

**RETROSPECTS AND PROSPECTS OF AGRICULTURAL
DEVELOPMENT OF BEED DISTRICT IN MAHARASHTRA**

by

Miss. Rathod Kalpana Bhimrao
(Reg. No.016/200)

A thesis submitted to the
MAHATMA PHULE KRISHI VIDYAPEETH
RAHURI - 413 722, DIST.AHMEDNAGAR
MAHARSHTRA, INDIA

In partial fulfillment 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,
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2018

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
Diploma

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Date : / /2018

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ABSTRACT

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Research Guide : Dr. V.G. Pokharkar

Department : Agricultural Economics

Agriculture is an important sector of Indian economy as it contributes about 17.32 per cent to the total GDP and provides employment to over 60 per cent of the population. Indian agriculture has registered impressive growth over last few decades. Agricultural production constitutes the single largest economic activity in India. In view, it was decided to undertake a study *viz.*, "Retrospects and Prospects of Agricultural Development of Beed District in Maharashtra" covering a period from 1990-91 to 2015-16 with the objectives to study the growth rates in area, production and productivity of major crops, to study the changes in socio-economic indicators of agricultural development, factors responsible for agriculture development and SWOT (Strengths, Weakness, Opportunities and Threats) analysis of agricultural development in Beed district.

The present study was based on the secondary data on various parameters of agriculture for the period starting from 1990-91. The data for last 26 years i.e.1990-91 to 2015-16 on the various aspects such as land use pattern, cropping pattern, inputs, livestock etc. in respect of Beed district was collected from published sources *viz.*, socio-economic abstract of Beed district, Directorate of Economic and Statistics, NABARD report etc.

The study revealed that, the annual compound growth rates of area, production and productivity of all cereal crops fluctuated widely during the period under consideration in Beed district. Among cereals area and production of maize and wheat increased significantly. Whereas, area, production and productivity of jowar and bajara was declined over the period of time. Among the different cereals, annual growth rates in area, production and productivity of maize and wheat were increased for entire period of twenty six years. The compound growth rates of area under total cereals, total food grains and oilseed have been declined in Beed district. Whereas, the area under pulses, sugarcane and cotton has been significantly increased. It indicates that there crop diversification in Beed district. The farmers are diverted from foodgrain crops to non-foodgrain crops to earn more profit from farming.

The net irrigated area decreased during the study period. The percentage of net irrigated area to net sown area also decreased over the period of time. It was mainly due to fluctuation and erratic rainfall from last 20 years. The consumption of fertilizer showed an imbalance use during the study period. In view of this, the productivity of almost all the crops was below than State average and decreased over the base year 1990-91.

The livestock population was decreased over period of time. The numbers of goats and sheep were decreased during the study period. The rainfall was decreased over the base year. The use electric of pump and tractor had increased considerably over the period of time. The detailed observation revealed that the use of wooden ploughs and iron ploughs were replaced by tractors.

The length of National highways, state highways, major district roads and other district road has increased over the base year 1990-91. This would automatically facilitate farmers to visit distance markets and also acquire improved technology regarding agriculture from distant places.

The regression coefficients of the variables *viz.*, percentage of gross cropped area to net cropped area (X_3), percentage of area under commercial crops to gross cropped area (X_4), and total milch animal (X_8) were turned out to be positive and highly significant indicating thereby that the agricultural production of Beed district is highly responsive to these important variables. The percentage of consumption of total fertilizer (NPK) per hectare in (MT) (X_3) and amount of loan (short term) disbursed through DCCB per year (₹ in lakh). (X_7) was non-significant and negative. The analysis therefore concluded that the independent factors *viz.*, percentage of gross cropped area to net cropped area (X_3), percentage of area under commercial crops to gross cropped area (X_4) and total milch animal (X_8) have shown a significant positive association with the increase in the value of aggregate crop output in Beed district.

The study suggests that, the Beed district is rainfed district, therefore irrigation development should be given top priority to execute various minor irrigation projects and water harvesting schemes in the Beed district. The productivity of almost all the crops of Beed district was less than that of State average productivity. So efforts are needed to increase the crop productivity of Beed district through technology adoption by NGO, Extension agencies and Universities etc. and Beed district is a rainfed district (85%). however, livestock is declining especially goat and sheep. Hence, the open goat and sheep rearing may be encouraged among the farmers for increasing the farm income in Beed district.

1. INTRODUCTION

“Economic growth without social progress lets the great majority of people remain in poverty, while a privileged few reap the benefits of rising abundance”

- Jhon F. Kennedy

Agriculture sector is the mainstay of the Indian economy, contributing about 17.32 per cent of National Gross Domestic Product (GDP) and more importantly, about half of India's population is wholly or significantly dependent on agriculture and allied activities for their livelihood.

Indian economy is known as agricultural economy. Agriculture is the main occupation in developing countries like India. Development of agriculture sector determines growth of other sectors of the economy and hence prosperity of nation. At present agriculture contributes 21 per cent share in the national income and it sustains 70 per cent of population for their livelihood. Agriculture contributes largest share in earning foreign exchange, it has gone up to 52 per cent, so it is a largest economic activity in India. Agriculture is not merely an occupation but way of life, which for centuries has shaped the thought and outlook of many millions of people. Among the whole world, Indian economy ranks fourth position and it indicates importance of agriculture.

Five year plans started since 1950-51 for the rapid development of country, but by knowing the importance of agriculture, planner gave top priority for agriculture sector and paid attention purposively in each plan towards agriculture development. The scenario of Indian agriculture has been changed after mid sixties as a result of green revolution. According to Dr. M.S. Swaminathan (1980) the green revolution in our country has generated a climate of confidence in our agriculture capabilities and very first time agriculture came at top level of importance. Due to the green revolution, India became self sufficient and it has given fillip to general economic development through its forward and backward linkages.

The contribution of agricultural sector to GDP has continued to decline over the years, while that of other sectors has increased. In 1970-71, agriculture contributed about 44 per cent of GDP, which declined to 31.4 and 14.6 per cent in 1990-91 and 2009-10 (at 2004-05 prices), respectively. Nevertheless, agriculture remains a major source of employment, absorbing about 60 per cent of the total national work-force in 2004-05, down from about 70 per cent in 1971. Importance of agriculture in a country like India is not likely to decline due to concerns for food security, employment, rural poverty and availability of wage goods.

Indian agriculture has registered impressive growth over last few decades. The food grain production has increased from 51 million tonnes (MT) in 1950-51 to 273.88 MT during

2016-17 highest ever since independence. The production of oilseeds (nine-major oilseeds) has also increased from 5.00 to 25.30 MT during the same period.

The rapid growth has helped Indian agriculture to mark its presence at global level. India stands among top three in terms of production of various agricultural commodities like paddy, wheat, pulses, groundnut, rapeseeds, fruits, vegetables, sugarcane, tea, jute, cotton, tobacco, leaves, etc (GOI, 2008-09). India has successfully implemented several agricultural development schemes in the country.

Agriculture development plays an important role in the growth of other sectors of economy. Agricultural development is defined as the process that creates the conditions for the fulfilment of agricultural potential. Those conditions include the accumulation of knowledge and availability of technology as well as the allocation of inputs and output.

1.1 Agriculture Development

The development of agriculture is a process through which the shift takes place from stage of traditional to the stage of modernized agriculture resulting in increased production and productivity 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 agriculture development includes, use of high yielding varieties of seeds, adaption of improved package of practices including fertilizers, plant protection measures, irrigation, use of modern machinery, etc., for increasing productivity of farm enterprises. The process aims at getting the maximum advantage of the available resources *viz.*, land, labour, capital, etc., on the farm and finally depicts the prominent change in resource use and allocation, productivity of crops over a period of time in region. The process of agriculture developments thus, important from the view point of increasing agriculture production in the country.

1.2 Agricultural Development in India

Recognizing the important role of agriculture in the economic development of country, the five-year plans assigned high priority to agricultural development. Agriculture has been the major source of livelihood in India since the primordial age. The invent of Moghuls followed by British did not change the situation to the desired level. Agriculture remained totally primitive, deteriorative and the deficiency of food grains has lead to witnessing of a number of horrible famines. The agriculture sector in many developing countries could not move ahead because of a large number of physical, natural, economical, social, political and human factors. Since, the post-independence period, several measures have taken to swing-up agricultural sector. The First Five Year Plan allotted 31 per cent of its total investment on agriculture and allied activities. The agriculture sector has however, shown a mixed type of performance during the post-independence period. During the fifties and early sixties the growth in agricultural

output was largely contributed by the expansion in land area sown under different crops and not by any major technological change. As the agriculture sector in some of the developing countries has shown the signs of development today it was almost of traditional type till very recently as the output from agriculture was mainly derived from land (of whose supply remained mostly fixed) and labour (of whose marginal productivity was almost equal to zero) inputs.

The conditions did not remain the same and since 1966-67 with the onset of the process of agricultural development involving technological change with the introduction of high yielding varieties of seeds during mid thirty's 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 food grains. The production of other crops as cotton, sugarcane, oilseeds, fruits and vegetables has increased during the seventies and eighties.

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 of India. It is seen that technological changes were specific to the crops such as wheat, cotton, paddy, groundnut, all of which were grown under irrigated conditions in Haryana, Western Uttar Pradesh (Uttaranchal), Punjab and few pockets of Gujarat, Maharashtra, Tamil Nadu and Andhra Pradesh. Many of the pulses and oil seed crops as well as commercially important crops such as sugarcane, tobacco and chilly remained outside the phenomenon of technological change for a long time.

1.3 Agricultural Development in Maharashtra

In Maharashtra, all possible efforts have been made to increase agricultural production and thereby to involve in the national campaign of development of agriculture, which commenced during the post independence period. The development schemes *viz.*, CADA, DPAP, SFDA, MFAL, etc., have been launched in the state. Maharashtra is fore runner in respect of many new schemes of agricultural development. 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 agricultural sector grows, the impact of its development is felt in other sectors of the economy and it accelerates the overall economic development of a 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 of four regions *viz.*; Konkan, western Maharashtra, Marathwada and Vidarbha regions which represent varying types of natural, physical, social and economical conditions, quite distinct from each other. The variabilities in topography, soils 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 regions. The inter-regional comparison

of the performance of agriculture has revealed that the technological advances in agriculture could not make such progress in their contribution to increase the production and productivities of various crops in different region. Because of these variabilities there existed significant imbalances and disparities in income levels of farm 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 sector 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 districts and regions and among individual crops within the regions of Maharashtra.

The introduction of new agricultural strategy i.e. green revolution boosted towards advanced one. They have now realized the importance of use of crucial inputs viz., irrigation, credit, fertilizer, high yielding variety seeds, plant protection measures etc., for increasing agricultural production. It appears that the above said inputs along with the new technology in agriculture have propounded effects in influencing the productivity and as a result at production in agriculture. The agriculture in Maharashtra underwent several changes on account of the national campaigns for agricultural development since mid-eighties. 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, cropping pattern, growth rates in area, production and productivity of important crops and identification of major factors influencing the agricultural production. The examination of changes in growth rates of area, production and yield of major crops as divided into three periods would be useful to know the performance of crops it is in this context, the present study of development of agriculture in a well defined area mostly the district, would help us to know the growth patterns of cultivated crops productivity, infrastructural facilities and measures to be taken to overcome the hurdles in the way of development.

It is observed that Beed district in western Maharashtra is one of the developed district in agricultural development activities. In view of this, it was therefore decided to undertake a study

viz., "Retrospects and Prospects of Agricultural Development of Beed District in Maharashtra" covering a period from 1990-91 to 2015-16 in Marathwada region.

1.4 Agriculture development in Beed district

Agriculture is the major occupation of majority of the population in Beed district, and largely depends on Mansoon rain. Economic, industrial, educational and social development of this area is dependent on agricultural production. Despite of higher promotions per capita availability of food over time did not increase significantly. The growth rate of agricultural production is only around 2 per cent. The growth rate of production in agriculture must be more than the growth rate of population. Hence there is an urgent need to accelerate agricultural growth to address issues on food security, nutritional adequacy and income generation. This can be achieved by identifying the problems in crop production, infrastructure facilities, issues related to the natural resources, input management and accordingly there is need to improve agricultural services keeping in view the vision and objectives.

In view of this, it is observed that the Beed district in Marathwada region is one of the backward district in Agricultural Development activities. Majority of the people from Beed district migrate seasonally to the western Maharashtra in sugar factory and also Marathwada region suffer drought from 3-4 year continuously. It directly affect the Agricultural economy.

1.5 Objectives of the study

- i. To estimate the growth rates in area, production and productivity of major crops in Beed district.
- ii. To study the changes in socio-economic indicators of agricultural development in Beed district.
- iii. To assess the changes in infrastructural development for agriculture in Beed district.
- iv. To identify the factors responsible for agricultural development of Beed district.
- v. To workout SWOT (Strength, Weakness, Oppurtunities and Threats) analysis of agricultural development in Beed district.

1.6 Scope and utility of the study

The present study is restricted to Beed district of Maharashtra with reference to above objectives only. However, the findings of the study can be projected to wider area having similar agro-climatic conditions. The study focuses a 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. The important conclusions, which are drawn from this study, will help for planning and execution of agricultural development programmes in the district. The changes in the land use, cropping pattern, area, production and productivity of crops would indicate certain trends, which could be corrected for balanced agricultural growth in the district.

1.7 Limitations of the study

The present study is based on the secondary data obtained from published sources as well as from development agencies in Beed district. The findings are based on the availability as well as reliability of the data on different aspects of the study. The data collected from District Statistical abstracts and Epitomes published by Department of Agriculture. As the data is secondary one has to go forward by considering these data, its reliability is the only limitation of the study. However, an attempt is made to have an in depth analysis of the data to accomplish the objectives with meaningful conclusions.

2. REVIEW OF LITERATURE

This chapter has been devoted to present reviews of previous studies, which are identical in the present one. The basic purpose of this chapter is to understand the methodology adopted and the trend of conclusions derived in the earlier related studies so that a suitable methodological framework could be developed for the present study. The present study seeks to examine the various aspects of agricultural development in Beed district. A limited number of scholars have tried to study the agricultural development in Beed district and their analysis was too inadequate to provide empirical evidence relating to the development of agriculture in the district. In spite of fact, a thorough investigation has been made in this study to achieve all the objectives.

The goals, assumptions and development strategies for increasing production and productivity of land and labour in agriculture in Beed district have been very similar to various developing district of State. Moreover, the districts shares some common characteristics such as religions, socio-economic characteristics of people, tropical climate with the rainfall concentrated in a few months in the year and highly variable, major crops grown and cropping pattern, highly dependence on agriculture and the presence of tremendous diversity in cultures, farming systems, sociological and psychological characters, etc. The review of literature on the development of agriculture in some other districts and state is, therefore, useful to identify various aspects of agriculture and to decide suitable methodological frame work for the proposed study. For the sake of convenience, the reviews collected from various sources have been grouped under the following major headings.

- i. Growth rates in area, production and productivity of major crops.
- ii. Changes in socio-economic indicators of agricultural development.
- iii. Changes in infrastructural development for agriculture.
- iv. Factors responsible for agricultural development.
- v. SWOT (Strength, Weakness, Oppurtunities and Threats) analysis of agricultural development.

2.1 Growth Rates in Area, Production and Productivity of Major Crops

Swarup and Singh (1977) analyzed the status of agricultural development in Himachal Pradesh for the period 1951-52 to 1973-74 and observed that the different crops showed varied performance in the state. They also highlighted the scope of diversifying agriculture through cultivation of fruits and vegetables. However, they have not analyzed the district-wise performance of all the components of agricultural development.

Joshi and Haque (1980) studied the state wise long term prospects of balanced agricultural growth in India by analyzing data on agricultural outputs and inputs for the years

1955-56 to 1975-76. They examined the relative role of different factors in influencing agricultural productivity in various states. They revealed that there were not only large scale inter-regional disparities and intertemporal fluctuations in the existing agricultural growth rates, but also the likelihood of such disparity and fluctuation affecting the future growth adversely. They suggested the need for a concerted effort to regulate and plan long-term balanced agricultural growth in the country.

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 new HYV's the pattern changed only for wheat during the period of post 1965.

Grewal and Rangi (1983) critically examined the factors associated with growth pattern of agriculture in Punjab. They observed notable five-fold increase in the production of foodgrains in the state of Punjab during the period 1960-61 to 1982-83. They concluded that, Punjab with less than 2 per cent of the area in the country accounted for as much as 60 per cent of the total foodgrains produced for the central pool. They found the growth rates of production of three major foodgrains (paddy, wheat, jawar) in the Western region indicated that the growth rates had declined for paddy and wheat and slightly improved for jawar. The growth rates of yield particularly in case of paddy and wheat had shown declining tendencies during the last five years. They observed that only there was variation in the growth rate of production between crops in the region but also between states within crop.

Thakur and Sharma (1984) studied the growth in foodgrain production in Himachal Pradesh. They observed the stagnant foodgrains production in Himachal Pradesh after the period of green revolution. The overall growth rate in total foodgrain production from 1951-52 to 1983-84 was 2.55 per cent for Himachal Pradesh as against 2.61 for India and 6.66 for Punjab. They observed that the compound growth rates of foodgrain production and productivity which were higher in pre-green revolution period (1951-52 to 1965-66) declined during the post green revolution period. They enlisted number of problems and constraints and gave the pertinent suggestions to improve the foodgrain production.

Bhalla and Tyagi (1989) analysed the pattern of agricultural development across different states of India. According to them, the new seed-fertilizer technology introduced in mid-sixties brought about significant but varying changes in the level of growth across various states. However, the new technology could hardly take root in hilly, eastern and central regions of the country. The growth was region as well as resource based favouring well-endowed states like Punjab, Haryana and Uttar Pradesh. This has given rise to regional disparities in the pattern of agricultural development.

Hanumantha Rao (1989) studied the state wise growth rates of production for paddy and foodgrains 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 balances in growth witnessed in the early years of green revolution and were getting redressed to some extent in the recent period.

Ramakrishna (1993) studied the trends in growth rates of agricultural production, area and productivity for all crops. He analyzed the sources of growth in agricultural production and also examined the relationship between instability and the growth during 1950-51 to 1990-91 was 2.69 per cent. The increase in the growth rate of agricultural output was mainly due to an increase in area in fifties and due to productivity increase in the later periods. Decline in production of non-food grains was mainly due to large decline in area under these crops. He also concluded that the productivity in Indian agriculture was positively associated with instability whereas the same association could not be attributed to both output and area.

Thakur *et al.* (1994) studied the growth as well as the factors effecting farmers decisions relating to area allocation under important food grain crops in Himachal Pradesh. They suggested that the maize based agro-industries (like poultry feed, beverages, baby corn, etc.) should be established in the state to provide remunerative returns to the farmers. They also observed that the farmers were not responsive to the relative returns of the crops. They also suggested that regulated markets should be strengthened at least at the district level in the state, so as to provide continuous remunerative prices to farmers.

Chand (1995) analyzed the growth, composition and intensity of different categories of animals in Himachal Pradesh. He observed that the livestock population in Himachal Pradesh increased from 47 lakhs in 1972 to about 50 lakhs in 1982, recording a growth rate of 0.6 per cent in the subsequent decade. The composition of livestock in terms of bovine, ovine and other animals did not undergo any change during the last two decades, while their growth rates have decelerated sharply. He revealed that the availability of grazing land was more favourable to increase the share of sheep and goats. According to him, the biotic pressure of livestock in the hill region could be reduced through curbing human population, growth, regulated grazing and improvement of the stock of animals.

Kumar (1996) analyzed the prospects for pulses production under rainfed situation and found that the area, production and productivity of pulses had remained almost static in India over the past three decades. Suggestions were made to utilize pesticides and fertilizers to increase the area under pulse cultivation.

Jagannathan (1998) reported the trends and pattern 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 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.

Sharma *et al.* (1998) examined the performance of food grain production and marketing in Himachal Pradesh. They observed differential pattern of growth in production of food grain crops across different districts of Himachal Pradesh. High variability was observed in the production of wheat and paddy. Based on the consumption pattern and supply of different food crops, it was estimated that the state had a surplus of about 35% of maize. But the state was having deficit in case of wheat, paddy and pulses. They emphasized the need for designing technological missions by involving State Department of Agriculture and Agricultural University to chalk out a plan for higher production and efficient marketing of food grains.

Shamsuddin *et al.* (1999) studied the growth in Malaysian agriculture and observed that the industrial crops witnessed continuous price instability, rising cost of production, imperfect market structure, trade barriers and low productivity on small holder farms. The average total factor productivity growth over the study period, 1961-94 was 3.3 per cent. The growth in the total factor productivity that was high at 5.7 per cent in 1960s, slowed down to 3.8 per cent in 1980s and further declined to the extent of 1.9 per cent in 1990s. They suggested improvement in farm and agronomic practices on the small holders, technology advancement, intensification in research and development, emphasis on market extension and market mechanism to improve the growth in factor productivity.

Singh and Chandra (2001) examined the growth trends in area; yield and production of foodgrains in Uttar Pradesh registered a considerable change in agricultural development during different phases of green revolution. They found that the growth rates in area and production of foodgrains were higher in post green revolution period than pre-green revolution period. They suggested that further increase in foodgrain production was possible only by increasing the yield which could be achieved by using the inputs more efficiently in the state.

Naik and Pandit (2001) examined the prospects of fruits and vegetables production in Gujarat *vis-a-vis* in the country as a whole. The diverse agro-climatic conditions prevailing in the country were found favourable for large variety of tropical, subtropical and temperate fruits and vegetables. They revealed that the growth rates in yield for fruits and vegetables in India were higher than in world. They emphasized the need to understand market requirement, consumer orientation in research and development of varieties and technology for the post-harvest and adequate infrastructural development to promote production and trade in fruits and vegetables.

Dhillon and Ali (2002) examined the productivity growth in the agricultural sector of Punjab. They revealed that the introduction of package of green revolution and its wide adoption changed the agricultural scenario of Punjab. Extensive use of modern inputs increased the production and productivity of paddy and wheat. However, there has been sharp decline in the area under soil protective crops like pulses and oilseeds largely due to adoption of high yielding varieties of paddy and wheat and rotation of these crops. They suggested that for sustainable development of agricultural production, the use of available resources should be reoriented and steps should be taken to transform agriculture from merely paddy-wheat production system to other crops like oilseeds, pulses and vegetables.

Basnet (2006) studied the agricultural development in Nepal and concluded that in livestock sector, 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, hen eggs 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, the researchers have shown that the farmers were maintaining productivity of food grain crops with more or less stable acreage crops. The future requirement for increasing population must come from yield rather than from area expansion. Thus, it was suggested to increase crop diversification toward vegetables, fruits and cash crops.

2.2 Changes in Socio-Economic Indicators of Agricultural Development

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.

Subramanian *et al.* (1983) analyzed the area under different crops in the four representative districts viz., Chengale, Pattue, Salem, Thanjavur and Madurai in Tamil Nadu and concluded that the relative productivity of crop variety and the rainfall were the factors responsible for changes in cropping pattern.

Balister and Singh (1988) compared the cropping patterns and farm structure for the year 1961-62 and 1983-84 to assess the impact of technological change in Agra district of Uttar Pradesh. The researcher observed that new technology tended to promote specialization of crop enterprises, thus increasing farm income increased over the period due to increased cropping intensity, changes in cropping pattern and increased use of modern inputs.

Jairath and Swarup (1991) concluded a study in Himachal Pradesh to determine the level of agricultural developments on the basis of selected indicators such as net area cultivated per farmer and area under HYVs of seeds. They observed that districts like Sirmaur and Kangra have benefited remarkably from HYVs and complementary agricultural inputs, while districts like Shimla and Kinnaur have made little progress in crop production. They suggested the need for more farmer oriented approach to technology transfer and innovation adoption in backward areas. They recommended improved credit, irrigation and cooperative services dealing with storage and marketing to enhance the pace of agricultural development.

Duraisamy (1992) conducted a study on effect of education and extension on agricultural production and found that education has a significant and positive effect on sole and multi-crop production systems. One year increase in education of the head of farm household increased the paddy output by one per cent and the gross sale value from all crops by 4 per cent. In monetary units one additional year of education yields the worker effect of Rs.109 and the allocative effect of Rs.257. The extension effect on the paddy output was about 6 per cent and gross value around 10 per cent. He suggested the need for educating the rural folk (men and women) by providing extension services at their door steps.

Mandar and Sharma (1995) studied the production performance of cereal crops in India through state wise analysis. They found that wheat production increased because of intensive and extensive utilization of land and input use. In the case of jowar except Maharashtra all other states registered negative growth rates indicating more profitable superior food crops have replaced this coarse cereal in those states. In the case of bajra, production had not changed significantly over study period except Punjab due to decline in area under this crop.

Moorti *et al.* (1996) studied the production constraints in hill agriculture with special reference to irrigation in Himachal Pradesh. They found that the marginal value productivities of irrigation water were higher as compared to other inputs. They revealed that irrigation acted as the main constraints in enhancing the production of major food crops, viz., paddy and wheat. They suggested that irrigation development should be given top priority in order to bring about a significant breakthrough in stagnant foodgrain production in Himachal Pradesh.

Singh and Singh (1999) studied the changes in pattern of land utilization and operational land holdings in Madhya Pradesh. They concluded that pattern of land utilization and land ownership of operational land holdings have a direct impact on distribution, accumulation and generation of wealth. They concluded that total reported area and land available for crop cultivation increased vis-a-vis total land not cultivated decreased. They also revealed that net irrigated area and irrigated area more than once recorded a poor growth during the study period. The average size of total area operated by total number of operational holdings came down from

4 ha to 2.63 ha. They suggested that land utilization programmes need an efficient and careful attention in coming years in order to achieve a sustainable goal in rural development.

Rupkumar (2001) studied regional disparities in agricultural development in Maharashtra and concluded that the land use pattern 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 during the same period. Technological changes in agriculture led to improvement in productivity of conventional forms of inputs after 1972.

Bhakta (2003) observed that the area under paddy cultivation in 1997-98 of Meghalaya was 105.1 thousand hectares and the production of paddy was 105.1 thousand tonnes. The per acre yield of paddy is quite low in the state. 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 and land under cultivable waste. The cropping pattern of the district dominated by cereals has been tilted towards commercial crops.

Semwal *et al.* (2004) analyzed the changes in spatial patterns of agricultural land use and crop diversity and dependence of agro ecosystems on forests, during the period of 1963-1993 in a small watershed in Central Himalaya India. Their study revealed that the increment of agricultural land by 30 per cent at the cost of high intensity of biomass removal from forest. They concluded that the continued depletion of forest resources would result in poor economic returns from agriculture to local people.

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 forests 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 to 32.67 per cent during the period of 32 years.

2.3 Infrastructural Development of Agriculture

Tewari and Sharma (1984) analyzed the determinants of investment pattern for different sizes of holdings and found higher cropping intensity on vegetable farms rather than cereal farms. Higher investment on modern inputs was also recorded only 36 per cent of the investment

on vegetable farms. Land was found to be an important asset for income besides irrigation and land reclamation works.

Diwakar (1988) studied the constraints in adoption of modern Agriculture technology in Meghalaya and reported that the infrastructural and organizational facilities are very much essential for adoption of modern technology in Meghalaya. Analysis of secondary data revealed that the transport facilities continue to be serious bottleneck for adoption of modern technology.

Anonymous (1993) studied the agricultural development and distribution of grains through inter-regional and intra-regional analysis in Uttar Pradesh. The average consumption of fertilizers in all the districts as well as regions of the state had increased positively since 1970-71 to 1990-91. Further, they concluded that the gains of agricultural development had not been shared equally as a consequence both regional and inter-regional inequalities had increased.

Narain *et al.* (1993) evaluated the economic development of different districts of Orissa State. For this study the district level data for the year 1990-91 on forty six different indicators depicting various facts of development of different sectors of economy were utilized. The study concluded that the agricultural and industrial developments were found to be mutually associated. The indicators like irrigation, fertilizers, foodgrains production, medical facilities, and decadal growth rate of population, literacy, banking facilities, etc., needed for improvement of varying magnitude.

Desai (1994) examined the contributions of institutional credit, self-finance and technological change all made better contributions to agricultural growth under land and labour augmenting new technologies of mid-1960s. He suggested that there must be synergy in policies for institutional credit, public investment and basic agricultural research. This would facilitate more rapid and broad based scale-neutral technological change which has a potential to provide more efficient complementarity between agricultural growth and equity.

Badal and Singh (2001) conducted a study on technological change in maize production. They observed that shift in production of HYV technology was due to change in slope as well as shift in the intercept, implying thereby the existence of neutral as well as non-neutral technological change. Technological change was attributed for 30 per cent of total yield increase in HYVs technology in kharif maize production. Therefore, by replacing local varieties of maize with HYVs of maize the farmers could increase their income by 30 per cent. They further stated that the development of maize based agro-industries would help realize better price of maize.

Anant (2002) studied the role of institutional reforms for agricultural growth. According to him, the most striking aspect of transformation has been in the production of foodgrains where a deficit prone country has been converted into a situation of plenty. This increase in production was made possible by expansion of irrigation, spread of new technology and addition to rural infrastructure like roads, market yards and warehouses. He outlined interconnection between the

three critical areas of markets, finance and infrastructure and suggested the change in education, social action and development of civil society to raise the standard of living of the populace.

Gill (2002) studied the role of institutional reforms in agricultural growth in India. He pointed out that favourable institutional arrangement would promote economic progress while unfavourable arrangements may act as a factor impeding economic development. He stressed the need to maintain a balance between efficient, optimum and equitable use of water along with its conservation to ensure sustainability of irrigation. He further suggested greater and firm support from the government in establishment of regulated markets and their vigorous regulation to protect the farming community. He also advocated the continuation of minimum support price and procurement mechanism for food security and development of agriculture.

Shreeranjana (2006) studied the problems of over dues in Meghalaya and concluded that the Meghalaya has been consistently showing poor recovery levels both in the priority sector as well as in other poverty alleviation programs. In fact, these advances have largely turned into chronic over dues and non-performing assets (NPA) of the banking industry requiring considerable sum of provisions to be made by the bank as per the Reserve Bank of India norms. Meanwhile, with almost all the over dues turning assets into loss during the last 5-7 years, the banks are not in position to open the credit channel at the grass root level. The state Co-op. Bank, SBI and the RRB have larger presence in the rural areas. These banks are finding it difficult to issue fresh credit as majority of the societies and the borrowers have become defaulters piling up huge over dues.

Kumar *et al.* (2007) studied the livestock sector in North Eastern Region in India and observed that the credit flow in North Eastern Hilly region was very low. The credit availability was Rs. 650/- per ha of net sown area, which was much lower than the national average of Rs. 3450/- per ha. The lack of institutional credit is a severe constraint to development of livestock as the flow of credit to livestock is even worse than that of agriculture.

Tiwari (2008) analyzed the role of infrastructure and agricultural development in Himachal Pradesh brings out an assessment of the progress made during 1981-2001 in Himachal Pradesh. In this paper, the two major components of development, viz. The agricultural and economic infrastructure sectors have been analyzed at district level in the State of Himachal Pradesh.

Rama Rao *et al.* (2008) studied the performance of agriculture in Andhra Pradesh and reveal that The credit supply for agriculture increased from Rs.2956 to Rs.14113 (at current prices) during the period 1995 to 2005 at a growth rate of 38 per cent in Andhra Pradesh. The absorption of credit in the resource poor district like Adilabad enhanced at a greater pace (45 %). In districts viz. Srikakulam, Visakhapatnam, Guntur and Rangareddy, the growth rate of credit flow was above 50 per cent. On a per ha basis, the highest credit flow was above Rs.20000 (in

2005) in West Godavari, Guntur and Nellore districts mainly on account of credit to aquaculture sector.

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

Souvik *et al.* (2010) studied that irrigation and agricultural sector performance in Orissa and their influence on economic development of the state. In spite of increase in irrigation potential over the years, food grain production in Orissa has showed slower growth; however, assured irrigation supply has increased paddy area during dry season by 60 per cent.

The studies on infrastructural development for agriculture have reported that the infrastructural and organizational facilities are essential for adoption of modern technology. The credit availability was very low and institutional credit was a severe constraint in the development of agriculture.

2.4 Factors Responsible for Agricultural Development

Rao (1968) in his pioneering work, "fluctuations in agricultural growth" stated that inputs like fertilizers and improved seed were used under the conditions of assured irrigation may promote growth with stability, but if used under the conditions of uncertain rainfall or in areas irrigated by tanks and wells may increase the range of fluctuations in outputs with growth.

Sagar (1978) studied the contribution of individual technological factors in agricultural growth of Rajasthan. In this case an attempt has been made to measure the contribution of three technological factors viz., high yielding varieties of seed, fertilizer and irrigation in the growth of agricultural productivity in Rajasthan during 1967 to 1974. He noted that wheat registered 40 per cent yield increase on account of above technological factors. On examination of their contribution, he observed that high yielding varieties contributed 26 per cent of the yield growth while the share of other two factors was 74 per cent. At the overall level, the share of the new varieties of seed was 15 per cent. The share of fertilizer and irrigation was 30 per cent and 18 per cent, respectively.

Naikwadi (1980) studied the development of agriculture in Sangli district of Maharashtra and concluded that the agricultural production influenced by 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.

Bhagat (1983) studied the inter regional disparities in agricultural infrastructure in Bihar. He found that Bihar plain regions were sufficiently endowed with the infrastructural facilities and hence using new agricultural practices also the level of agricultural productivity was also high, whereas these facilities were lacking very much in the Chotanagpur plateau region. Study

further revealed that availability of infrastructure indicates the farmers to go for widespread use of new agricultural practices leading to higher level of agricultural productivity.

Sarkar (1993) studied technology and agricultural development in tribal Bihar and investigated the level of adoption of new technology and constraints on the diffusion of new agricultural technology in tribal areas of Bihar state, India. New agricultural technology has not made an effective impact in the area. Diffusion of new technology was found to be lower in the upland zone than in the lowland area and relatively higher for wheat than other crops. Among the constraints identified were lack of assured irrigation, lack of capital, lack of awareness of the recommended packages of practice, high cost of HYV seeds and related inputs, lack of timely availability of HYV seeds and credits high risk, lack of HYV technology suited to rainfed condition; poor infrastructure and weak administrative arrangement.

Pariyar and Singh (1995) studied the farm mechanization in Nepal and argued the low level of mechanization was one of the factors responsible for the low productivity in agriculture. Higher production and increased employment could be achieved through selective mechanization. In view of the diminishing feed resources and low productivity of draught animals, the agricultural sector may face severe energy constraints in the future. The constraints can overcome in the terai plains by supplementing draught animals with other power sources.

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 1996. 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 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 state, 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 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.

Birthal *et al.* (2005) studied the vertical coordination in high value food commodities and reported that the high value agriculture requires more capital, improved technologies, quality inputs and better support service. Lack of access to these may constraint small diversification. Most high value commodities are perishable and need immediate transportation from production to consumption centers and markets. Rural markets for high value commodities are thin and marketed surplus of small holders is usually too small to economically trade in distant urban markets due to high transportation costs.

2.5 SWOT Analysis of Agricultural Development

Bindu *et al.* (2014) studied SWOT analysis of Dairy Industry in India and concluded that, technically skilled labours and investment in manufacturing of finished dairy products are strength and opportunities of dairy industry whereas bad road and inadequate transportation facility and high price sensitivity of dairy products are weakness and threats of dairy industry in India.

Nandanwar (2015) studied SWOT analysis of Amravati district of Maharashtra and concluded that, production of Nagpuri oranges, agrarian economy with cotton, soybean and red gram as major crop and fairly rich forest resources are some of the strength of the district. Lack of food and fruit processing facilities, poor and inadequate irrigation facilities and crisis of farmer's suicide are major weakness of the district. Development of Agro-tourism, high-tech agriculture and rejuvenation of milk product societies are opportunities for the development of district in future.

Anonymous (2003) studied and analyzed the strength, weaknesses, opportunities and threats of production, processing and marketing of cashew and cashew products and other fruit production, processing and marketing.

Anonymous (2004) studied Identification of sustainability issues using participatory SWOT analysis: A case study of egg production in the Netherland. Study concluded that combination of a brainstorming session and SWOT analysis with a heterogeneous group of stakeholders constitute a useful tool to order, structuring these listed aspects and to identify relevant issues for sustainable development.

Shreshta *et al.* (2004) studied Exploring the potential for silvipasture in south central Florida: an application of SWOT-AHP method and results revealed that, strength and opportunities for silvipasture adoption outweigh its weakness and threats.

Chavan and Sharma (2007) carried out SWOT analysis of Indian Agro forestry and they pointed out that basis of traditional knowledge, broad range of goods and services offering by technology such as soil fertility improvement, enhancement of biodiversity, timber production are strengths of Indian Agro forestry and lack of focused research and development, generalization of recommendations, lack of proper marketing channels for agro forestry produce are weaknesses of Indian Agro forestry.

Anonymous (2010) studied SWOT analysis of Hazard Analysis Critical Control Point (HACCP), study reveals that promoting good hygienic practices and HACCP principles where appropriate, are important components to ensure that food chain. It highlighted internal Strength and Weakness as well as the external Opportunities and Threats, the government is facing towards implementation of HACCP system.

Chen *et al.* (2011) studied SWOT analysis of agriculture producer in the supply chain of Chinese Agro-products and concluded that the opportunities of producer in supply chain of agricultural product are analyzed from the aspect of laws, policies, capitals and technologies.

Bindu *et al.* (2014) studied SWOT analysis of Dairy Industry in India and concluded that, technically skilled labours and investment in manufacturing of finished dairy products are strength and opportunities of dairy industry whereas bad road and inadequate transportation facility and high price sensitivity of dairy products are weakness and threats of dairy industry in India.

Kiran and Shastry (2014) studied SWOT analysis of Andhra Pradesh state seed Development Corporation (APSSDC) to evaluate the performance of APSSDC through SWOT analysis and to develop a strategy for effective functioning of organization.

To sum up above reviews, it appears that both the institutional and technological factors are responsible for agricultural growth. The technological factors are inclusive of technical skills, research, education and use of modern techniques while institutional factors include conditions that are useful for creating suitable infrastructure for development of agriculture. The availability of crucial inputs is the major component of this aspect which has significant influence in improving farm productivity. The major problems of agricultural development in Beed district are dominance of traditional production technology under rain fed condition, drought, low rainfall, inputs, credit and marketing. Therefore, strategies for agricultural development should include improved agricultural practices.

3. METHODOLOGY

This chapter deals with the plan of investigation and sources 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 sampling design, sources of data and method of data collection and techniques of analysis adopted to accomplish each of the objectives defined in the present study.

3.1 Basic Approach of the Study

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

Specifically, the present study attempts to analyze the changes in land use and cropping pattern for thirty years starting from 1990-91 to 2015-16 for knowing the trend of farmers in resource allocation and product mix as a result of agricultural development in Beed districts. The changes are measured by estimating proportions to the respective totals for different selected points of times i.e. The impact of new technology on agricultural production has been assessed by estimating compound growth rates in area, production and productivity of major crops grown in Beed district for three different periods viz., Period-I (1990-91 to 2002-03), Period-II (2003-04 to 2015-16), and period-III (entire period 1990-91 to 2015-16). This became useful to compare the growth rates of the selected crops for the above said periods and for knowing their performance in Beed district.

An attempt is also made to identify the factors influencing agricultural production by way of multiple regression analysis. This is done by considering total agricultural production of Beed district in monetary terms as a dependent variable and the factors such as Percentage of gross irrigated area to gross cropped area (X1), consumption of total fertilizer (NPK) per hectare in kilogram(X2), percentage of gross cropped area to net cropped area (X3), percentage of area under commercial crops to gross cropped area (X4), amount of loan (short term) disbursed

through DCCB per year in lakhs rupees (X5), total annual rain fall (mm) in the Beed district (X6), Total area under fruits crops (00' ha) (X7) and Total milk production in 00'Mts (X8) as an independent variables. The research procedure adopted for studying the above aspects of the study has been explained in the discussion below.

3.2 Data Requirement and Sources of Data

The present study is based on secondary data collected from various agencies viz., Published statistical literature and by contacting officials of the Zilla Parishad, Cooperative and districts statistical office, Pune central building, Pune and Season and crop reports Published by Directorate of Agriculture, Maharashtra state, Pune. Some other reports viz., Statistical Abstract of Maharashtra, Socio-Economic Review and District Statistical Abstract of Pune were also scanned for getting relevant information and various websites of Beed district and Maharashtra Government. The data requirements of this study were on land use and cropping pattern, area, production and productivity of major crops, livestock population and livestock production, fertilizers and HYV's seeds distributed, credit advanced through district cooperative bank for accounting period 1990-91 to 2015-16.

The data relating to above mentioned aspects were collected from Directorate of Economics and Statistics, Government of Maharashtra State., Department of Agriculture Beed district and various websites of Beed district and Government of Maharashtra.

3.3 Method of Analysis

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

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

The data obtained on area, production and productivity of major crops viz., cereals, pulses, oilseeds and cash crops for the period from 1990-91 to 2015-16 in respect of Beed district were used for estimation of compound growth rates. The data were computerized to have compound growth rates of area, production and productivity of the above said crops for three different periods viz. Period-I (1990-91 to 2002-03), Period-II (2002-3 to 2015-16), and Period-III (1990-91 to 2015-16). This became useful for studying the changes in the performance of the selected crops during the above periods in Beed district.

I. 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 00' hectares, production in 00' tonnes and yield in quintals per hectare

a = Intercept

b_i 's = Regression coefficient

t = Time period in year

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

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

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

3.3.2 Factors influencing agricultural production in Beed district

The information regarding total agricultural production, percentage of gross irrigated area to gross cropped area, consumption of total fertilizer (NPK), percentage of gross cropped area to net cropped area, percentage area under commercial crop to gross cropped area, amount of loan (short term) disbursed through DCCB, total annual rainfall, total area under fruits crops and total milch animal in the district during the Period i.e. 1990-91 to 2015-16 was 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.

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

Where,

- Y = Total agricultural production (foodgrain + non-foodgrain) in crores rupees of Beed district (Rs.in thousands)
- A = Intercept
- b_i 's = Regression coefficients
- X1 = Percentage of gross irrigated area to gross cropped area.
- X2 = Consumption of total fertilizer (NPK) (in metric ton)
- X3 = Percentage of gross cropped area to net cropped area
- X4 = Percentage of area under commercial crops to gross cropped area
- X5 = Amount of loan (short term) disbursed through DCCB per year (Rs.in crores)
- X6 = total annual rain fall of the Beed district (mm)
- X7 = Area under fruits crops (00' ha.)
- X8 = Total milch animal (in number).
- U_t = Error term

Dependent variable

Total agricultural production in Beed district (Y): The total agricultural production obtained from food grain and non food grain crops in Beed district during the period 1990-91 to 2015-16 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 cropped area (X1)
The percentage of gross irrigated area to gross cropped 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 cropped area would boost the agricultural output of the district.
2. Consumption of total fertilizer (NPK) in total gross cropped area (in metric ton) (X2)
This variable was constructed in order to know the effects of fertilizer use on aggregate crop output.
3. Percentage of gross cropped area to net cropped area (X3)
It was expected that the increase in percentage of gross cropped area to net cropped area would have a positive effect on farm output of the district and therefore this variable was considered.
4. Percentage of area under commercial crops to gross cropped area (X4)
5. Amount of loan (short term) disbursed through DCCB per year in lakhs rupees (X5).
Disbursement of short term loan has positive impact on increasing the agricultural production.
6. Total annual rainfall in mm in Beed district (X6).The data available on annual average rainfall in the districts were used to develop this variable. The purpose was to examine the effect of total annual rainfall on aggregate farm output in the districts.
7. Total area under fruits and vegetables crops (00' ha) (X7).
8. Total milch animal (numbers)

The usual statistical procedure was adopted for testing the significance of the estimates of parameters.

4. SALIENT FEATURES OF THE STUDY AREA

4.1 Geographical Features

4.1.1 Location

Beed district lying between 18⁰.28' and 19⁰.28' North latitude and 74⁰.54' and 76⁰.57' East longitude is situated partly in the upper Godavari basin.

The district is bounded on the North by Aurangabad and Jalana district, on the East by Parbhani and Latur districts, on the South by Osmanabad and Ahmednagar districts. It consists of 11 tahsils, 11 towns and 6 Nagar Parishads, 11 Panchayat Samitti and 1 Nagarpanchayat, There are 1360 villages and 1020 Gram Panchyats according to 2011 census.

4.1.2 Administrative set-up

Until recently, the district was in Aurangabad Division, however now it is included in Aurangabad Revenue Division newly formed since February 1981. For Administrative purpose the district is divided in to five sub divisions, which cover 11 tahsils in the district as detailed below.

Administrative set up

Sr. No.	Name of sub division	Name of tahsil
1.	Beed	(1) Beed (2) Gevrai
2.	Majalgaon	(1) Majalgaon (2) Vadavani (3) Dharur
3.	Ambajogai	(1) Ambajogai (2) Kej
4.	Parali	(1) Parali
5.	Patoda	(1) Patoda (2) Aashti (3) Shirurkasar

4.2 Topography

4.2.1 Soil

The soils of the district are essentially derived from Deccan trap which is predominant, rock formation of district. The main factor that has influenced the development of soil is undulating and hilly topography of district. The soils of the district can be broadly grouped in to three kinds.

1. Shallow black soils,
2. Moderately deep black soils,
3. Medium black deep soils and deep black soils.

4.2.2 Rivers

Three main rivers of district are Godavari, Manjra and Sina. The Godavari flows along the northern district boundary in deep bed with high banks. Low land Beed consists of the Godavari valley proper or the Gangthadi on the North. The soil in this region is deep and extremely fertile. Jowar, wheat, cotton tur, gram, maize are main crops grown. The main tributaries of Godavari within the district are Lendi, Bindusara, Sindhafana, Saraswati and Wan.

The Manjra rises in Northern edge of the Balaghat plateau, a little above Gaurwadi near Manjarsumbha. The river flows in a general south eastern direction and flows in a deep bed with high banks and hence the river is not easily available for irrigation. Except for the Inchana and the Wan, all the streams of the plateau drain in to Manjra. The Sina raises North of Ahmednagar and flows in South-East direction. It forms a part of the South-West district boundary with Ahmednagar district the and third region comprises practically the whole of Ashati tahsil and forms the Sina basin portion of Beed district.

4.2.3 Hill ranges

Physiographically, the district is broadly divisible in to the three divisions, viz; the low-lying northern division or low land Beed, the higher part in the South forming part of Balaghat plateau or highland Beed and third low-lying undulating area South-Westland west of highland Beed. It comprising almost of whole of Ashtitahsil laying mostly in Sina basin.

4.2.4 Climate

Climate of the district is dry except during the South-West monsoon season. The average annual rainfall in the district is 750mm. The rainfall increases as one proceeds from West to East, it varies from 665.3mm at Ashti near western border of the district to 850.6mm at Ambejogai near the eastern broder. About 80 per cent of total annual rainfall is received during the South-West mansoon. The maximum average temperature in district is 37⁰c. December is the coldest months of the year with mean daily minimum temperature at about 12⁰c and from March onwards temperature being to increase rapidly. May is the hottest month of the year with mean daily maximum temperature at about 42⁰c.

4.3 Area and demography

The district has an area of 11169 square k.m which consist of 3.48 percent of total area of the State. According to 2011 census population of the district is 2585962 out of which 1352491 are males and 1233471 are females. The density of population is 202 persons per square k.m. The sex ratio is 916 females per 1000 males. Out of total population 17.73 lakh i.e., 82.10 percent population in rural area as against 3.86 lakh i.e., 17.90 percentage of urban. Literacy of district is 68.48 per cent. There are 64 literate females per 100 males according to 2011 census. Rural literacy is 67 per cent out of which 78.76 per cent are males and 51.82 per cent females.

4.4 Agriculture

4.4.1 Land use pattern

The land use pattern of the Beed district in the year 2015-16 is presented in Table 4.1

Table 4.1 Land use pattern of Beed district in (2015-16)

Sr. No	Particulars	Area (00ha)	Percentage to the total
1	Total geographical area	10686	100
2	Area under forest	228	2.13
3	Barren and uncultivable land	233	2.18
4	Land under non agril.use	370	3.46
5	Permanent pastures and grazing land	304	2.84
6	Area under miscellaneous trees	13	0.12
7	Cultivable waste	369	3.45
8	Other fallow land	412	3.86
9	Current fallow	938	8.78
10	Net sown area	7819	73.17
11	Irrigated Area	1333	12.47
12	Area sown more than once	2589	24.22
13	Gross cropped area	10408	97.39
14	Intensity of cropping (%)		133.1

Source: Directorate of Economics and Statistics, Govt. of Maharashtra, Mumbai, 2016

Total geographical area of district is 1068600 hectare; the net cropped area for the year 2015-16 was 781900 hectares which formed 73.17 per cent of the total geographical area. The area covered by forests was 2.13 per cent. The gross cropped area was 1040800 hectares with the cropping intensity 133.1.

The area under forest was 22800 hectares and 2.13 per cent to the total geographical area. The area under non agriculture use was 37000 ha. The area under cultivable waste, other fallow land and current fallow were 36900, 41200 and 93800 hectares, respectively during the year 2015-16. The area sown more than once was 258900 hectares, which contributes 24.22 per cent to the total geographical area.

4.4.2 Cropping pattern

The details of cropping pattern of Beed district for the 2015-16 is given in Table 4.2.

The cropping pattern it is seen that, the gross cropped area of district was 1040800 hectares for the year 2015-16. The proportion of area occupied by cereals as 47.50 per cent while that of pulses was only 16.41 per cent. Thus, food grain crop have predominance in the cropping pattern of Beed district, since these crops alone account for 37.31 per cent of the total cropped area. The Cotton (32.10 per cent) and sugarcane (3.46 per cent) are the two important commercial crops grown in district. The area under these crops was 334100 and 36100 hectares respectively. Total oilseed crop contributes about 17.05 per cent area. The area under fruit crop was 5300.ha.The area under fruit crop has increased.

Table 4.2 Cropping pattern of Beed district (2015-16)

Sr. No.	Crop	Area ('00')	Percentage to the gross cropped area
1	Paddy	3	0.02
2	Wheat	480	4.61
3	Jowar	3012	28.93
4	Bajara	1276	12.25
5	Maize	172	1.62
6	Total cereals	4953	47.5
7	Gram	706	6.78
8	Red Gram	723	6.94
9	Green Gram	66	6.3
10	Black gram	203	1.95
11	Total pulses	1708	16.41
12	Total foodgrain	6661	63.99
13	Groundnut	175	1.68
14	Sunflower	21	0.20
15	Sesamum	32	0.3
16	Linseed	7	0.06
17	Safflower	21	0.20
18	Soybean	1451	13.94
19	Total oilseed	1775	17.05
20	Sugarcane	361	3.46
21	Cotton	3341	32.10
22	Fruit crop	53	0.50
23	Vegetable crop	75	0.72
	Gross Cropped Area	10408	100

Source: Directorate of Economics and Statistics, Govt. of Maharashtra, Mumbai, 2016

4.4.3 Animal Husbandry

The main purpose of cattle in the district is for draft and milch purpose. Seasonally migratory agriculture labourers require indigenous bullocks for carrying sugarcane from field to factory.

The total cattle was 582080. There were 240284 Buffaloes. Total livestock in Beed district was 12383224. The number of sheep and goats were 66211 and 336223 respectively. In livestock population, the cattle and buffaloes were 47.00 per cent and 19.00 per cent, respectively. The sheep's, goats, and others were 11.58, 27.15 and 5.34, respectively.

Table 4.3 Livestock population in Beed district, (2015-16)

Sr. No.	Particulars	Numbers	Percentage to total livestock population
1	Cattle	582080	47.01
2	Buffaloes	240284	19.42
3	Goat	336223	27.15
4	Sheep	66211	5.35
5	Other	18000	1.45
6	Total livestock	1238324	100.00
7	Poultry	9797575	

Source: Directorate of Economics and Statistics, Govt. of Maharashtra, Mumbai, 2016

4.4.4 Irrigation

Irrigation is the most important input in the agriculture. A significant change in cropping pattern could be brought with the help of adequate irrigation facilities. The economic progress of the district is indirectly and inseparably related to the management of its scarce water resources. About 30 per cent of the cultivable area is under irrigation and rest 70 per cent is dependent on rainfall. The surface irrigation account for approximately 69.17 per cent of the total irrigated area while the second main source of is well irrigation, Source-wise irrigated area during 2015-16 is given in Table 4.4.

Table 4.4 Source wise irrigation area in Beed district, (2015-16)

		(Area in '000'ha)
Sr. No.	Particular	2015-16
1	Surface irrigation other than Wells	92
2	Well irrigation	40
3	Net area irrigation	133

Source: Directorate of Economics and Statistics, Govt. of Maharashtra, Mumbai, 2016

4.4.5 Agricultural Machinery

It seems that the cultivators in the district are enthusiastic about the use of modern machinery and implements. The number of oil engines and electric motors for irrigation was 2900 and 41512, respectively. According to 2015-16 the number of bullock carts were 41323 and number of tractors were 1683. There are 40,942 plough which included 9655 wooden plough and 31287 iron ploughs.

Table 4.5 Uses of implement and machineries of Beed district, for the year (2015-16)

Sr. No.	Items	2015-16
1	Wooden plough	9655
2	Iron plough	31287
3	Bullock carts	41323
4	Oil engines	2900
5	Electric motor	41512
6	Tractor	1683

Source: Socio-Economic survey of Beed district 2016

4.5 Infrastructural Facilities

4.5.1 Markets

There are total 9 Agricultural Produce Market Committees formed for better functions. Marketing centers, development of markets and marketing facilities help the agriculture business in two ways. Firstly in easy purchase of production inputs such as seeds, fertilizer, insecticides and pesticides, fungicides and also other pulses needed in the production process and secondly

by easy disposal of agriculture surplus regulated by Marketing committee. In Beed district there are small markets at each tehsil.

4.5.2 Banking

There were 17 bank offices of different bank in Beed district during 1960-61. This numbers has increased to more than 750 at the end of 2012. Commercial banks are leading in the district. The progress of Co- operative bank in financing agriculture is commendable in district.

4.5.3 Transport and communication

It is an important infrastructural facility in the development of any region. These facilities are conducive to the development of agriculture since the surpluses of agriculture could be moved easily from one place to other where demand exists. It was found that the total road length was 13129 km. National highway and state highway roads length was 191.35 km and 1638.10 km in districts, the railway route was 47.86 km since 2016. The communication facilities are provided through telephone, mobiles and the network of post office in district.

4.5.4 Education and health

The literacy percentage of the district is only 68.23 per cent. Due to seasonally migration of laborers' to the sugar factory area in Western Maharashtra, their children are also with them. Because of this half semester of the children are in sugar factory locality. They live outside the locality at least for six months as a result of which number of children leaves the school at primary level.

The medical facilities in the district are expanding day by day. Swami Ramanand Tirth Hospital provides better facilities to rural people at Ambejogai which is a Government's hospital. Now in district, there are 14 hospitals, 47 primary health centre and many private clinics.

4.5.5 Electricity

The programme of massive electrification of rural area and thereby to provide electricity for electric pumps, co-operative irrigation lifts, etc aimed at agriculture development has undertaken in the district since 1960-61. In all 1269 villages are electrified in district as March 1999. Electricity supply is provided to the 85000 agricultural pumps.

4.5.6 Irrigation projects

There are 2 big irrigation projects viz., Manjara and Majalagaon and also medium 10 and small 84 projects in the district which provides irrigation to 15200 hectares area.

5. RESULTS AND DISCUSSION

The first major direct effect of the green revolution has been a sharp rise in foodgrain production. Adoption of new modern technology caused a shift from traditional agriculture to modern agriculture, subsistence to commercial, extensive cultivation to intensive cultivation and from low income giving enterprises to high income giving enterprises. The performance of agriculture in Beed district during the period of 26 years beginning from 1990-91 was mixed type among different regions and crops as well. The growth in output of some crops was contributed by area expansion; whereas for other crops, improvement in yield levels was the major factor contributing to production increase. For some crops, both area expansion and yield improvement were the major sources of production increase. There have been few other crops in which case the performance was quite unsatisfactory. In the light of this mixed type of crop performance over the time period, it becomes imperative on the part of researchers to probe in detail into the pattern of area allocations as well as production and productivity differences of various crops during the different time periods.

This chapter attempts to analyze the changes in area allocations of major crops, also pattern of production and productivity differences during the different time periods in the Beed district. The empirical evidences relating to changes in performance of major crops has been derived from the periods of 1990-91, 2000-01 and 2015-16. The data on the above aspects were collected and analyzed for twenty six years starting from 1990-91 to 2015-16 of Beed district and results so obtained are explained as below.

5.1 Annual Compound Growth Rates

The period wise compound growth rates in area, production and productivity of cereals, pulses, oilseeds and cash crops for the period 1990-91 to 2015-16 are presented in Table 5.1.

The cropwise detailed growth rates are explained below

5.1.1 Growth rates of area, production and productivity of cereals

Among the cereals, the area under *rabi* jowar, bajara and total cereals was decreased by 0.09, 1.88 and 1.81 per cent per annum, respectively for the overall period (1990-91 to 2015-16). Whereas, the area under maize and wheat was increased to tune of 6.10 and 3.95 per cent per annum, respectively during overall period. At the overall period the production of *rabi* jowar and total cereals was declined. The production of maize and wheat was increased by 2.63 and 3.32 per cent per annum, respectively due to area expansion.

The performance of area in second period and productivity in first period was quite satisfactory. It is interesting note that the productivity of all cereals was negative in second period (2003-04 to 2015-16). It may be due to erratic and inadequate rainfall in Beed district during second period.

5.1.2 Growth rates of area, production and productivity of pulses

Among the pulses area under gram, red gram, black gram and total pulses was increased to the tune of 6.02, 0.63, 3.14 and 0.62 per cent per annum, respectively for the overall period. Whereas area under green gram declined by 8.35 per cent per annum.

The production of gram, red gram and total pulses was increased by 7.10, 1.95 and 1.99 per cent per annum, respectively due to both by area expansion and productivity improvement. The production of pulses was quite satisfactory in period I as compared to period II. The production of food grains was declined by 1.17 per cent per annum for the overall period. The production of total food grains was declined to the tune of 1.17 per cent per annum for the overall period by both declined in area and productivity.

The area, production and productivity of total food grains was declined in period II. Whereas the production of total food grains was increased by 1.70 per cent per annum due to only productivity improvement by 2.38 per cent per annum in period I.

5.1.3 Growth rates of area, production and productivity of oilseeds

Among the oilseeds the area under all the oilseeds namely 'viz' groundnut, sunflower, safflower, sesamum, soybean and total oilseeds has been declined except soybean for the overall period. The production of groundnut, sunflower, safflower and sesamum has been declined by 3.84, 14.1, 10.5 and 9.16 per cent per annum, respectively due to both declined in area and productivity for the overall period. However, the production of soybean have increased by 23.9 per cent per annum due to area expansion by 26.5 per cent per annum.

The performance of area, production and productivity of all oilseed except soybean was quite fluctuating in period I and II.

At the overall period the production of total oilseeds have been increased by 0.68 per cent per annum and it was mainly due to productivity improvement by 1.53 per cent per annum. The performance of area, production and productivity of total oilseeds was quite satisfactory in period II (2003-04 to 2015-16) as compare to period I (1990-91 to 2015-16).

5.1.4 Growth rates of area, production and productivity of cash crops

The sugarcane and cotton are the two important cash crops grown in district. Among the cash crops the production of sugarcane was increased by 3.85 per cent per annum for the overall period. Whereas the production of cotton was increased to tune of 11.08 per cent per annum by both area expansion and productivity improvement.

The productivity of sugarcane and cotton has been declined at higher rates during period II as compare to period I.

From the forgoing the discussion it is concluded that the area under total cereals, total foodgrains and total oilseeds has been declined. Whereas the area under pulses, sugarcane and cotton has been significantly increased. It indicates that there a is crop diversification in Beed

district. The farmer are diverted from foodgrain crops to non foodgrain crops to earn more profit from farming.

Table 5.1 Compound growth rates of major crops

Sr. No.	Crop	Period I			Period II			Overall period		
		1990-91 to 2002-03			2003-04 to 2015-16			1990-91 to 2015-16		
		A	P	Y	A	P	Y	A	P	Y
A.	Cereals									
1	R. Jawar	1.24	0.57	-0.66	-0.71	-2.99	-2.29	-0.09	-0.64	-0.55
2	Bajara	0.48	2.65	2.00	-4.33***	-6.58	-2.34	-1.88***	-1.74	0.10
3	Maize	-0.57	2.68	3.16	8.97	4.00	-4.56	6.10***	2.63*	-2.39
4	Wheat	6.33*	8.32*	1.46	2.51	-0.70	-3.14	3.95**	3.32*	-0.62
5	Total cereals	0.06	0.73	0.65	-3.35	-6.22	-2.98	-1.81**	-2.45**	-0.65
B	Pulses									
1	Gram	3.95**	5.03	1.09	7.63***	5.47	-2.01	6.02***	7.10***	0.80
2	Red Gram	0.84	1.56	1.34	2.67**	-3.64	-6.18	0.63**	1.95	0.96
3	Black Gram	7.93**	8.60*	0.62	6.69*	-7.55	-13.4**	3.14***	2.98	-0.16
4	Green Gram	-4.59	-5.92	-1.39	-6.09*	-16.3***	-10.85**	-8.35***	-7.44***	0.01
5	Total Pulses	-1.28**	0.73	1.61	3.35**	-1.71	-4.66	0.62*	1.99*	1.36
6	Total Foodgrain	-0.17	1.70	2.38	-0.19	-3.93	-3.76	-0.78**	-1.17	-0.14
C	Oilseeds									
1	Groundnut	-4.59*	-2.67	1.42	0.40	-7.87*	-8.24	-2.99***	-3.84*	-0.89
2	Sunflower	-8.86**	-9.98**	-2.51*	-24.0***	-31.6***	-10.0**	-11.5***	-14.1***	-3.297*
3	Safflower	1.21	2.17	0.90NS	-22.0***	-24.5***	-3.13	-10.1***	-10.5***	-0.47
4	Sesamum	-3.98***	-4.49	-1.15	-8.65***	-11.82***	-3.47	-6.77***	-9.16***	-2.01*
5	Soybean	16.9*	20.4**	2.96	12.3***	9.46	-2.60	26.5***	23.9***	-2.02
6	Total oilseeds	-4.20***	-3.61	0.60	1.59	1.60	0.12	-0.79*	0.68	1.53
D	Cash crops									
1	Sugarcane	7.82**	6.68**	-1.08	5.46	1.81	-4.13	5.73***	3.85**	-1.71**
2	Cotton	10.2***	11.2***	0.88	12.4***	7.42	-4.64	9.75***	11.08***	1.21

***, **, * Significance at 1, 5 and 10 per cent level of significance. Area in 00' ha, production in 00'tones, yield kg ha⁻¹.

Area in 00 ha, production in 00 tonnes, yield kg ha⁻¹. Sugarcane: production in 00'tonnes, yield in tonnes ha⁻¹. Cotton: Production in 00' bales and yields in kg lint.

5.2 Changes in Socio-Economic Indicators of Agricultural Development

5.2.1 Changes in the land use pattern

The discussion relates to land use pattern of Beed district presented in the preceding chapter has revealed that, area under utilization remaining same, there have been marked changes in the area allocations for different land use categories during the period under consideration. From the agricultural point of view, these changes are of significant importance since the it is the production base of agriculture and its sustainability are depends upon determinants such as cultivated area, land use intensity and the proportion of cropped area under irrigation. The information given in Table 5.2 relates to the net sown area, area sown more than once and gross cropped area seems to be of greater use to assess the changes in the land dependent production base of agriculture in Beed district over period of time. The area under forest was 21600 hectares i.e. 2.02 per cent of total geographical area in the year 1990-91 which was increased to 22800 hectares i.e. 2.13 per cent in the year 2015-2016. It means that area under

forest increased and showed significant change during study period. Barren and uncultivable land also increased from 1.36 per cent to 2.18 per cent. Land under non-agriculture was decreased from 42000 hectares to 37000 hectares during the period from the year 1990-91 to 2015-16. It may be used for buildings, industry and other non-agriculture purposes. There is variation in the cultivable waste land. It was 27500 hectares in the year 1990-91 which increased to 36900 hectares in the year 2015-16. The area under permanent pastures and land under miscellaneous trees decreased over the period of time. Both of it was decreased from the year 1990-91 to the year 2015-16. This fact revealed that, the area under pasture and grazing land may be utilized for bringing under plough on account of the increasing pressure of population on cultivated land.

Table 5.2 Changes in land use pattern in Beed district

(Area '00' ha)

Sr. No	Particulars	Years			Percent change of land use pattern over base year 1990-91	
		1990-91	2000-01	2015-16	2000-01	2015-16
1	Total geographical area	10686 (100)	10686 (100)	10686 (100)	100	100
2	Area under forest	216 (2.02)	225 (2.10)	228 (2.13)	4.16	5.55
3	Barren and uncultivable land	146 (1.36)	185 (1.73)	233 (2.18)	26.71	59.58
4	Land under non agric. use	420 (3.93)	390 (3.64)	370 (3.46)	-7.14	-11.90
5	Permanent pastures and grazing land	358 (3.35)	320 (2.99)	304 (2.84)	-10.61	-15.08
6	Area under miscellaneous trees	35 (0.32)	21 (0.19)	13 (0.12)	-40	-62.85
7	Cultivable waste	275 (2.57)	300 (2.80)	369 (3.45)	9.09	34.18
8	Other fallow land	375 (3.50)	390 (3.64)	412 (3.85)	4.00	9.86
9	Current fallow	470 (4.39)	678 (6.34)	904 (8.45)	44.25	92.34
10	Net sown area	6059 (57.7)	7138 (66.6)	7819 (73.17)	17.80	29.04
11	Irrigated Area	1915 (17.19)	1737 (15.20)	1333 (12.47)	-9.29	-30.39
12	Area sown more than once	1640 (15.34)	2115 (19.79)	2589 (24.22)	28.96	57.86
13	Gross cropped area	7699 (72.04)	9253 (86.58)	10408 (97.39)	20.18	35.18
14	Intensity of cropping (%)	127.06	129.63	133.1	2.022	4.75

(Figure in parenthesis indicates percentage to geographical area)

Source : Directorate of Economics and Statistics, Govt. of Maharashtra

The current fallow land was 47000 hectares i.e. 4.39 per cent of the total geographical area in the year 1990-91 which suddenly increased to 67800 hectares in the year 2000-01 and again increased to 90400 hectares in the year 2015-16 i.e. 8.45 per cent of total geographical area. It may be due to the fluctuations and erratic rainfall in Beed district during last 15-20 years. The other fallow land showed increasing trends up to 2015-16 which increased from 37500 hectares in 1990-91 to 41200 hectares in the year 2015-16. The net sown area was 605900 hectares i.e. 57.7 per cent of total geographical area in the year 1990-91 which has significantly increased in second and third periods. It was 713800 hectares in the year 2000-01 further increased to 781900 hectares in 2015-16. The percentage of net sown area to the total geographical area was 73.17 per cent in 2015-16.

The irrigated area was decreased tremendously during entire period from 1990-91 to 2015-16. In 1990-91, irrigated area was 191500 hectares. Due to less rainfall and utilizing cultivable waste land for cultivation purpose the proportion of dry area to irrigated area was increased. It could also be seen from the table 5.3 that area sown more than once increased from 164000 hectares to 258900 hectares in 2015-16. The area sown more than once has increased by 57.86 percentages in 2015-16 over base year 1990-91. The gross cropped area slightly increased from 72.04 to 97.39 per cent of geographical area. It is highest in 2015-16 i.e. 1040800 hectares, 97.39 percent the total geographical area. It was increased significantly and is a good indication of agriculture development. The intensity of cropping which is measure of land use efficiency did not show much change during the period from 1990-91 to 2015-16. The range of cropping intensity was 127.06 to 133.1 per cent. It was decreased during the period 1990-91.

5.2.2 Changes in irrigated area

The changes in irrigated area of Beed district during the period 1990-91 to 2015-16 are presented in Table 5.3.

It is seen that the net area irrigated in 1990-91 was 191500 hectares which was decreased to 133300 hectares in 2015-16. The percentage of net irrigated area to net sown area was 31.60 per cent in 1990-91 which decreased to 45.98 per cent in 2015-16, over the base year 1990-91. The percentage of gross irrigated area to gross cropped area was 26.02 per cent in 1990-91, which decreased to 43.50 per cent. This table reveals that the area under irrigation has decreased to a large extent which is a bad sign from the view point of agricultural development in Beed district.

Table 5.3 Changes in irrigated area

(Area in '00' ha)

Sr. No.	Particulars	1990-91	2000-01	2015-16	Percent change over base year	
					2000-01	2015-16
1	Net area sown	6059	7118	7819	17.47	29.04
2	Net irrigated area	1915	1737	1333	-9.29	-30.39
3	Percent of net irrigated area to net sown area	31.60	24.19	17.07	-26.36	-45.98
4	Gross cropped area	7699	9253	10408	20.18	35.18
5	Gross irrigated area	2004	3049	1534	52.14	-23.45
6	Percent of gross irrigated area to gross cropped area	26.02	32.95	14.71	26.63	-43.50

Source: Season and Crop Reports Agricultural Department, Maharashtra state, Beed. Year (1990-91, 2000-01, 2015-16).

5.2.3 Changes in irrigated area by various sources

Table 5.4 present trend in the area irrigated by various sources during the period from 1990-91 to 2015-16. It can observed from the Table. 5.4. that the main source of irrigation was through well covering 108500hectare of land i.e. about 56.67 per cent of the net irrigated area in the year 1990-91. However, the proportion of the net irrigated area through wells decreased from 56.67 per cent to 30.38 per cent during the period from 1990-91 to 2015-16.

Table 5.4 Changes in irrigated area by various sources

(Area in '00' ha)

Sr. No.	Particulars	1990-91	2000-01	2015-16	Percent changes over base year	
					2000-01	2015-16
1	Surface irrigation other than well	830 (43.34)	899 (51.76)	928 (69.62)	8.33	11.85
2	Wells irrigation	1085 (56.66)	838 (48.24)	405 (30.38)	-22.78	-66.67
3	Net area irrigated	1915 (100)	1737 (100)	1333 (100)	-9.30	-30.38

Source:-Directorate of Economics and Statistics, Govt. of Maharashtra, Mumbai. (1990-91, 2000-01, 2015-16)

The area irrigated by surface irrigation other than wells increased significantly from 43.34 per cent to 69.62 per cent during 1990-91 to 2015-16. It is noted that irrigation lifts installed on the Manjara and Majalgaon irrigation projects and Godavari river are important source of irrigation next to wells in Beed district.

5.2.4 Changes in the cropping pattern

The details regarding the changes in the cropping pattern of foodgrain and non-foodgrain crops during the period 1990-91 to 2015-16 in Beed district are presented in Table 5.5 respectively.

Table 5.5 Changes in area under major crops at different points of time

Sr. No.	Crop	Area '00' ha			Percent change over base year	
		1990-91	2000-01	2015-16	2000-01	2015-16
1	Wheat	326 (3.12)	430 (4.12)	480 (4.61)	24.18	47.23
2	Jawar	3889 (37.25)	3460 (33.19)	3012 (28.93)	-11	-22.55
3	Bajara	1642 (15.23)	2136 (20.49)	1276 (12.25)	30.08	-22.28
4	Maize	45 (0.43)	48 (0.46)	172 (1.62)	6.66	282.22
5	Total cereal	6042 (57.88)	6143 (58.93)	4953 (47.5)	1.67	-18.02
6	Gram	231 (2.21)	252 (2.41)	706 (6.78)	9.09	205.62
7	Red gram	517 (4.95)	534 (5.12)	723 (6.94)	3.28	39.84
8	Green gram	326 (3.12)	170 (1.63)	66 (0.63)	-47.85	-79.75
9	Black gram	35 (0.33)	130 (1.24)	203 (1.95)	271.14	480
10	Total pulses	1343 (12.86)	1264 (12.12)	1708 (16.41)	-5.88	27.17
11	Total foodgrain	7385 (70.75)	7407 (71.06)	6661 (63.99)	0.29	-9.80
12	Groundnut	214 (2.05)	145 (1.39)	175 (1.68)	-32.24	-18.22
13	Sunflower	599 (5.70)	151 (1.44)	21 (0.20)	-74.79	-96.49
14	Sesamum	89 (0.85)	99 (0.94)	32 (0.30)	11.23	-64.04
15	Safflower	415 (3.97)	294 (2.82)	21 (0.20)	-29.15	-94.93
16	Soyabean	5 (0.04)	33 (0.31)	1451 (13.94)	560	144600
17	Total oilseed	1739 {16.66}	1036 (9.93)	1775 (17.05)	-40.42	2.07
18	Sugarcane	210 (2.01)	340 (3.26)	361 (3.86)	61.90	71.90
19	Cotton	236 (2.26)	829 (7.95)	3341 (32.10)	251.27	1315.67
20	Fruit crop	40 (0.38)	47 (0.45)	53 (0.50)	17.5	32.5
21	Vegetabl crop	340 (3.25)	207 (1.98)	75 (0.72)	-39.11	-77.94
22	Gross cropped area	7699	9253	10408	20.18	35.18

Source:-Directorate of Economics and Statistics, Govt. of Maharashtra, Mumbai (Year 1990-91, 2000-1, 2015-16)

It is noted that the area under total cereals first increased and further decreased where as area under total pulses has increased over a period of time. The area under Rabi jowar and bajra decreased over a study period. However, the area under soybean and gram drastically increased.

Among the cereals, the area under bajra has decreased by 22.28 per cent during 2015-16, over a base year 1990-91. The area under total pulses increased by 27.12 per cent during 2015-16, over the base year 1990-91. Among the pulses, maximum area was under red gram. Area in case of oilseed crops increased by 2.07 during 2015-16, over the base year 1990-91. However, the area under cash crops like sugarcane and cotton was increased over the base year by 71.90 and 1315.67 per cent, respectively. The data indicate that farmers are constantly moving towards commercial crops particularly sugarcane and cotton. The area under fruit crop was increased 32.5 per cent during the year 2015-16, over the base year 1990-91. Therefore the area under foodgrain crops showed a declining trend. The changes in the acreage under major crops at selected points of time in Beed district have been depicted by way of line graph in Fig. 5.6.

5.2.5 Comparison of productivity of major crops of Beed district to Maharashtra state

The comparison of average productivity of major crops of Beed district to Maharashtra state table 5.6. It is clearly noted that the productivity of almost all the crops of Beed district was less than that of State average productivity. The average productivity of wheat, total cereals, black gram and total oilseeds in Beed district was for below than state average productivity.

Table 5.6 Comparison of productivity of major crops of Beed district to Maharashtra state

Sr. No.	Crops	Productivity (q/ ha) (2015-16)		Percent change of over Maharashtra state
		Beed district	Maharashtra state	
1	<i>Kharif</i> jowar	2.83	5.94	-52.35
2	<i>Rabi</i> Jawar	2.86	3.22	-11.18
3	Bajara	2.57	4.16	-38.22
4	Wheat	2.75	10.77	-74.46
5	Total cereal	2.63	8.99	-70.74
6	Gram	2.63	5.39	-51.20
7	Red gram	1.61	3.59	-55.15
8	Green gram	0.61	1.90	-67.89
9	Black gram	0.34	2.14	-84.11
10	Total pulses	1.84	4.04	-54.45
11	Total foodgrain	2.54	7.45	-65.90
12	Groundnut	4.39	10.78	-59.27
13	Sunflower	2.05	2.24	-8.48
14	Sesamum	0.51	1.40	-63.57
15	Safflower	1.84	2.25	-18.22
16	Soyabean	1.64	4.85	-66.18
17	Total oilseed	1.48	5.16	-71.31
18	Sugarcane	2.20	7.00	-68.57
19	Cotton	0.51	1.58	-67.72

Source:- www.mahaagri.gov.in

5.2.6 Changes in human population of Beed district.

The demographic features and changes over last two census has been displayed in table 5.7. It can be clearly visualised that the population of Beed district little over 25 lakhs during census 2011. The population increased by 20 per cent between census periods 2001 to 2011. This clearly shows that population growth has slowed down which might be due to more awareness about family planning.

Table 5.7 Changes in human population of Beed district

Sr. No.	Particulars	Population		Percent change over census 2001
		2001	2011	2011
1.	Population	2161550	2585049	20
2.	Male	1116656	1349106	21
3.	Female	1044894	1235943	18
4.	Density(No./km ²)	202	242	20
5.	Sex ratio	936	916	-2
6.	Child sex ratio (0-6 yr)	894	807	-10
7.	Literacy rate (%)	67.99	76.99	13
8.	Urban populations	387000	514298	33
9.	Rural population	1701562	2070751	21

The increase in density of population is 20 per cent during census period 2001 to 2011. The number of females per thousand male at district level has decreased from 936 in 2001 census to 916 in 2011 census. But this sex ratio is bad sign for Beed district. The child sex ratio (807) was very low in census 2011.

Beed district has achieved remarkable progress on literacy front. This can be clearly visualized as the overall literacy rate at the Beed district has increased from 67.99 per cent in 2001 to 76.99 per cent in 2011 census. This literacy rate is good sign for Beed district.

5.2.7 Changes in the livestock population

Table 5.8 depicts the changes in livestock population which indicates that the population of goat and sheep, has decreased in during 2012. It is seen from the Table 5.8 that the buffalo's population has been increased by 27.43 per cent over the base year. The population of poultry has also increased by 1193.0 per cent over the base year. While the cattle population was highest in the census year of 2007 i.e. 667398 and it was declined to 582080 in the year 2012. The number of goats and sheep were 531593 and 162714 respectively in the year census year of 1997 which has decreased to 336223 and 66211 respectively in the census of year 2012.

This increased was about 22 per cent during the study period. The poultry population continuously increasing during the period 26 years in Beed district.

Table 5.8 Changes in livestock population

Sr. No.	Live stocks	Population (in numbers)				Percent change over base year		
		1997	2002	2007	2012	2002	2007	2012
1	Cattle							
	Exotic	95499	124000	173657	130743	29.84	81.84	36.90
	Indigenous	522054	471000	493741	451337	-9.77	-5.42	-13.5
	Total	617553	595000	667398	582080	-3.65	8.07	-5.74
2	Indigenous cow	128000	113000	105000	93000	-11.7	-17.9	-27.3
	Exotic cow	44000	61000	81000	66000	38.63	84.09	50.0
3	Buffaloes	188552	209000	258088	240284	10.84	36.87	27.43
4	Goat	531593	352545	456408	336223	-33.6	-14.1	-36.7
5	Sheep	162714	168705	91589	66211	3.68	-43.7	-59.3
6	Other	116262	22352.1	16391.54	13113.23	-80.7	-85.9	-88.7
7	Total livestock	1617883	1942603.1	1484877	1238324	20.07	-8.22	-23.4
8	Poultry	757691	820457	942581	9797573	8.28	24.40	1193.0

Source:- NABARD REPORT, 2016

5.2.8 Changes in consumption of fertilizers use

With the exploitation of additional water resources for irrigation purpose, introduction of seeds of high yielding varieties of crops and increases in the acreages under commercial crops, the use of chemical fertilizers increased rapidly in Beed district. Table 5.9 presents the information regarding to the annual consumption of Nitrogen, Phosphorus and Potash through the chemical fertilizers in Beed district at six points of time. The changes in consumption of fertilizers at different points of time in Beed district are shown graphically in Fig. 5.9.

Table 5.9 Changes in fertilizer consumption (in M.T)

Sr. No.	Year	N	P	K	Total	Per cent change over base year (1990-91)			
						N	P	K	Total
1.	1990-91	8343	3058	1085	12486	100	100	100	100
2.	1995-96	15245	8587	2845	26677	182	180	162	113
3.	2000-01	20154	12758	4405	37317	141	317	306	199
4.	2005-06	34717	20741	11436	66894	316	578	954	5257
5.	2010-11	61270	40248	26118	127636	634	31216	2307	922
6.	2015-16	42549	28500	11388	82437	410	831	950	560

Source: -Agricultural department office, Beed

The consumption of N,P and K have increased by 4,8 and 9.5 times to the base year 1990-91.

5.2.9 Use ratio of N, P and K

The balance use N, P and K is very important for better crop yield and soil health. The information on the fertilizer consumption ratio is presented in Table 5.10. It is revealed from the taste that the use of N, P and K was not used as per recommended ratio i.e. 4:2:1 in Beed district.

Table 5.10 Ratio of (NPK) fertilizer consumption (MT)

Sr. No.	Year	Fertilizer consumption in (M.T)			Ratio of fertilizer consumption		
		N	P	K	N	P	K
1	1990-91	8343	3058	1085	6.6	2.4	8.6
2	1995-96	15245	8587	2845	5.7	3.2	1.0
3	2000-01	20154	12758	4405	5.4	3.4	1.1
4	2005-06	34717	20741	11436	5.1	3.1	1.7
5	2010-11	61270	40248	26118	4.8	3.1	2.1
6	2015-16	42549	28500	11388	5.1	3.4	1.3

Source: -Agricultural department office, Beed

5.2.10 Changes in average rainfall

The changes in the average rainfall of Beed district are presented in Table 5.11. timely and sufficient rainfall is very important for agricultural growth in any region. It is seen from the Table 5.11. that the rainfall in Beed district showed a varying nature throughout the entire period under study. It is observed that the rainfall in twenty six year had fluctuated. Due to such variation in rainfall during the span of 26 years, the water availability also varied leading to the variation in agricultural production.

Table 5.11 Changes in average rainfall (mm)

Sr. No.	Year	Annual average rainfall (in mm)	Total rainfall (in mm)	Percent change over base year	% rainfall
1	1990-91	664.60	700	0	105.32
2	1991-92	664.60	328	-53.11	49.38
3	1992-93	664.60	690	110.17	103.79
4	1993-94	664.60	647	-6.20	97.35
5	1994-95	664.60	376	-41.94	56.52
6	1995-96	664.60	653	73.80	98.22
7	1996-97	664.60	937	43.59	141.05
8	1997-98	664.60	483	-48.51	72.62
9	1998-99	664.60	1143	136.86	172.00
10	1999-2000	664.60	504	-55.89	75.87
11	2000-01	664.60	886	75.88	133.43
12	2001-02	663.10	734	-17.20	110.72
13	2002-03	663.10	582	-20.64	87.86
14	2003-04	663.10	459	-21.11	69.31
15	2004-05	663.10	542	18.10	81.86
16	2005-06	663.10	897	65.36	130.84
17	2006-07	663.10	615	-31.43	92.87
18	2007-08	663.10	662	7.64	99.86
19	2008-09	663.10	696	5.1	104.96
20	2009-10	663.10	677	-2.72	102.10
21	2010-11	663.10	795	17.42	119.59
22	2011-12	663.10	961	20.88	144.93
23	2012-13	663.10	440	-54.21	66.14
24	2013-14	666.36	671	52.5	100.76
25	2014-15	666.36	370	-44.85	55.60

26	2015-16	666.36	330	-10.81	49.58
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Source:-Agricultural department office,Beed

5.3 Development in Infrastructure Facilities

There is a great variation in the district in respect of natural resource endowment, its exploitation, land use and cropping pattern, use of modern inputs like fertilizer, irrigation and various other factors over the entire period which determine the spread and level of agricultural development. In effect, the performance of individual crops in respect of area, production and productivity was mixed type. In case of paddy, wheat and gram crop there was sizable increase in production. The farmer's response to price changes and technological innovations was appreciable for a limit, number of crops as a result of which their production increased speedily consisting partly because of area expansion and partly due to productivity improvement. The development which took place in the infrastructure facilities was indirectly responsible for agricultural development in Beed district which is explained as below.

5.3.1 Changes in the use of implements and machinery

It is observed from the Table 5.12 that, the use of electric pump and tractor had increased considerably over the period under study. The detailed observations revealed that the use of wooden ploughs, iron ploughs and its accessories were replaced by tractors. The utilization of agricultural implement in the Beed district during viz., Wooden plough, Iron plough, Bullock cart, Oil engine, Electric motor, Tractor were 9655, 31287, 41323, 2900, 41512 and 1683 in the year 2012.

The use of tractors increase by 118.5 per cent in the year 2012 over the base year 1992. The use of electric motors which showed an increase by 17.52 per cent over base year. It was mainly due to the increase in area under irrigation.

It is thus clear that the use of tractors and pump sets, had increased considerably in the district over a period of time contributing significantly in the development of agriculture in the district.

Table 5.12 Changes in the use of implements

Sr. No.	Particulars	1992	1997	2002	2007	2012
1	Wooden plough	10983 (100)	7090 (-35.4)	8530 (-22.3)	9093 (-17.2)	9655 (-12.0)
2	Iron plough	39825 (100)	24651 (-38.10)	31738 (-20.3)	31512 (-20.8)	31287 (-21.4)
3	Bullock cart	45063 (100)	47676 (5.79)	42861 (-4.88)	42092 (-6.59)	41323 (-8.29)
4	Oil engine	2808 (100)	2396 (-14.6)	2120 (-24.50)	2505 (-10.7)	2900 (3.27)
5	Electric motor	35323 (100)	42282 (19.70)	42930 (21.5)	42221 (19.52)	41512 (17.52)
6	Tractor	770 (100)	1246 (61.8)	1300 (68.8)	1450 (88.3)	1683 (118.5)

(figures in parentheses indicates percentage changes over the base year 1991)

Source:- Directorate of Economics and Statistics, Govt. of Maharashtra, Mumbai.(1990-90, 2000-01, 2015-16)

5.3.2 Changes in the development of road and rail length

The development of roadways is essential for better transport and communication. It provides basic infrastructure facility for marketing of agricultural produce. Table 5.13 revealed that the length of National highways, State highways, major district roads and other district roads increased substantially over the entire period. The length of national highways, state highways, major district roads and other district roads has increased by 191.35, 40.33, 23.7 and 42.29 per cent, respectively over the base year 1990-91. This would automatically facilitate farmers to visit distance markets and also acquire improved technology regarding agriculture from distant places. This would help to improve the farming operation through input supply and distribution which in turn will lead to the development of the district as a whole.

Table 5.13 Changes in road and rail length (kms.)

Particular	1990-91	1995-96	2000-01	2005-6	2010-11	2015-16
National highway	0.00	0.00	79.00 (100)	187.95 (137.9)	191.35 (142.2)	191.35 (142.2)
State highway	921 (100)	937.44 (1.78)	1099 (19.32)	1150 (24.86)	1213.30 (31.73)	1292.45 (40.33)
Major district road	1330.97 (100)	1384.08 (3.99)	1627 (22.24)	1863 (39.97)	1213.30 (-8.84)	1638.10 (23.07)
Other district roads	1523.29 (100)	1524.86 (0.10)	1589 (4.31)	1770.42 (16.22)	2030.77 (3.49)	2167.60 (42.29)
Village roads	1400 (100)	1840.11 (31.43)	4778 (241.2)	5350.55 (282.1)	6681.25 (377.2)	7634.53 (445.3)
Total roads	5685.23 (100)	6254.36 (10.0)	9685.27 (70.35)	9975.8 (75.46)	10306.50 (81.28)	13129.03 (130.9)
Railway	40.00 (100)	40.00 (000)	47.86 (19.65)	47.86 (19.65)	47.86 (19.65)	47.86 (19.65)

(Figures in parentheses indicates percentage changes over the base year 1992)

Source: Directorate of Economics and Statistics, Govt. of Maharashtra, Mumbai. (2011-12)

It is interesting to note that the railway line was increased only by 19.65 per cent to the base year 1990-91 and its remain same from the year 2000-01 onwards.

5.3.3 Changes in credit disbursed through DCCB in Beed district

Credits play an important role in development of agriculture. As Indian farmers are poor so authentic and timely supply of credit gives boost to the agricultural production in it.

Table 5.14 Change in credit disbursed by DCCB in Beed district

Sr. No.	Year	Loan disbursed (Rs in lakhs)	Percentage change over base year
1	1990-91	128567	-
2	2000-01	1183903	820.8
3	2015-16	85865.39	-33.21

Source- DCCB bank office Rajuri West, Beed

It is revealed from the Table 5.14 that the credit disbursed through DCCBs in Beed district has been continuously increasing during the II period under study. The credit disbursed by DCCB increased from Rs.128567 lakhs to 1183903 lakhs during the period from 1990-91 to 2000-01. But after 2000-01 it was decreased by 33.2 percent to the base year 1990-91.

5.4 Factors Influencing the Agricultural Production

In the earlier part of this chapter we have discussed the changes in land use pattern, cropping pattern, input use, change in the infrastructural facilities, annual compound growth rates in area, production and productivity of major crops in Beed district. The analysis relied mostly on the sample mean, percentage and proportion of individual items in the total of respective variation. The type of analysis deployed for the purpose, however had certain limitations of its own as it could not measure the relative contribution of individual variables in combination of other variables in influencing total agricultural development of Beed district. The factors responsible for agricultural production in Beed district are very important. Therefore, the multiple linear regression equation was fitted to the data to obtain the factors responsible for agricultural production in Beed district.

The details regarding the specification of the multiple linear regression model and measurement of variables have already been given in the methodology chapter. The following variables were selected for estimating the multiple linear regression equation. The equation is of following type.

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

Where,

Y = Total agricultural production of food grain + non-food grain in Beed district. (₹ in thousands).

a = intercept

b₁'s = Regression coefficient

X₁ = Percentage of Gross Irrigated Area (GIA) to Gross Cropped Area (GCA).

X₂ = Consumption of total fertilizer (NPK) (in metric ton)

X₃ = Percentage of Gross Cropped Area (GCA) to Net Cropped Area (NCA).

X₄ = Percentage of area under commercial crops to Gross Cropped Area.

X₅ = Amount of loan (short-term) disbursed through DCCB per year (₹ in lack).

X₆ = Total annual rain fall in the Beed district (mm).

X₇ = Area under fruits crops (ha)

X₈ = Number of milch animals (No).

u_t = error term.

The production function analysis with above variables was carried out for the macro level time series data of agricultural development in Beed district and presented in Table 5.15.

The regression coefficients of the variables *viz.*, Percentage of gross cropped area to net cropped area (X₃), Percentage of area under commercial crops to gross cropped area (X₄) and Total milch animal (X₈) were turned out to be positive and significant indicating thereby that, the agricultural production of Beed district is highly responsive to these important variables. The regression coefficient of Percentage of gross irrigated area to gross sown area was turned out to be negative and significant at 5 per cent level of significance, indicating that decrease in gross irrigated area, proportionately decrease the total agricultural output. The percentage of Consumption of total fertilizer (NPK) in metric ton (X₂) was significant but negative.

The analysis therefore concluded that the independent factors *viz.*, Percentage of gross sown area to net sown area (X₁), Percentage of area under commercial crops to gross sown area (X₅) and Total milch animal (X₉) have shown a significant positive association with the increase in the value of aggregate crop output in Beed district.

Importantly the factors such as increase in gross sown to net sown area and percentage of area under commercial crop do have the positive association with the increase in the value of crop output the regression. Coefficients of these factors have turned out to be non significant.

Table 5.15 Multiple linear regression for agricultural development in Beed district

Sr. No.	Particulars	Regression coefficient	't' calculated
1	Constant	-24439759.6	
2	Percentage of Gross Irrigated Area to Gross Cropped Area (X ₁)	-79475.69** (33238.27)	-2.39109
3	Consumption of total fertilizer (NPK) in m.t (X ₂)	-65.04** (22.67)	-2.868
4	Percentage of Gross Cropped Area to Net Cropped Area(X ₃)	194300.39** (92778.83)	2.094
5	Percentage of area under commercial crops to gross cropped area (X ₄)	111820.28** (48963.80)	2.2837
6	Amount of loan (short term) disbursed through BDCCB per year (₹ in lakh) (X ₅)	-0.602795 (0.55544)	-1.0852
7	Average annual rain fall in the Beed district (X ₆)	-622.6708 (779.64)	-0.7986
8	Area under fruit crops (ha)(X ₇)	7.78653 (16.857)	0.4618
9	Total milch animal (X ₈)	53.7193*** (17.7093)	3.0333
10	R ²	0..6896	-
11	D. F.	25	-
12	Number of observations	26	-

(Figure in the parenthesis indicates standard errors of respective regression coefficient)

(Note:- ***, ** and * significant at 1, 5 and 10 per cent level of significance level.)

It is noted that, if percentage of gross cropped area to net cropped area increase by one percent the agriculture output in Beed district will increase by Rs.194300.39. Similarly, if the milch animals increase by one number the agriculture output of Beed district will increase by Rs. 53.72.

The regression coefficient of amount of loan disbursed through Beed DCCB, average rainfall and consumption of total fertilizer was turned out to negative and non significant. It was mainly due to the low disbursement of short term loan, erratic and insufficient rainfall and unbalance use of chemical fertilizers, respectively.

5.5 Strengths, Weakness, Opportunities and Threats (SWOT) Analysis

Strengths

- ‘Cotton is leading crop of district.
- Responsive soils to different inputs and management practices.
- Strong Panchayat Raj System for effective Planning and implementation of development schemes at grass root level.
- A growing tendency to diversify from traditional agricultural crops to horticultural crops.
- Diversified Agro climatic situations suitable for cultivation of different crops.
- Wide range of crops, vegetables and fruit crops.
- Good telecommunication facilities available within district.

Weaknesses

- Mono cropping and growing *rabi* jowar as subsistence farming.
- Lack of scientific attitudes and laggardness of farmers.
- Fast deteriorating soil health and productivity due to imbalance application of chemical fertilizers and low application of organic inputs.
- Regularly drought prone area.
- Crop loan recovery problem.
- Inadequate market infrastructure and predominance of intermediaries.
- Poor postharvest management and value addition.
- Inadequate irrigation facilities, agricultural extension services and input delivery system.
- High population pressure on agriculture. Due to growth of population and division of families’ fragmentation of landholdings.
- Farmer suicide problem.

Opportunities

- Scope for increasing cropping intensity with water harvesting measures and crop diversification.
- Prospect for increasing production and cultivation of all types of crops.

- Scope for increasing pulses and oilseeds production with sub soil moisture under maximum tillage.
- Scope for engagement of progressive farmers into contract farming and establishment of agro -based industries.
- Wide opportunities for exports with special reference to cotton.
- Potential for increasing livestock population and promoting allied sectors, such as, dairy, poultry, duckery, goatery, sheep rearing *etc.*,
- Promoting river lift irrigation
- Popularisation of drip and sprinkler irrigation for horticultural crops.
- Large scale implementation of artificial insemination program, breed up gradation and enhancing milk production. Scope for organizing more number of awareness camps-cum-training programs and huge scopes for large investment in the sector.
- Excellent opportunities for private sector investment in poultry and dairy.
- Adopting a newer and sustainable technologies and use of inputs.
- Promotion of organic farming.
- Environmental degradation related awareness among population.
- Infrastructure development for marketing and agro processing.
- Increased awareness of good health creating demand for organic produces.
- Protection and development of forest through Joint Forest management committee (JFM).
- Involvement of Improved Integrated crop management technology (ICMT) scope to increase productivity of crop.
- Marketing of various agro commodities through Mohostavs, Self help Groups, Mahila Mandal.

Threats

- Diversion of agricultural land to other economic activities.
- Decreasing trend of agricultural labour force due to migration.
- Degraded environment and ecosystem, erratic behavior of monsoon and deterioration of quality of surface water & depletion of ground water.
- Limited market information system and other infrastructure for market promotion.
- Less area under forest
- Over use of chemical fertilizers & pesticides.
- Growing industrial activities deplete grazing land.
- Absence of cold chain facility.
- Recurrence of disease problems in poultry and dairy sectors.

6. SUMMARY AND CONCLUSIONS

In Maharashtra, all possible effort were made for the development of agriculture and thereby involve in the national campaign of the increasing agricultural production during the post independence period. It is believed that the process of agricultural development must have brought about structural changes in land use and crop pattern and farm productivity of crop due to use of new technology in agriculture. It was thought to be an useful exercise to undertake a scientific assessment of the process of agricultural development in well defined area over period of time. A study of this kind may have a detailed probe in examining the trend in the land use and crop pattern, growth rate of important crop, development of infrastructural facility and identification of major variable influencing agricultural production. The change in growth rate of area, production and productivity of major crop due to use of modern technology during the green revolution period can also be examined. in view of this, the present study, *viz.*, 'Retrospects and prospects of Agricultural Development of Beed District in Maharashtra was undertaken with following specific objectives

- i. To estimate the growth rates in area, production and productivity of major crops in Beed district.
- ii. To study the changes in socio-economic indicators of agricultural development in Beed district.
- iii. To assess the changes in infrastructural development for agriculture in Beed district.
- iv. To identify the factors responsible for agricultural development of Beed district.
- v. To workout SWOT (Strength, Weakness, Oppurtunities and Threats) analysis of agricultural development in Beed district.

The time series data from the year 1990-91 to 2015-16 for studying the above objective of the study were personally collected from the published as well as relevant source. The changes in land use and crop pattern and input use were studied for the decadal year starting from 1990-91 to 2015-16 and by estimating proportion to the respective base year at the selected point of time. The impacts of agricultural development on agricultural production has been assessed by annual compound growth rates of area, production and productivity of major crops. The multiple linear regression equation was fitted to the data for the period from 1990-91 to 2015-16 for studying the functional relationship existing between the aggregate of crop output in thousands of rupees in Beed district as the dependant variable *viz.*, Percentage of gross irrigated area to gross cropped area (X_1), Percentage of gross cropped area to net cropped area (X_2), Consumption of total fertilizer (NPK) per hectare of gross Irrigated area (kg) (X_3), Percentage of area under commercial crops to gross cropped area (X_4), Amount of loan(short-term) disbursed through

DCCB per year (₹in lack) (X_5). Total annual rainfall in the Beed (mm) (X_6), Area under fruits crops (ha) (X_7) and Number of milch animals (No) (X_8).

6.1 Summary of findings

The findings of the study have been briefly summarized as below.

1. The area, production and productivity of all cereals fluctuated widely during the period under consideration in Beed district. Among the cereals, annual growth rates in area and production of wheat and maize were observed to be positive and significant for entire period of twenty six years. The growth rates of area, production and productivity of jowar, and bajra were negative and non significant. The area and production of total pulses increased significantly during the entire period. The annual compound growth rates of production and productivity of oilseeds were negative. The annual compound growth rates of area and production of sugarcane were positive during overall period. The compound growth rates of area, production and productivity of cotton were positive and significant during overall period. The growth rates of area, production and productivity of soybean were positive and significant. The growth rates of area, production and productivity of sesamum were decreased during entire period. However, the area under total cereals, total food grains and total oilseeds has been declined, whereas the area under pulses, sugarcane and cotton has been significantly increased. It indicates that there is a crop diversification in Beed district. The farmers are diverted from foodgrain crops to non foodgrain crops to earn more profit from farming.
2. The land utilization pattern over the years showed that the net cropped area was increased by only 24.04 per cent in the year 2015-16 to the base year 1990-91. The area under forests was slightly increased 2.02 per cent in 1990-91 and 2.62 per cent in 2015-16. The irrigated area has been continuously declined over a different point of time.
3. The gross cropped area in 1990-91 was 769900 hectares; it had been increased to 1040800 hectares during 2015-16.
4. It was confirmed that cereal crops still dominated in the cropping pattern of the Beed district. The area under total cereals at the district level was increased by 1.67 per cent in 2000-01 and again decreased by 18.02 per cent in 2015-16 over the base year 1990-91. The proportion of area under pulses and oilseeds increased during the same period.
5. The area under cash crops like cotton was increased 1315.67 per cent over the base year. The data indicate that the farmers are constantly moving towards crops particularly soybean, and cotton. Therefore, the area under food grain crops showed a declining trend.
6. The consumption of fertilizer revealed the imbalance use of fertilizer trend during the study period. This directly affect the productivity of the crops.

7. The productivity of almost all the crops of Beed district was less than that of State average productivity.
8. The net irrigated area of district was 191500 hectares in the year 1990-91 which has decreased up to 133300 hectares in 2015-16. The gross irrigated area also decreased during the study period.
9. The use of iron plough, electric pump and tractor had increased considerably over the period under study. The detailed observation revealed that the use of wooden ploughs and bullock carts was replaced by iron ploughs and tractors.
10. The credit disbursed through DCCB in Beed district has been drastically decreased during the period under study. The credit disbursed by DCCB decreased from Rs. 128567 lakhs to 85865.3 lakh during the period from 1990-91 to 2015-16.
11. The length of national highways, state highways, major district roads and other district roads increased substantially over the study period. The length of national highways, state highways, major district roads and other district roads has increased by 142.2, 40.33, 23.07 and 42.29 per cent, respectively over the base year 1990-91. This would automatically facilitate farmers to visit distance markets and also acquire improved technology regarding agriculture from distant places. This would help to improve the farming operation through input supply and distribution which in turn will lead to the development of the district as a whole. But rail length is very low in Beed district.
12. The regression coefficients of the variables *viz.*, Percentage of gross cropped area to net cropped area (X_3), Percentage of area under commercial crops to gross cropped area (X_4) and Total milch animal (X_8) were turned out to be positive and significant indicating thereby that, the agricultural production of Beed district is highly responsive to these important variables.

6.2 Conclusions

The following specific conclusions have emerged from the findings of the study.

1. For the entire period (1990-91 to 2015-16) the production of maize, wheat, black gram, soybean and sugarcane crops were increased only by expansion of area .
2. The production of *rabi* jowar, groundnut, sunflower, sesamum and safflower crops has been declined due to decline both in area and productivity.
3. The area under forest and net sown area was slightly increased.
4. Net irrigated area and gross irrigated area was decreasing significantly during the entire period.
5. The area sown more than once was slightly increased during the entire study period.
6. Major source of irrigation was surface irrigation other than well during entire period.

7. The area under total cereals has been decline, whereas area under pulses and oilseed crops has been increased. It indicates the crop diversification in Beed district.
8. Recently the area under soybean crop has been increased drastically.
9. The child sex ratio was very low in census 2011.
10. The livestock population decreased during entire study period but buffalo and exotic cow was increased.
11. The total annual rainfall was fluctuated during entire the period (1990-91 to 2015-16).
12. There was a imbalance use of chemical fertilizer. The N:P:K ratio (i.e. 4:2:1) is not followed in Beed district.
13. The bullock and bullock operated implements were replaced by the tractors and accessories over a period of time.
14. The rail length (47 km) was very low during entire study period.
15. Inadequate supply of crop loan by DCCB bank in Beed district.

6.3 Policy Suggestions

The policy suggestions based on the conclusions of the present study for the agricultural development in Beed district are as under

1. Irrigation has remained the major limiting factor for the development of agriculture in the Beed district. Most of the crops are grown under unirrigated conditions and the production of crops depends more on the rainfall pattern. Therefore, irrigation development should be given top priority to execute various minor irrigation projects and water harvesting schemes in the district.
2. The productivity of almost all the crops of Beed district was less than that of State average productivity. So efforts are needed to increase the crop productivity of Beed district through the efforts of NGO, Extension agencies and Universities.
3. Beed district is a rainfed district (85%). However, livestock is declining especially goat and sheep. Hence, the open goat and sheep rearing may be encouraged for increasing the farm income in Beed district through subsidiary business.

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7. VITAE

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