed in the district. These facilities are conducive to the development of agriculture as the surplus of agricultural

goods could be more easily from one place to other where there is a demand. It found that total road length in Sangli district during 2013 was 13236 km. There are three National highway passes through the district *viz.*, Mumbai-Bangalore. Today the total length of railway routes is around 173 km. The communication facilities provided through the network of 499 post offices and 4526 PCOs. There are telephones and mobiles as a media of communication. There were 8.44 lakhs personal mobile connections in working condition.

4.7.4 Education and Health

The literacy percentage of the district is 81.48 %. In the year 2012-13, there were 2160 primary schools, 623 secondary schools, 186 higher secondary schools. There were 117 junior and senior colleges in the district. There were two engineering colleges, 11 D.Ed colleges, 1 law college, 2 medical colleges, 2 polytechnic colleges and 2 pharmacy colleges in the district. In addition, number of private colleges in the district.

The medical facilities in the district are expanding day by day. Sangli and Miraj are the well-known centers for availability of the best medical facilities. At the end of 2012-13, under government there were 20 hospitals, 80 dispensaries 5 maternity hospitals and 59 primary health centers and 320 sub branches. In private sector there were number of hospitals. To restrict population growth, about 74 family planning centers available and at the end of 2012-13 near about 34663 family planning operations were done.

4.8 Irrigation projects

At the end of year 2012-2013, net irrigated area was 158400 hectares. It account for 24.40percent to the total cropped area. The major irrigation project is Chandoli dam on Warna river in Shirala Tahsil having ultimate irrigation potential 121.92 Th. Ha, it will provide irrigation to Sangli, Satara and Kolhapur district. Also 5 medium and 54 Minor irrigation projects have come in to existance. In addition, other small and medium irrigation projects have been undertaking by the governments. Government gives subsidies to farmers for motivate them to build farm pond on their field.

4.9 Electricity

All villages of district are provided with electricity. Of the total electricity use, household use was 20.05 percent, Industrial use was 6.61percent and agricultural use was 57.96percent. Government charges less for per unit electricity consumption to farmers for irrigation purpose or other agricultural use. Electricity Supply provided to 728 villages.

4.10 Rural Development Programmes

For the improvement of below poverty line population, many plans have been implementing until today and continuous efforts have been make to bring welfare of rural people. Employment Guarantee Scheme provides gainful and productive employment on approved works to all unemployed person in the rural areas. The types of work in the scheme are *viz.* minor irrigation tanks, percolation tanks, contour bunding and nala bunding. Aim is to provide employment to rural people

complemented with agricultural development. It has given 8.69 lakhs man days employment in year 2012-13 and money spent on this plan was around 6187 lakhs rupees.

Other schemes are like Drought Prone Area Programme, Training to Rural Youth for Self Employment Programme (TYRSEM), Development of Women and Children in Rural Area (DWCRA), Indira Awas Yojana gives benefit to the beneficiaries. In the year many families benefited under Swarnjayanti Gram Swarojgar Yojana (SGSY).

5. RESULT AND DISCUSSION

5.1 General

The process of agricultural development initiated by the adoption of sound agricultural policy during post independence period and subsequently strengthen by the inception of green revolution during mid-sixties in the country must have brought about some structural changes in the land use and crop patterns of the farms. It said that a breakthrough in agricultural technology caused a shift from traditional agriculture to modern agriculture, subsistence to commercial, extensive cultivation intensive cultivation and from low income giving enterprises to high income giving enterprises in Indian agriculture during post-green revolution period.

The farmers became conscious about the development basic asset that is, land and diverted resources to those enterprises, which will avail the benefits of new technology for increasing agricultural production. It was thought appropriate to study changes in the land use and crop pattern of a basic planning in, district and find out a trend a agriculture over a period of time. The present chapter has been therefore, organized to explain the processed facts regarding structural changes in the land use and crop pattern because of agricultural development during the period from 1980-81 to 2012-13 in Sangli district. The data on above aspects collected for given years starting from 1980-81 to 2012-13 in respect of Sangli district analysed and the result so obtained are explain below.

5.1 Changes in Land use pattern

The information about changes in land use pattern is presented in the Table 5.1. It can be seen from the table that, the total geographical area remained constant during the years *viz.*, 1980-81, 1995-96 and 2012-13 and it was 861000 hectares. The area under forest was 47200 hectares i.e. 5.48 per cent of total geographical area in 1980-81, which decreased to 43400 hectares in 2012-13, i.e. it decreased by 8.05 per cent over the base year. It shows non-significant change during the period under study. The decrease in area under forest may be due to the problems like industrialization, population growth; it is not a desirable change for maintaining ecological balance in Sangli district.

Barren and uncultivable land decreased from 4.67 per cent to 4.27 per cent. Land under non-agricultural use was increased from 27700 to 49600 hectares during the period from 1980-81 to 2012-13. It is used for buildings, industries and other non-agricultural purposes. The cultivable wasteland area showed an increase, it was 5400 hectares in 1980-81 and 14800 hectares i.e. 1.72 per cent of the total geographical area in 2012-13. There is more need to minimize the cultivable wasteland. The area under permanent pastures decreased and land under miscellaneous trees increased over a period. Permanent pastures decreased from 17000 hectares to 15300 hectares. The proportion of permanent pastures to the total geographical area from 1980-81 to 1995-96 increased and decreased from 1995-96 to 2012-13.

Table 5.1 Changes in land use pattern of Sangli district

(Area in '00' ha)

Sr. No.	Particulars	1980-81 (Base Year)	1995-96	2012-13	Per cent change over the base year	
					1995-96	2012-13
1	Geographical area	8610.00	8610.00	8610.00	00	00
2	Forest	472.00 (5.48)	476.00 (5.53)	434.00 (5.04)	0.85	-8.05
3	Barren and uncultivable land	402.00 (4.67)	382.00 (4.44)	368.00 (4.27)	-4.98	-8.46
4	Land under non-agricultural use	277.00 (3.22)	390.00 (4.53)	496.00 (5.76)	40.79	79.06
5	Cultivable waste	54.00 (0.63)	249.00 (2.89)	148.00 (1.72)	361.11	174.07
6	Permanent Pastures	170.00 (1.97)	202.00 (2.35)	153.00 (1.78)	18.82	-10.00
7	Land under Miscellaneous tree	130.00 (1.51)	163.00 (1.89)	150.00 (1.74)	25.38	15.38
8	Current fallow	335.00 (3.89)	527.00 (6.12)	425.00 (4.94)	57.31	26.87
9	Other fallow	618.00 (7.18)	467.00 (5.42)	579.00 (6.72)	-24.43	-6.31
10	Net sown area	6152.00 (71.45)	5754.00 (66.83)	5857.00 (68.023)	-6.47	-4.79
11	Irrigated area	688.00 (7.99)	1186.00 (13.78)	1580.00 (18.35)	72.38	129.65
12	Un-irrigated area	5464.00 (63.46)	4568.00 (53.05)	4277.00 (49.68)	-16.40	-21.72
13	Area sown more than once	424.00 (4.93)	1062.00 (12.33)	797.00 (9.25)	150.47	87.97
14	Gross cropped area	6576.00 (76.38)	6816.00 (79.16)	6654.00 (77.28)	3.65	1.19
15	Cropping intensity (%)	106.89	118.5	113.6		

(Figure in parentheses indicate the percentage to total geographical area)

Source: Socio-economic review and statistical abstract of Sangli district, 1980-81 to 2012-13.

The current fallow land was 33500 hectare i.e. 3.89 per cent of the total geographical area in 1980-81, which increased to 52700 hectare in 1995-96 (6.12 per cent) and again decreased to 42500 hectare in 2012-13 i.e. 4.94 per cent of total geographical area. As compared with the base year 1980-81, it increased by 26.87 per cent. It may be due to mono-cropping system by taking commercial crop.

The net sown area was 615200 hectares i.e. 71.45per cent in 1980-81, which has declined to 575400 hectares i.e. 66.83 per cent in 1995-96, and latter on increased to 585700 hectares i.e. 68.03 per cent in 2012-13. However, there was decrease in net sown area over the base year i.e. by 4.79 per cent. This indicates that, the cultivated area might be shifted towards land under non-agricultural use. On detailed examination of the net sown area, the un-irrigated area showed significant decline from 63.46 per cent to 49.67 per cent of the total while irrigated area was increased from 68800 hectares i.e., 7.99per cent to 158000 hectares i.e. 18.35 per cent during the period under study. This shows that the dry area declined by 21.72 per cent while the irrigated area increased by 129.65 per cent during the period under study.

The area sown more than once increased during 1995-56 and latter showed decline in 2012-2013. The gross cropped area was 657600 hectares i.e. 76.38 per cent, which indicate significant increase to 681600 hectares i.e. 79.16 per cent in 1995-96 and finally showed decline in 2012-13, which was less than base year 1980-81.This shows that the gross

cropped area increased by 1.19 per cent during the period under study. The intensity of cropping which is a measure of land use efficiency did show increase during period from 1980-81 to 1995-96. However, it decreased during 2012-13 as compare to 1995-96 for the period understudy; it has increased from 106.89 to 113.6 per cent over the base year.

The change in the major components of the land use pattern during the study in Sangli district has graphically presented in Figure 5.1.

To sum of whole, it can said that the area under forest decline while the land under cultivable waste and current fallows showed increasing trend during the period under study. The net sown area declined by 4.79 per cent while the un-irrigated area showed significant decline of 21.72 per cent during the whole period of study. It is significant to note that the area under irrigation increased by 129.65 per cent. The intensity of cropping has increased from 106.89 per cent to 113.6 per cent during the period under study. Thus, the hypothesis stated that, there is an expansion in cultivated and irrigated area biased towards commercialization of agriculture due to agricultural development in Sangli district is partially proved.

5.3 Expansion in irrigation area

The changes in irrigated area both net and gross in Sangli district during the period from 1980-81 to 2012-13 have presented in Table 5.2.

It is apparent from the from Table 5.2 that the net area irrigated was 68800 hectares in 1980-81 which has

increased to 158000 hectares i.e. 129.65 per cent during the last 33 years in the district. The proportion of net irrigated area to the net sown area has increased from 11.18 per cent in 1980-81 to 26.98 per cent in 2012-13. The gross area irrigated also showed the similar trend. This means that the irrigated area has significantly increased in Sangli district during the period under study. The increasing trend in both net and gross irrigated area can be visible in the figure 5.2.

Table 5.2 Changes in irrigated area in Sangli district

(Area in '00' ha)

Sr. No.	Particulars	1980-81 (Base Year)	1995-96	2012-13	Per cent change over the base year	
					1995-96	2012-13
1	Net sown area	6152.00	5754.00	5857.00	-6.47	-4.80
2	Net irrigated area	688.00	1186.00	1580.00	72.38	129.65
3	Percentage of net irrigated area to net sown area	11.18	20.61	26.98	-	-
4	Area sown more than once	424.00	1062.00	797.00	150.47	87.97
5	Gross irrigated area	996.00	1425.00	1740.00	43.07	74.70
6	Gross cropped area	6576.00	6816.00	6654.00	3.65	1.19
7	Percentage of gross irrigated area to gross cropped area	15.15	20.91	26.15	-	-

Source: Socio-economic review and statistical abstract of Sangli district, 1980-81 to 2012-13.

Table 5.3 presents trends in the area irrigated by various sources during the period from 1980-81 to 2012-13.

It can be noted that the well is the principal source of irrigation covering 113400 hectares of land i.e. about 71.77 per cent of net irrigated area in the year 2012-2013. Area under well irrigation increased from 50000 hectares to 113400 hectares

during entire period under study. However, the proportion of area irrigated by wells showed decrease from 72.67 per cent to 71.77 per cent during the period from 1980-81 to 2012-13.

Table 5.3 Trends in the area irrigated by various sources in Sangli district (Area in '00' ha)

Sr. No.	Particulars	1980-81 (Base Year)	1995-96	2012-13	Per cent change over the base year	
					1995-96	2012-13
1.	Surface irrigation other than wells	188.00 (27.33)	343.00 (28.92)	446 (28.23)	82.45	137.23
2.	Well irrigation	500.00 (72.67)	843.00 (71.08)	1134 (71.77)	68.60	126.80
3.	Net area irrigated	688.00 (100.00)	1186.00 (100.00)	1580 (100.00)	72.38	129.65

(Figures in parentheses indicate percentage to the total net irrigated area)

Source: Socio-economic review and statistical abstract of Sangli district, 1980-81 to 2012-13.

The area irrigated by surface irrigation was 18800 hectares (27.33per cent) in 1980-81, which has increased to 44600 hectares (28.48per cent) in 2012-13. It is note that irrigation lifts installed on the irrigation projects and rivers are important source of irrigation next to wells in the district.

5.4 Changes in the cropping pattern

The details related to the changes in cropping pattern of Sangli district are presented the Table 5.4.

It seen from the Table 5.4 that the area under Rice decreased from 20800 hectares 1980-81 to 16200 hectares in 2012-13. The area under Wheat decreased from 37600 hectares in 1980-81 to 12000 hectares in 2012-13 i.e. from 5.72 per cent to 1.80 per cent of the gross cropped area. The area under Rabi

Jowar increased continuously from 1980 to 2013 i.e. 15.04 to 24.9 per cent to the gross crop area. The area under Bajra showed slight decrease in 1995-96 but there was drastic decrease in area during 2012-13 over base year. Total cereals showed decline in 2012-13 over the base year.

Table 5.4 Changes in cropping pattern of Sangli district
(Area in '00' hectares)

Sr. No.	Particulars	1980-81 (Base Year)	1995-96	2012-13	Per cent change over the base year	
					1995-96	2012-13
1	Rice	208.00 (3.16)	146.00 (2.14)	162.00 (2.43)	-29.81	-22.12
2	Wheat	376.00 (5.72)	218.00 (3.20)	120.00 (1.80)	-42.02	-68.09
3	<i>Kharif</i> -Jowar	1362.00 (20.71)	1110.00 (16.29)	438.00 (6.58)	-18.50	-67.84
4	Rabi-Jowar	989.00 (15.04)	1413.00 (20.73)	1657.00 (24.90)	42.87	64.54
5	Bajra	889.00 (13.52)	846.00 (12.41)	163.00 (2.45)	-4.84	-81.66
6	Maize	51.00 (0.78)	111.00 (1.63)	244.00 (3.67)	117.65	378.43
7	Other cereals	27.00 (0.41)	56.00 (0.82)	17.00 (0.26)	107.41	-37.04
8	Total cereals	3902.00 (59.34)	3900.00 (57.22)	2801.00 (42.09)	-0.05	-28.22
9	Gram	200.00 (3.04)	255.00 (3.74)	110.00 (1.65)	27.50	-45.00
10	Red Gram	145.00 (2.20)	131.00 (1.92)	30.00 (0.45)	-9.65	-79.31
11	Green Gram	13.00 (0.20)	49.00 (0.72)	36.00 (0.54)	276.92	176.92
12	Black Gram	60.00 (0.91)	63.00 (0.92)	40.00 (0.60)	5.00	-33.33
13	Other pulses	503.00 (7.65)	346.00 (5.08)	35.00 (0.53)	-31.21	-93.04
14	Total Pulses	921.00 (14.00)	844.00 (12.38)	251.00 (3.77)	-8.36	-72.75
15	Total foodgrains	4823.00 (73.34)	4744.00 (69.60)	3052.00 (45.86)	-1.64	-36.72
16	Groundnut	434.00 (6.60)	331.00 (4.86)	194.00 (2.91)	-23.73	-55.30
17	Sunflower	2.00 (0.03)	59.00 (0.86)	16.00 (0.24)	2850.00	700.00

Table 5.4 contd...

Sr. No.	Particulars	1980-81 (Base Year)	1995-96	2012-13	Per cent change over the base year	
					1995-96	2012-13
18	Safflower	78.00 (1.19)	119.00 (1.75)	7.00 (0.11)	52.56	-91.03
19	Soybean	-	469.00 (6.88)	408.00 (6.13)	-	-13.01
20	Other oilseeds	12.00 (0.18)	52.00 (0.76)	9.00 (0.14)	333.33	-25.00
21	Total oilseeds	526.00 (8.00)	1030.00 (15.11)	634.00 (9.53)	95.82	20.53
22	Grapes	8.00 (0.12)	38.00 (0.56)	241.24 (3.63)	375.00	2915.50
23	Other fruits	7.00 (0.11)	25.40 (0.37)	268.36 (4.03)	262.86	3733.71
22	Fruits	15.00 (0.23)	63.40 (0.93)	509.60 (7.66)	322.67	3297.33
23	Sugarcane	247.00 (3.76)	449.00 (6.59)	612.00 (9.21)	81.78	147.77
24	Cotton	31.00 (0.47)	16.00 (0.23)	2.00 (0.03)	-48.39	-93.55
25	Other crops	934.00 (14.20)	514.00 (7.54)	1844.40 (27.71)	-44.97	97.43
26	Gross cropped area.	6576.00 (100.00)	6816.00 (100.00)	6654.00 (100.00)	3.65	1.186

(Figures in parentheses indicate percentage to the total gross cropped area)

Source: Socio-economic review and statistical abstract of Sangli district, 1980-81 to 2012-13.

Area under red gram was 14500 hectares in 1980-81 and decreased up to 3000 hectares in 2012-13 that is from 2.20 per cent 0.45 per cent. In addition, area under Black gram declined over base year.

Green gram increased from 1300 hectares to 3600 hectares during 1980-81 to 2012-13 i.e. from 0.2 per cent to 0.54 per cent.

Total pulses decreased from 92100 hectares to 25100 hectares i.e. 14 per cent to 3.77 per cent during 1980-81 to 2012-13. Area under total foodgrains decreased from 482300 hectares to 305200 hectares during 1980-81 to 2012-13.

Total oilseeds increased from 52600 hectares to 63400 hectares during 1980-81 to 2012-13. All oilseeds showed decreasing trend. The area under safflower was 7800 hectares in 1980-81 later on it is increased to 11900 hectares in 1995-96 and further it showed decrease in area i.e. 700 hectares. Soybean was introduced in the district in 1987 and area under soybean was 46900 hectares in 1995-96 later on it was decreased to 40800 hectares in 2012-13.

Area under Sugarcane showed tremendous increased. It was 24700 hectares in 1980-81 and increased up to 61200 hectares in 2012-13. Area under fruit increased from 1500 hectares to 50960 hectares due to Maharashtra government's Orchard planning programme. Area under cotton showed, decreasing trend. It can be seen from the table that the area under commercial crops is increasing *viz.*, Sugarcane except cotton.

The changes in acreages under major crops during the period from 1980-81 to 2012-13 in Sangli district have been depicted by way of a line graph in Figure 5.2

5.5 Changes in Productivity of major crops

The information related to productivity of major crops in the district is presented in the Table 5.5.

Table 5.5 Changes in average productivity of major crops in Sangli district

(Productivity in 'kg/ha')

Sr. No.	Crops	1980-81 (Base Year)	1995-96	2012-13	Per cent change over the base year	
					1995-96	2012-13
1	Rice	1928.00	2397.00	1641.00	24.33	-14.89
2	Wheat	691.00	1417.00	1617.00	105.07	134.01
3	<i>Kharif</i> Jowar	1624.00	1470.00	751.00	-9.48	-53.76
4	Rabi Jowar	283.00	620.00	361.00	119.08	27.56
5	Bajra	204.00	291.00	131.00	42.65	-35.78
6	Maize	1098.00	964.00	1611.00	-12.20	46.72
7	Total cereals	721.00	954.00	652.00	32.32	-9.57
8	Gram	140.00	796.00	677.00	468.57	383.57
9	Red Gram	75.00	453.00	170.00	504.00	126.67
10	Green Gram	308.00	476.00	199.00	54.55	-35.39
11	Black Gram	309.00	547.00	266.00	77.02	-13.92
12	Total pulses	201.00	513.00	434.00	155.22	115.92
13	Total foodgrains	621.30	875.00	634.00	40.90	2.09
14	Groundnut	638.00	1106.00	1338.00	73.35	109.72
15	Sunflower	667.00	627.00	355.00	-6.00	-46.78
16	Safflower	343.00	342.00	324.00	-0.29	-5.54
17	Soybean	NA	1989.00	1363.00	-	-31.47
18	Total oilseeds	582.00	1750.00	1106.00	200.69	90.03
19	Cotton	241.00	173.00	192.00	-28.22	-20.33
20	Sugarcane	87874.00	90000.00	102000.00	2.42	16.08

Source: Socio-economic review and statistical abstract of Sangli district, 1980-81 to 2012-13.

(Note: Soybean was introduced in the district after 1987, so data for 1980-81 is not available)

It can be concluded from the table that the productivity of most of the crops increased over the base year.

The critical observation show that the productivity of crops mostly increased during period II (1995-96 to 2012-13). The major reason for this may be the use of improved technology. Among different crops, the average productivity of wheat (134.01 per cent), rabi jowar (27.56 per cent), Maize (46.72 per cent) has increased over base year 1980-81 in Sangli district. It has noted that average productivity of wheat increased from 691 kg/ha in 1980-81 to 1617 kg/ha in 2012-13. In case of rabi jowar it is increased from 283 kg/ha in 1980-81 to 361 kg/ha in 2012-13 and in case maize from 1098 kg/ha to 1611 kg/ha. This happened particularly due to use of HYV's seeds and irrigation for these crops. In case of rice and bajra, the average productivity decreased. However, the overall productivity of total cereals has decreased to 9.57 per cent.

The average productivity of Pulses has increased from 201.00kg/ha to 434.00kg/ha (by 115.92per cent). Among the pulses in Sangli district, red gram and gram have shown increased productivity of 126.67 and 383.57 per cent respectively over the base year. The productivity of black gram increased from 309 kg/ha to 547 kg/ha in 1995-96 and later on, it decreased to 266 kg/ha in 2012-13.

Among the oilseeds, average productivity of groundnut has increased by 109.72 per cent over the base year may be due to commercial importance. The productivity of sunflower decreased by, 46.78 per cent over the base year. Soybean was introduced in the district after 1987, and it showed the productivity 1989 kg/ha in 1995-96 and later on it declines

to 1363 kg/ha in 2012-13. Also, safflower showed the continuous decrease in productivity it was 343 kg/ha in 1980-81 and it is decreased to 324 kg/ha in 2012-03 i.e. 5.54 per cent over the base year.

Among the cash crops, Sugarcane has shown increased productivity of 16.08 per cent over base year and cotton showed continuous decline in productivity it was 241 kg/ha in 1980-81 and it was decreased to 192 kg/ha in 2012-13.

The overall productivity total foodgrains have increased to 2.09 per cent over the base year. The changes in productivity of major crops in Sangli district during 1980-81 to 2012-13 are depicted in bar diagram Figure 5.3

5.6 Annual compound growth rates in area, production and productivity of cereals, pulses and total foodgrains

In the previous section, an attempt has been made to study the agricultural development in terms of changes in the land use, cropping pattern and crop productivity during the last 33 years, in Sangli district. It believes that the process of agricultural development has pronounced effects on the productivity of agriculture and as a result, higher level of agriculture production achieved per unit available resources. In order to present an overall picture of average productivity of major crops, their relative growth rates examined. The annual compound growth rate interval wise as well as overall basis were computed for area, production and productivity of principal

crops *viz.*, Rice, jowar, bajra maize, sunflower, groundnut, cotton crops for 33 years from 1980-81 to 2012-13 in Sangli district. For the purpose of scientific assessment of the agricultural development, compound growth rates of the above crops were separately estimated for area, production and productivity for 3 different periods *viz.*, 1980-81 to 1994-95, 1995-96 to 2012-13 and 1980-81 to 2012-2013. This attempt also made to identify major factors influencing agricultural production during the study period.

The period wise annual compound growth rates, in area, production and productivity of cereal crops for the period 1980-81 to 2012-13 presented in Table 5.6. The compound growth rates of area, production and productivity of all cereals, pulses, oilseeds, cotton and sugarcane fluctuated widely during the period under consideration. The production and productivity of cereals like wheat and Maize are positive and highly significant for the entire period of 33 years. The production and productivity of total cereals decreased non-significantly i.e.0.03 and 0.39 per cent per annum, respectively during the study period. It clearly showed for Sangli district the area production and production of total cereals during the span of 33 years had decreased.

Among different cereals, the annual compound growth rates in production and productivity of wheat and Maize for period II and III was positive and highly significant. In case of Rice annual compound growth rate of area for 33 years under study was positive and non-significant and of production and productivity was negative and non-significant. In general, the

annual growth rates of area, production and productivity of all cereals was fluctuating during entire period under study.

The per annum compound growth rates in productivity of total pulses in district have turned out to be positive and highly significant during the entire period under study. The productivity of total pulses in district had increased at the rate of 1.71 per cent. The growth rate for production seems to be almost zero showing growth of 0.2 per cent in production.

In case of Gram growth rates of area, production and productivity were positive and highly significant. Compound growth rates of area, production and productivity was 1.68, 5.48 and 3.74 respectively.

In case of red gram annual compound growth rates of area and production were negative and significant over entire period under study. In addition, growth rate for productivity was negative and non-significant.

For Green Gram annual compound growth rates for area and production were positive and highly significant i.e. 4.81 and 4.96 per cent. In addition, growth rate for productivity was positive non-significant.

In case of Black Gram annual compound growth rates for area was only positive i.e. 5.38 and for production and productivity were showed negative compound growth rates i.e. 3.23 and 0.26 respectively.

Table 5.6 Annual compound growth rates in area, production and productivity of cereals, pulses and total foodgrains in Sangli district

Sr. No.	Crop	Period I 1980-81 to 1994-95			Period II 1995-96 to 2012-13			Overall Period 1980-81 to 2012-13		
		A	P	Y	A	P	Y	A	P	Y
1	Rice	-1.63***	-3.35***	-2.92**	1.84	-0.51	1.84	0.7	-0.07	-0.06
2	Wheat	-4.11***	1.29	5.06***	-0.26	0.89	1.22**	-0.49	2.31***	2.64***
3	Jowar	1.59	6.67***	0.34	-2.52*	-0.83	-4.11**	0.56	1.6***	-1.65***
4	Bajra	-1.21*	4.92*	6.2**	-7.13**	-10.15	-3.22	-3.6***	-2.92	0.69
5	Maize	6.64**	10.08***	3.22**	7.96***	10.2***	3.6***	7.44***	9.32***	2.21***
6	Total Cereals	0.07	1.36	1.29	-1.09	-1.72	-0.65	-0.42*	-0.03	-0.39
7	Gram	3.8***	13.37***	9.22***	-0.75	-0.61	0.13	1.68***	5.48***	3.74***
8	Red gram	-0.92*	2.07	3.08	-5.5***	-6.3**	-2.42	-2.61***	-3.29**	-1.52
9	Green gram	11.14***	16.31***	4.24**	-0.77	-2.4	-1.65	4.81***	4.96***	0.12
10	Black gram	-1.58	-1.02	0.19	3.87	-4.16	-0.34	5.38*	-3.23	-0.26
10	Total pulses	0.67	4.22**	3.52*	-3.93**	-2.16	1.77	-1.5***	0.2	1.71***
11	Total Foodgrains	0.19	1.62	1.44	-1.54*	-3.08	-0.3	-0.57**	-0.37	0.59

(***, **, * indicates 1, 5 and 10 per cent level of significance respectively)

5.7 Annual compound growth rates in area, production and productivity of oilseeds and commercial crops

The annual compound growth rates in area, production and productivity of oilseeds and commercial crops in Sangli district depicted in Table 5.7.

The area, production and productivity of total oilseeds, cotton and Sugarcane had fluctuated widely during the period under study in Sangli district. The compound growth rates in area, production and productivity of total oilseeds for entire period have turn out to be positive and significant at the rate of 1.97, 3.62 and 1.59, respectively.

Among different oilseeds, compound growth rates of groundnut for area and production decreased significantly i.e. 2.12 and 2.32. Productivity was positive and highly significant i.e. 1.79 per cent per annum.

In case of Sunflower growth rates of area and production increased significantly by 9.88 and 8.95 per cent and productivity has turn out to be negative and highly significant i.e. 1.37 per cent per annum.

Among different commercial crops, cotton is declining. However, Sugarcane though it has positive and highly significant growth rates it is showing non-significant growth rate for productivity. This may attributed to different causes of increased in insect and pest problems. Sugarcane positive and highly significant growth rate for area and production which was 3.37 and 3.4 respectively and for productivity it was positive and non-significant i.e. 0.19 per cent per annum.

Table 5.7 Annual compound growth rates in area, production and productivity of oilseeds and commercial crops in Sangli district

Sr. No.	Crop	Period I 1980-81 to 1994-95			Period II 1995-96 to 2012-13			Overall Period 1980-81 to 2012-13		
		A	P	Y	A	P	Y	A	P	Y
1	Groundnut	-0.55	0.85	1.41	-1.98*	-4.43**	1.57	-2.12***	-2.32***	1.79***
2	Sunflower	33.93***	33.45***	-2.02**	-3.03	-3.12	-0.22	9.88***	8.95***	-1.37***
3	Safflower	1.76*	-9.29***	-5.3***	5.93**	-10.65**	-4.75***	4.23	-1.22	0.60
4	Soybean	76.14***	95.54***	12.22	0.21	-0.62	-0.83	9.6***	12.18***	2.25**
5	Total oilseeds	5.79***	14.27***	7.95***	-1.03	-2.75**	-1.74**	1.97***	3.62***	1.59**
6	Sugarcane	0.28	0.16	0.05	2.64**	2.82**	0.16	3.37***	3.4***	0.19
7	Cotton	-3.58**	-0.56	3.18**	-4.17	-6.64	-2.47	-1.46	-2.05	-0.54

(***, **, * indicates 1, 5 and 10 per cent level of significance respectively)

From the above analysis, it can be concluded that there exist wide variability in the performance of individual crops in terms of changes in their performance, total production, productivity in the district over the period under study. It clearly indicates the progress of agricultural development in Sangli district and its positive effects. Thus, the hypothesis stated that, the introduction of green revolution in agriculture has helped in increasing the production and productivity of major crops in Sangli district is partially proved.

5.8 Changes in consumption of NPK

The changes in consumption of N,P and K in Sangli district is presented in the Table 5.8

It can be seen from the table that the total consumption of fertilizers in Sangli district was 18690 MT in the year 1980-81, which has increased to 107005 MT in the year 2012-13 i.e. 472.53 per cent over the base year. Per hectare N, P and K consumption showed an increasing trend during the entire period under study, especially in the last 33 years. It is noted that during the span of last 33 years, the consumption of N, P increased as compared to K. It was mainly due to the farmer's awareness towards use of chemical fertilizers for improving the productivity of crops and the government's incentives and subsidy to phosphatic fertilizers.

The change in consumption of total fertilizers (N, P and K), at given periods in Sangli districts shown graphically in Fig. 5.4.

Table 5.8 Changes in total consumption of fertilizers in Sangli district (Fertilizer in 'MT')

Year	N	P	K	Total	Per hectare consumption (in kg)
1980-81 (Base Year)	12570 (100.00)	3123 (100.00)	2997 (100.00)	18690 (100.00)	28.42
1995-96	49080 (290.45)	17527 (461.22)	16546 (452.09)	83193 (345.12)	122.06
2012-13	71545 (469.17)	23480 (651.84)	11980 (299.73)	107005 (472.53)	160.8

Source: Socio-economic review and statistical abstract of Sangli district, 1980-81 to 2012-13.

Fertilizer association of India (1982), Naikwadi (1980) and Chauhan Rakhi (2005) obtained similar results.

5.9 Development in the infrastructure facilities

Under consideration of the natural resources and its exploitation, irrigation, fertilizers, modern implements, other inputs like seed, etc., had studied during period under study. The performance of individual crops in respect of area, production and productivity was of mix type. In case Sugarcane, Groundnut, Maize, Jowar there was sizable increase in production. New agricultural strategy i.e. Green revolution imparts technological innovations for some crops resulted in increase in production of those crops. In this process of development, infrastructural facilities play direct or indirect role.

5.9.1 Changes in area under high yielding varieties

The high yielding variety technology was introduced after 1966-67 shortly after the introduction of high yielding variety, it gained momentum during the years and area under high yielding variety had increased drastically. As compare to base year, the adoption of HYV's of Paddy, Jowar and maize had increased over the entire period.

Table 5.9 Changes in area under high yielding varieties in Sangli district (Area in '00' ha)

Year	Paddy	Kharif Jowar	Rabi Jowar	Wheat	Maize	Total
1980-81 (Base Year)	71.60 (100.00)	294.25 (100.00)	593.40 (100.00)	330.88 (100.00)	15.30 (100.00)	1290.13 (100.00)
1995-96	91.93 (28.39)	668.20 (127.09)	1201.00 (102.39)	200.56 (-39.39)	83.25 (444.12)	2161.69 (67.56)
2012-13	153.70 (114.66)	402.96 (36.94)	1524.40 (156.89)	117.60 (-64.46)	219.60 (1335.29)	2198.66 (70.42)

(Figures in parentheses indicate percentage to the base year)

Source: Socio-economic review and statistical abstract of Sangli district, 1980-81 to 2012-13.

The total area under HYVs was increased by 70.42 per cent over the base year. The area under HYVs of wheat decreased by 64.46 per cent but, this is not due to low adoption of HYV seeds of wheat it is due to area under wheat decreased from 37600 ha in 1980-8 to 12000 ha in 2012-13. It noticeable that the area under HYVs of maize has been increased tremendously by 1335.29 per cent over the base year i.e. 1980-81. Also, area under HYVs of paddy and jowar also increased.

5.9.2 Changes in the average annual rainfall

The information related to changes in the average annual rainfall in Sangli district is presented in the Table 5.10.

It can be seen from the table that, the rainfall in Sangli district showed a varying nature throughout the entire period under study. It is observed that the rainfall in period II and III had decreased by 11.30 and 10.86 per cent respectively to the previous decade and 11.30 and 2.93 per cent over the base year. Due to such variation in rainfall during the span of 33 years, the water availability also varied leading to the variation in agricultural production. Fluctuation in per cent change in rainfall to previous period the validity of above quoted statements, where we see

negative per cent change in rainfall over the period. And rainy days also decreased i.e. from 44 in 1980-81 to 29 in 2012-13.

Table 5.10 Change in the average annual rainfall in Sangli district

Period	Rainy days	Rainfall (mm)	Per cent change over the base year	Per cent change over previous period
1980-81 (Base Year)	44	645.70	100.00	-
1995-1996	44	572.70	-11.31	-11.31
2012-13	29	510.50	-20.94	-10.86

Source: Socio-economic review and statistical abstract of Sangli district, 1980-81 to 2012-13.

(A rainy day is a day on which 2.5 millimeters or more rain was recorded)

5.9.3 Changes in the use of implements and machinery

The information related to changes in implements and machinery in Sangli district from 1980-81 to 2012-13 is presented in the Table 5.11.

It observed from the table that, the use of Wooden plough, iron plough, oil engine and bullock carts had declined, whereas, the use of electric motors, sugarcane crusher and tractor had increased over the period under study. It was interesting to note that the use of traditional implements like wooden plough and Iron plough replaced by modern implements like tractors, which tremendously increased the base year.

The use of sugarcane crusher in Sangli district had continuously increased over a period under study. The most noticeable change was in case of electric motors, which showed an increase by 5.35 per cent over the base year. It was mainly due to increase in area under well irrigation. It is thus clear that use of tractors and electric motors had increased considerably in the district over the period contributing significantly in the development of agriculture in the district.

Table 5.11 Changes in the use of implements and machinery in Sangli district
(Implements in number)

Year	Wooden Plough	Iron Plough	Oil Engine	Electric Motors	Bullock Cart	Tractors	Sugarcane crusher
1980-81 (Base Year)	20473 (100.00)	35455 (100.00)	6450 (100.00)	28474 (100.00)	22201 (100.00)	2424 (100.00)	360 (100.00)
1995-96	23735 (15.93)	33046 (-6.79)	11164 (73.09)	24598 (-13.61)	41586 (87.32)	4000 (65.02)	1615 (348.61)
2012-13	13000 (-36.50)	21000 (-40.77)	5000 (-22.48)	30000 (5.36)	19000 (-14.42)	6524 (169.14)	1297 (260.28)

(Figures in parentheses indicate percentage to the base year)

Source: Socio-economic review and statistical abstract of Sangli district, 1980-81 to 2012-13.

Table 5.12 Changes in the Livestock population in Sangli district

Year	Cattle						Buffaloes		
	Indigenous			Exotic/crossbreed			He buffaloes	She buffaloes	calf
	Bullocks	Cow	Calf	Bullocks	Cow	Calf			
1980-81 (Base year)	118106 (100.00)	93024 (100.00)	69617 (100.00)	NA	NA	NA	3488 (100.00)	127791 (100.00)	72546 (100.00)
1982	125352 (6.14)	114507 (23.09)	315534 (353.24)	NA	NA	NA	12836 (268.00)	171717 (34.37)	104123 (43.53)
1987	111477 (-5.61)	117985 (26.83)	301243 (332.71)	NA	NA	NA	8549 (145.10)	187984 (47.10)	101284 (39.61)
1992	96834 (-18.01)	71664 (-22.96)	56147 (-19.35)	7880 (100.00)	40964 (100.00)	22897 (100.00)	8316 (138.42)	239169 (87.16)	134061 (84.79)
1997	93368 (-20.95)	70816 (-23.87)	61174 (-12.13)	5399 (-31.48)	27965 (-31.73)	18118 (-20.87)	7789 (123.31)	283616 (121.94)	176240 (142.94)
2003	79548 (-32.65)	66541 (-28.47)	95680 (37.44)	41701 (429.20)	33933 (-17.16)	35924 (56.89)	20796 (496.22)	237542 (85.88)	165003 (127.45)
2007	69411 (-41.23)	62726 (-32.57)	44699 (-35.79)	3760 (-52.28)	57734 (40.94)	34624 (51.22)	4888 (40.14)	296967 (132.38)	193268 (166.41)

Source: Socio-economic review and statistical abstract of Sangli district, 1980-81 to 2012-13.

Table 5.12 contd...

Year	Sheep	Goat	Total livestock	Poultry
1980-81 (Base Year)	253463 (100)	242132 (100)	1064701 (100)	1029692 (100)
1982	237043 (-6.48)	258145 (6.61)	1107101 (3.98)	1158025 (12.46)
1987	229239 (-9.56)	270079 (11.54)	1107306 (4.00)	2203654 (114.01)
1992	248297 (-2.04)	293858 (21.36)	1230406 (15.56)	2180118 (111.73)
1997	215702 (-14.90)	367092 (51.61)	1340495 (25.90)	2432525 (136.24)
2003	369967 (45.96)	207569 (-14.27)	1407771 (32.22)	2127346 (106.60)
2007	193960 (-23.48)	373000 (54.05)	1492000 (40.13)	402100 (-60.95)

Source: Socio-economic review and statistical abstract of Sangli district, 1980-81 to 2012-13.

5.9.4 Changes in the livestock population

Table 5.12 depicts the changes in livestock population, which indicates that the population of indigenous bullocks and cow has decreased by 41.23 and 32.57 respectively. Whereas, that of exotic cows, she buffaloes and total livestock had increased by 40.94, 132.38 and 40.13, respectively over period.

The main reason for increase in number of buffaloes is the higher milk yield obtained from them as compared to indigenous cow. The crossbreed bullocks used for drought purpose and therefore their population has increased. It can see that the livestock population has increased by 40.13 per cent over the base year. The population of she buffaloes has also increased by 132.38 per cent over the base year.

5.9.5 Changes in the development of road length

Roads are the very important and basic infrastructural facility. It needed for development of any sector of the economy. Its development gives better transport and communication of rural area to town. As agricultural production is seasonal and regional in nature, it requires quick transport for marketing. It can observe from the Table 5.13 that the road length in Sangli district has increased from 7504 km in 1980-81 to 13236 km in 2012-13. The railway remains constant i.e. 174 km over the entire period of study. There is need for development of railway and state highway because it helps to improve marketing, which in turn will lead to the development of agriculture as a whole.

Table 5.13 Changes in the development of road length in Sangli district

(Length in Km)

Year	National Highway	Main And Other State Highway	Major District Roads	Other District Roads	Village Roads	Other	Total	Railway
1980-81 (Base Year)	30 (100.00)	561 (100.00)	1380 (100.00)	1190 (100.00)	631 (100.00)	3712 (100.00)	7504 (100.00)	174 (100.00)
1995-96	30	917 (63.46)	1952 (41.45)	2710 (127.73)	2272 (260.06)	456 (87.72)	8337 (11.10)	174
2012-13	30	1325 (136.19)	1978 (43.33)	3938 (230.92)	5965 (845.32)	-	13236 (76.39)	174

(Figures in parentheses indicate per cent change over the base year)

Source: Socio-economic review and statistical abstract of Sangli district, 1980-81 to 2012-13.

5.9.6 Changes in credit disbursement through PACCS

Table 5.14 Changes in credit disbursed through PACCS in Sangli district (In thousand rupees)

Year	Credit disbursed through PACCS	Per cent change over base year
1980-81 (Base Year)	1394.70	-
1995-96	10902.68	681.72
2012-13	62815.61	4403.88

Source: Socio-economic review and statistical abstract of Sangli district, 1980-81 to 2012-13.

Credit is also one of the important inputs needed to the farmer for development of agriculture. As Indian farmers are poor, authentic and timely supply of credit gives boost to the agriculture. It revealed from the Table 5.14 that, the credit disbursed through PACCS in Sangli district has been continuously increasing during the period under study. The credit disbursed by PACCS increase from ₹ 1394.7 lakhs to 62815.61 lakhs during the period from 1980-81 to 2012-13. The tremendous increase in credit disbursement reveals that the farmers of Sangli district are taking advantage of institutional finance for overcoming their financial needs, is a significant change.

5.10 Factors affecting agricultural production

In the earlier part of this chapter, we have discussed the change in land use pattern, cropping pattern, input use, and change in infrastructural facilities, annual compound growth rates in area, production and productivity of major crops grown in Sangli district. This analysis mostly relied on the sample

mean, percentage and proportion individual items in the total of respective varieties. The type of analysis deployed for the purpose, however had certain limitation of its own, as it could not measure the relative contribution of individual variable in combination of other variables influencing total agricultural development of Sangli district.

In this study, the multiple linear regression equation fitted to the data to know which factors are responsible for agricultural production in Sangli district.

Multiple linear regression analysis

The results of estimated multiple linear regression analysis of Sangli district is depicted in the table 5.15.

During period I (1980-81 to 1994-95) the regression coefficient of the variable percentage of area of HYV seeds to gross sown area (X_4) was turned out to be positive and significant at one per cent level of significance. This indicates that, the agricultural production in Sangli district is highly responsive to this variable during period I. The value of R^2 was 0.925342 and the F value was 118.7059 in the period I (1980-81 to 1994-95).

During period II (1995-96 to 2012-13) the regression coefficients of the variables *viz.*, percentage of area under commercial crops to gross sown area (X_5) and amount of loan disbursed through PACCS per year in lakhs of rupees (X_6) was turned out to be positive and significant at five per cent level of significance. The value of R^2 was 0.938381 and the F value was 13.53663 in the period II (1995-96 to 2012-13).

Table 5.15 Results of multiple linear regressions for agricultural development

Sr. No.	Particulars	Periods		
		I (1980-81 to 1994-95) (N=15)	II (1995- 96 to 2012- 13) (N=18)	Overall (1980-81 to 2012-13) (N=33)
1	Intercept	-1661.75	10245.67	2905.959
2	Percentage of gross irrigated area to gross sown area(X_1)	19.99745 (18.23405)	-75.7755 (129.5473)	-3.52467 (61.14662)
3	Consumption of total fertilizer (NPK) per hectare of gross irrigated area in Kg (X_2)	0.368389 (0.873094)	1.153388 (5.844034)	3.723435*** (1.342416)
4	Percentage of gross sown area to net sown area (X_3)	1.648686 (4.388721)	-26.0882 (29.52111)	32.22474** (13.62388)
5	Percentage of area of HYV seeds to gross sown area (X_4)	36.56831*** (9.573739)	-65.5939 (217.6915)	22.06581 (38.61053)
6	Percentage of area under commercial crops to gross sown area (X_5)	20.23461 (9.893911)	249.3313** (104.0552)	94.98157*** (24.8932)
7	Amount of loan disbursed through PACCS per year in lakhs of rupees (X_6)	0.004187 (0.006326)	0.028234** (0.013007)	0.023629*** (0.007712)
8	Average annual rain fall in the Sangli (mm) (X_7)	-0.00937 (0.062543)	-0.87908 (1.232212)	-0.37711 (0.401111)
9	Area under fruits crops (ha) (X_8)	0.018656 (0.026439)	0.016285 (0.021222)	0.003388 (0.007874)
10	Number of milch animals (No) (X_9)	3.2905 (0.001394)	0.000197 (0.000895)	0.000521 (0.000519)
11	R^2	0.925342	0.938381	0.931713
12	F Value	118.7059	13.53663	34.86794

(Figures in parentheses are standard errors of respective regression coefficients)

(***, **, * indicates 1, 5 and 10 per cent level of significance respectively)

The regression coefficients of the variables for the overall period *viz.*, consumption of total fertilizer (NPK) per hectare of gross irrigated area in kg (X_2), per cent of area under

commercial crops to gross sown area (X_5) and Amount of loan (short-term and medium-term) disbursed through PACCS per year (₹ in lakhs)(X_6) where turn out to be positive and highly significant at one per cent level of significance indicating thereby that the agricultural production of Sangli district is highly responsive to these variables. The regression coefficient of the variable *viz.*, percentage of gross sown area to net sown area (X_3) was turn out to positive and significant at five per cent level of significance indicating thereby that the agricultural production of Sangli district is responsive to this important variable. Percentage of area of HYV seeds to gross sown area(X_4), area under fruits crop(ha) (X_8) and number of milch animals(No) (X_9) were non-significant but positive. While, the percentage of gross irrigated area to gross sown area (X_1) and average annual rainfall in the Sangli district (mm) (X_7) were non-significant and also negative.

At the overall period (1980-81 to 2012-13) the regression coefficients of the variables *viz.*, consumption of total fertilizer (NPK) per hectare of gross irrigated area in kg (X_2), per cent of area under commercial crops to gross sown area (X_5) Amount of loan (short-term and medium-term) disbursed through PACCS per year (₹ in lakhs)(X_6), percentage of gross sown area to net sown area (X_3) have shown a significant positive association with the increase in the value of aggregate crop output in Sangli district. It is noted that if the consumption of fertilizer per hectare of gross irrigated area is increased by 1 per cent, the value of aggregate crop output would significantly

increase by ₹ 3.7234 crores in Sangli district. This emphasizes importance of chemical fertilizers *viz.*, NPK in economy of Sangli district. Also, if percentage of gross irrigated to gross sown area(X_1) increase by one per cent, the value of aggregate crop output would decrease by 3.5246 crores. It is thus clear that consumption of total fertilizer (NPK) per hectare of gross irrigated area in kg (X_2), per cent of area under commercial crops to gross sown area (X_5), Amount of loan (short-term and medium-term) disbursed through PACCS per year (₹ in lakhs)(X_6), percentage of gross sown area to net sown area (X_3) have importance in the process of development in Sangli district.

Hence, we conclude that hypotheses regarding factors *viz.*, expansion of irrigated area, credit flow, consumption of fertilizer, area under HYV, area under commercial crop, area under fruits crop and number of milch animals etc., influencing agricultural production in Sangli district have been proved.

5.11 Strengths, weaknesses, opportunities and threats (SWOT) of agricultural development

SWOT is an acronym for Strengths, Weaknesses, Opportunities and Threats. By definition, Strengths (S) and Weaknesses (W) are considered to be internal factors over which you have some measure of control. Also, by definition, Opportunities (O) and Threats (T) are considered to be external factors over which you have essentially no control.

SWOT Analysis is instrumental in strategy formulation and selection. It is a strong tool, but it involves a great subjective element. It is best when used as a guide, and not

as a prescription. Successful businesses build on their strengths, correct their weakness and protect against internal weaknesses and external threats. They also keep a watch on their overall business environment and recognize and exploit new opportunities faster than its competitors.

5.11.1 Strengths for Agricultural development

Sangli district as it is a leading Turmeric producing and trading city in western India it is known as 'Turmeric city of Maharashtra'. More than 80 per cent of the turmeric trade in India takes place in Sangli.

1. The cooperative network adds value to this district. Vasantdada Patil cooperative sugar factory Asia's largest cooperative sugar factory situated in Sangli.
2. Sangli is known for its turmeric throughout globe and now to add the grapes are also known in many parts of this world.
3. Pomegranates and grapes produced in Sangli district have invaded foreign markets
4. There are number of marketing facilities such as regional markets, APMCs, taluka and district level markets and village markets by which farmers sell their produce and get remunerative prices.
5. Farmers in the district use various new technologies such as polyhouses, micro irrigation techniques and cold storages to increase the yield and minimize the losses.
6. The government of Maharashtra has set up a specialized state of the art wine park at palus. This 142-acre park is

located at palus, which produces one of the best quality grapes in the world.

5.11.2 Weakness for Agricultural development

1. Fail to establish as a recognized location specific brand i.e. Sangli Turmeric.
2. Insufficient work of extension workers regarding spread of new technology to rural region.
3. Small land holding of farmer it is also a main barrier in development of agriculture in district.
4. In the Sangli district, marketing and processing facility for turmeric, fruits, vegetables etc. is of poor quality.
5. Sangli district is a larger producer of grape but now days due to fluctuation in weather it is difficult to maintain export quality of grapes. Therefore, area under grapes decreases day by day.

5.11.3 Opportunities for Agricultural development

1. Development of new agro based industries in rural region to enhance the agricultural development. In addition, Sangli Food Park is being planned on a 305 acre at manerajuri in Sangli district.
2. Sangli district has entered into the new venture of wine manufacturing. The wine industry in Sangli has achieved the classic vintage category taste of wine. Overflowing fomenters exited for appraisalment of European and Australian market.
3. Milk based products/dairy products has very good potential as the district is adjacent to Kolhapur district and

surrounded by many holy places, hence milk products like khava, pedha, burfi has been major commodity amongst the devotees.

4. Being largest grape producing district, many international avenues can be explored in order to export the raisins and grapes as table fruit.
5. As the major irrigation project, "Chandoli dam" is on Warna river in Shirala Tahsil haing ultimate irrigation potential 121.92 thousand hectare. It will provide irrigation to Sangli, Satara and Kolhapur district. Also 5 medium and 54 Minor irrigation projects have come in to existance. There is a scope to increase the irrigation potential in the district.

5.11.4 Threats for Agricultural development

Non availability of testing facilities to carryout analysis of the contents of turmeric produced.

1. Lack of awareness and facilities of export quality packaging.
2. The physical settings of Sangli district shows a contrast of immense dimensions and reveals a variety of landscapes influenced by relief, climate and vegetation.
3. Among commercial crops, there is shift towards the heavy feeder commercial crops like sugarcane. Therefore, the area under Sugarcane was increased but the soils in the district becoming less productive due to extra use of water and fertilizer.

4. Also, due to excess use of water salinisation of soil occurs in the district.

5.11.5 Suggestions to overcome the problems

1. Government should undertake social forestry programme on large scale in order to increase the forest area in Sangli district.
2. This would also insure regular and sufficient rainfall in the district.
3. Non-agricultural use of land and wasteland should be decreased and maximum possible land should be brought under cultivation.
4. Construction of water storage structures such as Nala-bunding, counter bunding, bench terraces, dams, etc, to store the rainfall water. This will make possible to increase the net sown area in Sangli district by supplying water during slack area.
5. There should be strict implementation of law in regard of digging of wells. This will retain the ground water table for irrigation purpose.
6. Use of modern techniques of irrigation such as sprinkler, drip irrigation for economic use of available water.
7. Government should undertake extension programmes of subject like adoption of cropping pattern, use of HYVs in order to improve the productivity of crops in the district.
8. Taking in to consideration the importance of electricity for agriculture, the load shading should be minimized for

agricultural sector and there should be regularity in supply of electricity.

9. Provision should make for cooperative storage facility for group of villages or nearer city places.
10. To overcome the high transportation charges and various other marketing obstacles government undertake cooperative marketing of agricultural produce.
11. Arrange the farm visit for farmers in the developed area.
12. Timely supply of credit at cheaper rate of interest would ensure in increase in agricultural production.

6. SUMMARY AND CONCLUSION

Agricultural development is a strategic element in the process of economic development of a country. It has already made a significant contribution to the economic prosperity of the advanced countries. India being predominantly an agricultural and overpopulated country, the development of agriculture with increased output and productivity would contribute substantially to overall economic growth of a country. Agriculture is the single largest economic activity in India as it contributes 13.7 per cent in GDP in 2012-13, gives employment to both literate and illiterate, contribution in export also.

The role of agriculture in economic development of India continue to be of great importance, as a producer of food, as an employer of about two-third of the labour force and as a source of purchasing power for much of the non-agricultural consumer goods and services in the economy. The rapid growth of agriculture has therefore, being consider the basic requirement for suitable growth and development of the economy in India. The agriculture sector has however, shown a mixed type performance during the post independence period. The rate of growth of agricultural output, in general and that of foodgrain production in particular was lower than that of increase in population during the fifties and early sixties. Because of increasing pressure of population and stagnant productivity of agriculture, the country was required to depend heavily on foodgrain imports to meet internal demand for food. During this

period, the growth in agricultural output was largely contribution by the expansion in land area sown under different crops and not by any major technological change.

The situation however, underwent a significant change since 1966-67 with the onset of the process of agricultural transformation involving technological change. With the introduction of high yielding varieties of seeds beginning from 1964-65 and increasing availability of chemical fertilizers. Indian agriculture no longer continued to be traditional one as it was during the fifties. The increased agricultural production enabled India to have self sufficient in food and a marginal exporter of foodgrains. India ranks first in miki production and second in fruits and vegetables in the world.

However, the growth of agricultural is not uniform in the country. Regional imbalances leads to underutilization of economical resources both natural and human, in that process individual are discriminated. There are regional disparities at inter-state and intra-state levels. Not all the regions reaped the fruits of green revolution uniformly. The empirical evidence has revealed that, the technological change was crop specific and area specific because of the differentials in the chemical factors and regional equalities of natural resources endowments and past investment in the development of infrastructure facilities across different regions in India. Many of the pulses and oilseeds crops as well as commercially important crops remained outside the green revolution.

The need for reducing regional gap has argued from various angles such as social justice, accelerating the growth of economy proper utilization and exploitation of resources, available in the relatively backward region, maintaining national integration, political stability and utility. Government has given much attention for development since independence agricultural development means better standard of living for farm families. Increase in agricultural sector, impacts development in other sectors of economy. As compared with other states like Punjab, Haryana, Uttar Pradesh a development of agriculture in Maharashtra has not proved to be satisfactory. It is due to limited facilities for irrigation, credit, farm inputs and variation in natural resources among regions of Maharashtra.

In Western Maharashtra, region Sangli district is one of the forward districts in agricultural development. A study a primarily centered around the trend in land use and crop pattern, growth rates of important crops, development of infrastructural facilities and identification of major variables influencing the agricultural production. The changes in growth rates of area, production and productivity of major crops due to use of modern technology during the green revolution also examined. In view of this, the present study *viz.*, and economic appraisal of agricultural development in Sangli district has undertaken with following specific objectives.

- a) To study the changes in land use and cropping pattern,
- b) To study the growth rates in area, production and productivity of major crops,

- c) To study infrastructural development for agriculture of Sangli district,
- d) To identify the important factors responsible for agricultural development of Sangli district,
- e) To identify strengths, weaknesses, opportunities and threats (SWOT) and suggest measures.

The secondary data on various parameters of agricultural development during period starting from 1980-81 to 2012-13 i.e.33 years on the various aspects such as land use cropping pattern area, production and productivity of major crops, inputs, fertilizer, livestock, agricultural machinery, etc., in respect of Sangli district. The data were collected from District Statistical Abstract, Economic Survey Reports, Mahatma Phule Krishi Vidyapeeth, Rahuri library and Departmental database. The changes in land use, cropping pattern and input use studied for the 33 years starting from 1980-81 and ends in 2012-13 and by estimating proportions to the respective base year at the selected points of time.

The impact of agricultural development on agricultural production has assessed by estimating annual compound growth rates in area, production and productivity of crops *viz.*, Paddy, jowar, bajra, wheat, total cereals, gram, tur, mung, udid, total pulses, total foodgrains, groundnut, sunflower, total oilseeds, sugarcane and cotton in Sangli district for three periods *viz.*, period I 1980-81 to 1994-1995 ; period II 1995-96 to 2012-13 and also for the overall period (1980-81 to 2012-13). The multiple linear regression equation fitted for the data for the

period 1980-81 to 2012-13 to study the functional relationship existing between the aggregate value of crop output in crores rupees in Sangli district as the dependent variable and selected nine independent variable *viz.*, Percentage of gross irrigated area to gross sown area (X1), Consumption of total fertilizer (NPK) per hectare of gross irrigated area (kg) (X2), Percentage of gross sown area to net sown area (X3), Percentage of area of HYV seeds to gross sown area (X4), Percentage of area under commercial crops to gross sown area (X5), Amount of loan (short-term and medium-term) disbursed through PACCS per year (₹ in lakhs) (X6), Average annual rain fall in the Sangli (mm) (X7), Area under fruits crops (ha) (X8), Number of milch animals (No) (X9).

6.1 Summary of findings

The findings of the study have briefly summarized below.

- 1) The careful examination of the changes in land use pattern in Sangli district indicated that, the area under forest had decreased by 8.05 per cent during the entire period study. The area under barren and uncultivable land showed decreasing trend and it had declined from 4.67 per cent to 4.27 per cent of the geographical area over the period of 33 years. The area under cultivable waste showed increasing trend from 0.63 per cent to 1.72 per cent of the total geographical area under study.
- 2) During the span of last 33 years, the net sown area of Sangli district had declined by 4.79 per cent over the base year. The gross cropped area had also declined by 1.19 per

cent during the period under study. The net irrigated area of district was 68800 hectares in the year 1980-81, which increased up to 158000 hectares i.e. by 129.65 per cent in the year 2012-13.

- 3) The trends in area irrigated by various sources in Sangli district during the period under study indicated that, the percent of surface irrigation other than well to the net irrigated area had increased from 27.33 percent 28.48 per cent in respective 33 years had continuously increased. The percentage of well-irrigated area to net irrigated area was 72.67 percent in the year 1980-81 and it decreased up to 71.77 percent in the 2012-13 but actual area irrigated by wells had increased over the period under study.
- 4) Cereal crops are the dominating crops in cropping pattern during the overall period under study, as compare to other crop in Sangli district. During a span of last 33 year, the area under total cereals and total foodgrains had decreased. The area under total pulses slightly increased in 1995-96 but it decreased in 2012-13. The area total oilseeds increased over the base year but not as that of period II. The area under sugarcane had considerably increased during the period under study. It is interesting to note that the area under green gram had increased nearly three times over the base year i.e. area under gram was 1300 hectare during 1980-81 and it increased up to 3600 hectares in 2012-13. The area under the foodgrains had

decreased over the period under study but there was slight increase in period II.

- 5) The period wise annual compound growth rates in area, production and productivity of major crops in Sangli district indicated that, the area, production and productivity of maize increased significantly during the period under study. The production and productivity of wheat showed significant increase i.e. 2.31 and 2.64 percent per annum respectively for entire period under study. In case of jowar, growth rate of area was positive and non-significant, production was positively significant i.e. increased by 1.6 per cent per annum and that of productivity it was negatively significant i.e. decreased by 1.65 percent per annum. The production and productivity of total cereals was negative and non-significant over the entire period under study and the area decreased significantly over the period under study.

The area, production and productivity of gram in Sangli district had significantly increased at the rate of 1.68 per cent, 5.48 per cent 3.74 per cent respectively. annual compound growth rate of area and production in red gram decreased by 2.61 per cent and 3.29 per cent over the entire period under study and in case of productivity it non-significantly decreased by 1.52 per cent per annum. In case of green gram area and production increase, significantly by 4.81 per cent and 4.96 per cent over the entire period under study and productivity,

increase non significantly by 0.12 per cent. In case of total pulses growth rate of area decreased significantly by 1.5 per cent, growth rate production increased non significantly by 0.2 per cent and growth rate of productivity increased significantly by 1.71 per cent per annum over the entire period under study.

In case of total foodgrains growth rate of area decreased significantly by 0.57 per cent, growth rate of production non-significantly by 0.37 per cent and growth rate of productivity increased non-significantly by 0.59 per cent.

The growth rate of area, production and productivity of total oilseeds increased significantly by 1.97 per cent, 3.62 per cent and 1.59 per cent per annum respectively over the entire period under study. In case of groundnut, area and production decreased significantly by 2.12 percent and 2.32 per cent and per annum respectively and in case of productivity increased significantly by 1.79 per cent over the entire period under study. In sunflower area and production significantly increased by 9.88 and 8.95 per cent per annum respectively and productivity decreased significantly by 1.37 per cent per annum over the entire period under study.

In sugarcane, area and production increased significantly by 3.37 per cent 3.4 per cent respectively and increased in productivity not significant.

- 6) The adoption of HYV's of paddy and jowar increased by, more than two times over the base year 1980-81. In case of wheat, it decreased but it is due to decrease in the total under wheat and not due to the less adoption of HYV's. In case of maize area under HYV's increased to large extent i.e. from 1530 hectares in 1980-81 to 21960 hectares in 2012-13.
- 7) The use of wooden plough and iron plough replaced by, tractors over the entire study period. The wooden ploughs decrease by 36.50 percent over the base year while iron plough decreased by 40.77 percent over the entire period under study. The tremendous increase observed in case of Sugarcane crusher and it was 260.27 percent over the base year 1980-81. The use of sugarcane crusher showed continuous increase over the entire period. The number of electric motors had increased by 5.36 percent over the base year, which supposes the fact of increasing irrigation in district.
- 8) The credit disbursement through PACCS in Sangli district had increased continuously from Rs. 1394.70 lakhs in 1980-81 to Rs. 62815.61 lakhs in 2012-13. The loan disbursed by PACCS was conspicuous during the last two periods.
- 9) The population of indigenous bullocks and indigenous cows had declined while, that of exotic cows, he and she buffaloes, goat and total livestock had increased over the period in Sangli district. As that of poultry and sheep, the

total population had decreased over a period. The livestock population had increased by 40.13 percent over the base year, 1980-81.

- 10) The length of main and other state highways, major district roads, other district roads and village roads had increased substantially over the entire period. The length of National highway and railways remained constant over the entire period under study. The total road length had increased by 76.39 per cent over the base year 1980-81.
- 11) The rainfall showed variation throughout the entire period under study. The total annual rainfall had decreased continuously over the base year.
- 12) The changes in productivity of major crops showed that except rice, *kharif* jowar, bajra, green gram, sugarcane and cotton the productivity of all other crops had increased over the base year 1980-81. The productivity of maize had declined during II period and again increased in period III. The average productivity of wheat, rabi jowar, maize, red gram and gram increased considerably by 134.01, 27.56, 46.72, 126.67 and 383.57 percent respectively during the span of last 33 years in Sangli district.
- 13) The total consumption of fertilizers (NPK) in Sangli district was 18690.00 MT in year 1980-81, which has increased to 107005.00 MT in the year 2012-13. Per hectare, consumption of NPK showed an increasing trend during the period under study.

- 14) The critical examination of the multiple linear regression analysis for the agricultural development in Sangli district revealed that, the nine resource variables included in the model have explained jointly 93 percent total variation in the value of aggregate crop output of Sangli district. The regression coefficient of variables *viz.*, consumption of total fertilizer (NPK) per hectare of gross irrigated area in kg (X_2), percentage of area under commercial crops to gross sown area (X_5) and amount of loan disbursed through PACCS per year in lakhs of rupees (X_6) were turned to be positive and highly significant at 1 percent of level of significance. We also observed that percent of gross sown area to net sown area (X_3) was turned out to positive at significant at 5 percent of level of significance. The regression coefficients of area of HYV seeds to gross sown area (X_4), area under fruit crops in hectares (X_8), and number of milch animals (X_9) were positive but non-significant. While, the regression coefficients of percent of gross irrigated to area to gross sown area (X_1) and average annual rainfall in the Sangli (mm) (X_7) was negative and non-significant.
- 15) Reduction in forest area, rainfall, net sown area, total foodgrains, area under cotton, while increase in area under barren and uncultivable land, area under well irrigation, profuse use of chemical fertilizer, improper utilization of HYV's, electricity problem, lack of storage facilities are some of the main obstacles in the agricultural development. While, implementation of social forestry programme,

construction of water reservoirs, implementation of law regarding digging of wells, use of micro-irrigation techniques, extension programmes on improved farming, proper supply of electricity, provision of cooperative storage etc; some of the remedies to minimize the problems in agricultural development.

6.2 Conclusions

The following specific conclusions can be emerged from the findings of the study.

1. The area under forest declined by, 8.05 per cent during the period under study in Sangli district. The area under barren and uncultivable land had declined over the period under the study. Land under non-agricultural use had been increasing steadily. The area under current fallow land increased from 33500 hectares to 42500 hectares during 1980-81 to 2012-13.
2. The area under irrigation increased significantly. In the year, 1980-81 irrigated area was 68800 hectares and in 2012-13 it was 158000 hectares. The irrigated area increased by 129.65 per cent during the study period, which is an important achievement in the district.
3. The area under rabi jowar and maize had increased. The area under cereals has predominance in cropping pattern in Sangli district. Under pulses, the area under green gram increased.
4. The consumption of fertilizers (NPK) had increased.

5. There exist the changes of crops in area, production and productivity in the district over the period under study. The productivities of most of the crops had increased. The reason behind increase in productivity was the adoption of high yielding varieties.
6. The net sown area during entire period under study decreased by, 4.79 per cent over the base year 1980-81.
7. The agriculture in Sangli district showed significant increase in the use of tractors, electric motors and sugarcane crusher, indicates largely partial mechanization.
8. The population of indigenous bullocks and cows declined during the period under study while, the population of other livestock showed increasing trend. The exotic cow population increased which helped in increase in milk production. The use of bullocks for drought purpose declined due to use of tractors.
9. The multiple linear regression analysis indicated that the factors *viz.*, consumption of total fertilizer (NPK) per hectare of gross irrigated area in kg (X_2), percentage of area under commercial crops to gross sown area (X_5), amount of loan disbursed through PACCS per year in lakhs of rupees (X_6) and percent of gross sown area to net sown area (X_3) in Sangli district showed a significant positive association in increasing value of aggregate crop output. The nine variables included in the analysis explained jointly 93 percent total variation in the value of aggregate crop output of Sangli district.

6.3 Policy Implications

The policy implication based on the conclusions of the present study could be listed as under.

1. The empirical evidence relating to the decline in the area under forest up to 5.04 percent. The Sangli district forest department have to increase the area under forest to the level of 33 percent of the geographical area to maintain the ecological in Sangli district.
2. The imbalanced use of fertilizers and excessive use of pesticides particularly in fruits and sugarcane have also become cause of concern. The incidence of disease and pests is on the rise especially in sugarcane and fruits crops. Therefore, emphasis needs to be laid down on integrated nutrient and disease/pest management to maintain soil fertility and increase productivity. The scope of organic farming is much brighter in district.
3. In the district area under pulses, oilseeds and cereals decreased to noticeable extent therefore local government in Sangli have to give emphasis on increasing area, production and productivity of pulses, oilseeds and cereals in the district.
4. Farm mechanization has remained the major constraint in farming as most of the operations are still carried out manually, especially by rural women folk. Therefore, there is a need to develop small improved models of power tiller and other low cost implements to reduce farm drudgery.

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