

**DYNAMICS OF CROPPING PATTERN AND CROP
DIVERSIFICATION IN AMRAVATI DIVISION OF
MAHARASHTRA**

THESIS

**Submitted to
Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola
in partial fulfilment of the requirements
for the Degree of**

**MASTER OF SCIENCE
IN
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2016

DECLARATION OF STUDENT

I hereby declare that the experimental work and its interpretation of the thesis entitled "**DYNAMICS OF CROPPING PATTERN AND CROP DIVERSIFICATION IN AMRAVATI DIVISION OF MAHARASHTRA**" or part thereof has neither been submitted for any other degree or diploma of any University, nor the data have been derived from any thesis / publication of any University or Scientific Organization. The sources of material used and all assistance received during the course of investigation have been duly acknowledged.

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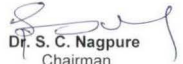
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CERTIFICATE


This is to certify that the thesis entitled "**DYNAMICS OF CROPPING PATTERN AND CROP DIVERSIFICATION IN AMRAVATI DIVISION OF MAHARASHTRA**" submitted in partial fulfillment of the requirements for the degree of "**Master of Science in Agriculture (Agril. Economics)**" of Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola is a record of bonafied research work carried out by **Korra Vijaya Lakshmi** under my guidance and supervision.

The subject of thesis has been approved by the Student's Advisory Committee.



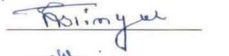
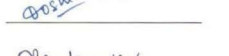
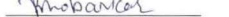
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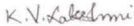
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(D) Abbreviations

%	- Per cent
/	- Per
@	- At the rate
Agril.	- Agricultural
APC	- Agricultural Prices and Costs Scheme
CGR	- Compound Growth Rate
CV	- Coefficient of Variation
Dr. PDKV	- Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola
e.g.	- Exempli gratia (For example)
et al.	- Et alia (and other)
etc.	- Etcetera
Fig	- Figure
Ha	- Hectare
i.e.	- That is
J	- Journal
Kgs	- Kilogram
M.S.	- Maharashtra State
Mha	- Million hectare
No.	- Number (s)
Viz.	- Videlicet (Namely)
Sr. No.	- Serial number
Viz.,	- Videlicet (namely)
w.r.t.	- With respect to

(E) Thesis Abstract

- a) Title of the thesis : "DYNAMICS OF CROPPING PATTERN AND CROP DIVERSIFICATION IN AMRAVATI DIVISION OF MAHARASHTRA"
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ABSTRACT

The research entitled "Dynamics of cropping pattern and crop diversification in Amravati division of Maharashtra" was carried with objectives to study the performance of major crops, to study the changes of cropping pattern, to study the crop diversification, to work out the advantageous crops in different districts of Amravati division.

The present study was based on secondary data collected from various government publications and pertains to a period of 43 year i.e. from 1970-71 to 2013-14. The present study has examined the growth rates of area, production and productivity of major crops, the trend in crop diversification, changes in cropping pattern and advantageous crops in different districts of Amravati division of Maharashtra. The compound growth rates of area, production and productivity of major crops were estimated for four sub-periods i.e. Period-I (1970-71 to 1979-80), Period-II (1980-81 to 1989-90), Period -III (1990-91 to 2000-01), Period-IV (2000-01 to 2013-14) and overall period (1970-71 to 2013-14). Coefficient of variation was used for analytical tools. Simple tabular analysis was used to examine the changes in cropping pattern in Amravati Division and districts of Amravati division i.e. Akola, Amravati, Buldhana and Yavatmal. In order to study the crop diversification Herfindahl index have been used. In order to work out the advantageous crops, land concentration ratio in different districts with comparative advantage was computed for last 10 years i.e. from 2004-05 to 2013-14.

In majority of districts of Amravati division i.e. Akola, Amravati, Buldhana and Yavatmal crop diversification has significantly increased during the study period. The diversification from subsistence crop to more commercial crops were took place in selected districts and in division also. There existed wide temporal changes in the cropping pattern of Amravati division. Over a period of study the proportions of area under jowar and cotton had reduced in Amravati division, whereas it was increased in respect of pulses. Soybean attained prestigious position in the cropping pattern of Amravati division. Soybean shows increasing land concentration ratio from year 2009-10 to 2013-14, so soybean is more advantageous crop in Akola, Amravati, Buldhana and Yavatmal districts in Amravati division.

CHAPTER I

INTRODUCTION

1.1 Background Information

Agriculture has always been the backbone of the Indian Economy and despite concerted industrialization in the last six decades; agriculture still occupies a place of pride. It provides employment to around 60 percent of the total workforce in the country. The significance of agriculture in India arises also from the fact that the development in agriculture is an essential condition for the development of the national economy. Agriculture sector is the principal source of food for consumption by non-agricultural workers. (Hrideshwer Gupta 2013).

To meet the challenges of a globalizing market in agriculture as well as the growing and changing needs of the population many countries in South East Asia have undertaken crop diversification to enhance productivity and cultivate high value crop with positive outcome. These countries are gradually diversifying their crop sector in favour of high value commodities, especially fruits, vegetables and spices. Diversification is taking place either through area augmentation or by crop substitution. If carried out appropriately, diversification can be used as a tool to augment farm income, generate employment, alleviate poverty and conserve precious soil and water resources.

Cropping pattern is defined as a combination of agricultural crops that are grown in a particular geographical area. It can be viewed either in terms of the area allocated for each crop, or, by the production composition in value terms for any specific area. Therefore, changes in cropping pattern can be seen as the changes in proportion of acreage or the value of production under different crops to total agricultural area or production. The cropping pattern usually

changes over time with the development of agriculture, as is evident in the case of agriculture in India (Vyas, 1996).

It is a well noted fact that the growth of agricultural production depends on both acreage and productivity growth. Productivity growth can be further decomposed into two parts. One is the yield growth and other is the cropping pattern change. The former measures the impact of changes in output per unit of area, while, the latter captures the shift of acreage from crops with relatively low values of output per unit of area to higher value crops.

Cropping patterns are the yearly sequence of crops grown and the spatial arrangement of crops. It is formulated within view to obtain maximum crop production under a given situation. Cropping patterns are dynamic and changes occur with changes in factors of production and physiological and social environments. Modifications made in cropping patterns are always to drive the maximum benefit from changed crop growing conditions. Indian agriculture has been diversifying during the last two decades towards High-Value Commodities (HVCs) i.e., fruits, vegetables, milk, meat, and fish products. The pace has been accelerated during the decade of 1990s. HVCs account for a large share in the total value of agricultural production. Supply and demand side factors coupled with infrastructural development and innovative institutions drive these changes. India is a country of about one billion people. Due to the challenge of feeding our vast population and the experience of food shortages in the pre-independence era (prior to 1947), 'self reliance' in food grains has been the cornerstone of our policies in the last 50 years.

Crop diversification in India is generally viewed as a shift from traditionally grown less remunerative crops to more remunerative crops. It is intended to give a wider choice in the production of a variety of crops in a given area so as to expand production related activities on various crops and also to lessen risk.

Sustainable growth of the agriculture depends considerably on the process of agricultural transformation, which in turn is well connected with shifts in production patterns i.e., on the extent of crop diversification. The importance of crop diversification becomes more pertinent particularly as a strategy to reduce inconsistency in agricultural production and yield. In essence, crop diversification helps the farmers in reducing variability in income, sustaining a reasonable income level and mitigating drought and enhancing water use efficiency.

Crop Diversification is a concept opposite to crop specialization, providing the relative areal strength between crops grown in a region. It is an agricultural technique where farmers harvest a variety of crops instead of just one. Crop diversification patterns have great relevance in the agricultural land use studies, and are an important component of the crop geography of a region. It reduces risk factor resulting from crop failure within a region. Though rich farmers prefer specialization, the poor and substitute farmers are interested in diversification of crops. Diversified crops tend to be more pest-resistant. Diversification enhances nitrogen in the soil to replenish the soil fertility. Thus, it increases the sustainability of arable land. It generates more employment as the agricultural workers remain busy in sowing, weeding, harvesting and marketing of crops throughout the year. Increase in intensity of cultivation and in yields per unit area are the only available options to meet future food needs to feed an ever increasing population. Farmers and their families benefit from greater variety in their diets, and therefore better nutrition.

Changes in cropping pattern in terms of acreage allocation among different crops have been the integral part of agricultural development of a region, which further depends on the money invested, production, available time etc. Crop diversification of a geographical area is based on physical, social and economic factors along with technological, geographical and institutional structure of that region.

Maharashtra is an important state and has been considered as one of the progressive state in India. In India, it is the second largest state in population and third geographical area. Since its formation in 1960, the state has secured higher growth rate vis-à-vis India economy for almost three decades and needs to move at a much faster pace. Planning commission's assessments indicate that the average annual growth rate for Maharashtra would be 10 per cent. The compound growth rate achieved during 2009-10 was 8.59 per cent. It was envisaged that the growth rate could be achieved by adopting comprehensive policy package and institutional reforms.

Geographically the state has 37.58 lakh hectares of land. Out of which 20.13 per cent and 53.90 per cent are under forest and the net sown area respectively. With the population pressure it may not be possible to bring any more acreage of land under cultivation. The population of the state is 11.23 crore (2011 census) out of this nearly 54.77 per cent live in rural area. The growth rate of population over the previous census (2001) is around 10.3 and 23.7 per cent in the rural and urban area respectively with the male female ratio of 1000:925 and overall literacy percentage is 82.91. The higher growth rate in the urban area may indicate some shift of rural population to urban area in search of work, effecting in the depletion of agricultural labour force of rural area.

In country like India and the progressive state of Maharashtra where agriculture sector contributes major share of their income, will have great impact on the increase/ decrease of per capita income, and therefore agriculture continues to play an important role in raising the living standard of the people. Analytical studies related to agricultural growth would provide valuable information for future planning and projections of agricultural output. There are many factors such as introduction of high yielding varieties of seeds, increasing irrigation facilities better application of fertilizers and manures, better prices and market facilities for agricultural commodities leads to promote agricultural development. The adoption of cropping pattern

optimally suited to the technological changes is also an important factor for augmenting growth of agriculture. An attempt therefore has been made to analyze the behavior of cropping pattern for last two and half decades, in Western Vidarbha region.

1.2 Importance of the study

The study of cropping pattern assumes a great significance as it is one of the important path for balanced development of agriculture to meet the requirements. The adoption of better cropping pattern optimally suited to the technological changes is an important one for augmenting agricultural growth. Cropping pattern of a particular area either state region, districts, etc. emerges through the interaction of physical, social, economic, technological, and infrastructural factors. It is a function of climatic elements, their periodicity expressed in terms of seasons, nature of soils, physiographic and man introduced factors like irrigation, fertilizers, etc. amongst the climatic factor, precipitation, its distribution and periodicity has a greater determinant value. The impact of each of these factors would differ depending upon the prevailing situation of a place. Cropping pattern indicates the percentage of area occupied by different crops. The variation in cropping pattern is also influenced by economic conditions and behaviour of farmers who decide the type of crops to be grown. Farmer might choose such crops combination which will be best suited to his field under the given conditions. Change in cropping pattern would be an integral part and popular mode of diversification and resource mobilization available to cultivators for higher agricultural production.

Cropping pattern has been dynamic to cope up the changing scenario and to meet ever changing demands of growing population. Limited availability of land raising population and declining yields, forced farmers to search for alternate ways for raising farm income, with the passage of time farmers because increasingly commercialized and started farming for maximizing their output. Now

the realization prevails amongst the farmers for the long term returns, and they are in search of optimum cropping pattern which can fulfill their aspirations. It is also found that the higher the technical inputs, lesser the degree of diversification.

In present scenario developmental paradigm of agrarian economy specifically in case of developing country like India, diversification concept is applied to individual farmers and to different farms as well as to study regions. In the third world country like India where man-land ratio is high enough, agricultural diversification especially in term of crop diversification is very much necessary (Let, 2011). At the same time, Indian agricultural is gamble in monsoon i.e., to get rid from helpless dependency on seasonal monsoonal rainfall, irrigation facilities –one of the most efficient infrastructure technological aids are earnestly required so that agricultural economy is established in the strong relative platforms (Let & Bhattacharya,2010).In this context, the study of crop diversification is very much important due to following reasons (Hussain, 2009):

- I. In the monsoonal country (e.g., India, Bangladesh), where whole agriculture system mainly depends of monsoon-rain; farmers often prefer to plough different crops in different seasons because of variability of rainfall and inadequacy of source of irrigation.
- II. In the tradition bound subsistent farming systems, the farmers grow several crops to meet the family requirements. In such areas, one may find a high degree of crop diversification.
- III. Diversification has usually been done by the farmers to enhance nitrogen in the soil and to replenish the soil fertility. Crop diversification increases the sustainability of arable soil.
- IV. The diversification of crops also generates more employment as the farmers and agricultural workers remain busy in the sowing, weeding, harvesting and marketing of different crops throughout the year. Diversification of crops also enables the farmers to provide a reasonable quantity of the costly inputs to their crops as

different crops need different quantities of inputs (e.g., chemical fertilizers, insecticides, pesticides and Irrigation).

In fact, it is obvious that greater the number of crops in combination, greater will be the degree of diversification. The main advantage of the study of crop diversification regions lies in the fact that it enables to understand that impact of physical and socio economics conditions on the agricultural mosaic. Moreover, it help to know the contemporary competition among the crops for an area and scope for rotation and effect on double cropping, total production and per hectare productivity. Hence, the present study was undertaken in Amravati division with following objectives.

1.3 Objectives

1. To study the performance of major crops in different districts of Amravati division.
2. To study the changes in cropping pattern in different districts of Amravati division.
3. To study the crop diversification in different districts of Amravati division.
4. To work out the advantageous crops in different districts of Amravati division.

1.4 HYPOTHESIS

Cropping pattern of Amravati division has changed over a period of time.

1.5 Scope and limitations

The study of changes in cropping pattern will help farmers to use the better availability of microclimate, inputs and changing scenario of market condition. Study of crop diversification also helps the policy makers to work according to changing trend. Economics of various crops gives an idea about their profitability which would help the farmers for allocation of scarce resources.

CHAPTER II

REVIEW OF LITERATURE

Review of literature gives the guidelines from the past researchers and provides foundation to the theoretical frame work for the present investigation. The review of past literature makes the investigator to get an insight in to the methods and procedures to be followed. This chapter deals with review of concepts used in the study as viewed by different authors and review of related studies in the past. Several studies have been carried out in the recent years to show the changes in behaviour of cropping pattern in various states of India. The available literature relevant to the objectives of the present study was reviewed and presented in this chapter under the following headings.

2.1 Performance of major crops

2.2 Changes in cropping pattern

2.3 Crop diversification

2.4 Advantageous crops

2.1 Performance of major crops

Mitra (1990) made an attempt to examine the growth of agricultural production in Maharashtra and its four regions for the period 1956-57 to 1984-85. The entire period of the study has been divided into two sub periods for estimation of the growth rates of area, production and yield of major crops. The author stated that annual compound rate of growth of agricultural production in the state as well as in all the regions specially that of food grains was relatively higher in twelve year period ending 1984-85, after a near stagnancy in sixteen year period ending 1971-72. The overall rate for the growth of production of food grain was around 2 per cent per annum which has been mainly brought about by growth in yield. Amongst cereals the rate of growth in yield of wheat is not of much higher order than those of other cereals. Jowar, pulses also show a very overall rate of growth in

production brought about by equally marginal rate of growth in area and yield. Comparatively Nagpur region showed a better performance mainly because of good performance under jowar. Groundnut and cotton did not show any significant overall growth in production. The overall growth of area under these two crops was negative and there was marginal increase in the rate of growth of yield for these crops.

Mundinamani et al. (1995) examined the growth performance of groundnut, sunflower, safflower and sesamum for the selected districts of Karnataka and the state as a whole. The study was conducted for the period from 1955-56 to 1989-90. Growth rates were computed for two sub-periods namely pre-green revolution period (1955-56 to 1989-9). They have fitted the exponential function i.e., $Y_t = a.b^t$ for the analysis. The results of the study showed that the growth in production was achieved mainly due to expansion of acreage in the study area and to some extent by yield effect in the recent years the improvement in yields was observed in areas where irrigation facilities were extended. They have stated that the potentiality of the viable technology developed for major oilseeds was not yet made a significant impact in increasing oilseeds productivity.

Shete et al. (1997) analyzed the nature of growth of agriculture among the four regions of Maharashtra viz. Western Maharashtra, Konkan, Marathwada and Vidarbha for the period from 1956-57 to 1989-90. They have estimated compound growth rates of area, production and productivity of total cereals, pulses, oilseeds, sugarcane and cotton during period I) (1950-57 to 1989-90), period II) (1967-68 to 1977-78), period III) (1978-79 to 1989-90) and the entire period of 34 years i.e., 1956-57 to 1989-90. The study revealed that performance of agriculture in Maharashtra was mixed type among different regions. The increase in the production at cereals during period I was due to area expansion while the productivity was declined. In oilseed Maharashtra continued to be a deficit state during the sixties and seventies. The result showed that aggregate output depended largely on the magnitude of cropping intensity.

Balappa et al. (1999) attempted to analyze the growth performance of red gram in Gulbarga district and Karnataka state as a whole over the period 1980 to 1994. The quadratic growth function was fitted for the estimation of growth rate in area and cubic function for production and productivity. The study showed that area under red gram declined significantly by 10 per cent and 9 per cent per annum respectively during 1980-81 to 1994-95 in Gulbarga district and Karnataka state as a whole. The analysis concluded that even though the area had declined significantly, the production did not decline to the significant increase in its productivity for the state as a whole.

Legesse (2000) found that during eighties wheat area showed a declining growth rate i.e., 3.94 per cent per annum but production and productivity showed a negative growth rate. During nineties the Karnataka state recorded a positive growth rate of 3.47 per cent in area while in production the state recorded a mild growth, productivity showed a negative growth rate.

Navadkar (2003) revealed that the area, production and productivity of cotton in India during 2001-02 were increased by 48.81, 2271.71 and 150 per cent change over 1950-51. It means that the production increased rapidly than once due to increased productivity by 2.5 times over 1950-51.

Marawar et al. (2004) examined the performance of oilseed in different district of Vidarbha for the period from 1980-81 to 2001-2002. The study revealed that area of Kharif groundnut decreased over the period of study in Vidarbha, whereas summer groundnut showed mixed trends. The area under sunflower and soybean was increased significantly in all the districts of Vidarbha. In general the area under total oilseeds was increased significantly. The production of Kharif groundnut decreased over the years of study but the production at sunflower. Summer groundnut, safflower and soybean increased significantly. The productivity of Kharif groundnut and soybean was increased. Sunflower was more or less stagnant over

the study period during the study period the productivity at safflower increased at a growth rate of 1.80 per cent in Vidarbha.

Ramphul (2012) studied the Performance and Suitability of Growing Crops in Haryana: District-level Analysis. The cropping pattern and performance of different districts in growing different crops in Haryana are assessed using three standards measures, namely) (i) location quotient, (ii) crop versatility index, and (iii) district versatility index over the period 1991-92 to 2008-09. The specialization of maize in Ambala and Yamunanagar, cotton in Hisar, sugarcane in Yamunanagar and Ambala, mustard in Rewari and Mahendragarh, gram in Mahendragarh, bajra in Rewari are the highest during the study period with the value of location quotients to be more than two. The specialization of wheat in Panipat, Hisar and Faridabad, rice in Kurukshetra, Kathal and Karnal, jowar in Rohtak and Faridabad is highest during the period of study. The highest specialization of bajra is observed in Mahendragarh, Rewari and Gurgaon. The increase in value of versatility indices for majority of districts during 2000-01 to 2008-09 as compared to 1991-92 to 1999-2000 implies the move towards specialization. It is established that maize, gram and cotton are highly localized crops.

Fridos Ahimad MD and Shaukat Haseen (2012) studied the Performance of India's Food Grains Production: A Pre and Post Reform Assessment from 1970-71 to 1990-91 and second from 1991-92 to 2008-09. Six parameters are taken into consideration for the analysis. These parameters are total food grains productions, area under cultivation, yield per hectare, consumption of fertilizers, area under irrigation and rain fall. The study revealed that, there is significant decline in growth of production and productivity of total food grain production in post reform period. However the growth of coarse cereal and pulses in post reform period has increased. But most heated items of food grain are rice and wheat whose growth of production and productivity adversely affected in post reform period. The adverse effect on production and productivity of rice and wheat is

not only reduction on subsidiary on agricultural inputs but also the overall declined in amounts of rain fall and shifts in the timing of the rain fall. Any change in rain fall patterns poses a serious threat to agriculture and therefore to the economy and food security.

Deepak K. Ray et al. (2012) analysed recent patterns of crop yield growth and stagnation with the Global yield trends. They found that global yield trends can be broadly divided into four types. First, 'yields never improved' areas that have witnessed no significant yield improvements to date. Second, 'yields stagnated' areas where yields previously improved, but now are stagnating or declining. This category includes a range of yield trends post a year of yield maximum, including yields hovering near the yield maximum (that is, a yield plateau) and yield declines at various rates. Third, 'yields collapsed' areas where yields decreased since the 1960s, or initially increased and then collapsed to the 1960s level. Fourth, 'yields still increasing' areas where yields are still increasing. Overall, their analysis showed that most of the world has historically experienced significant yield improvements. The percentage of the world never experienced maize, rice, wheat or soybean yield improvement is small. They found that the world's maize, rice, wheat and soybean crops are continuing to experience yield increases in over 70, 63, 61 and 76% of their harvested areas, respectively corresponding to 103, 96, 130 and 63 million hectares (m. ha). Globally, however, rice (35%) and wheat (37%) have substantial areas that are now witnessing yield stagnation. Maize (26%) and soybean (23%) have less area in yield stagnation. Furthermore, they also found that 3% of maize, 1% rice and 1% of wheat areas have experienced yield collapse. Areas where yields are still increasing currently contribute roughly 79%, 57%, 56% and 82% of the total global production in maize, rice, wheat and soybean, respectively. This then means that for wheat and rice, at least, yield stagnation may have profound implications on the ability of agriculture to meet the growing global demands for these commodities.

Amarendra Reddy.A (2013) Agricultural productivity growth in Orissa, India: Crop diversification to pulses, oilseeds and other high value crops. Inter-state comparison of agricultural sector with special emphasis on Orissa is done from 1971 to 2008 by using data from statistical abstracts of various states .Out of the Gross Cropped Area (GCA) of 9.0 mha in 2008, 77% is under food grains. Thus, only 23% of the GCA was under non-food grains, which includes oilseeds, fibre crops, and HVCs. Paddy occupies about 50% of GCA, followed by pulses (22%), oilseeds (9%) and HVCs (13%). Area under paddy decreased from 66% in 1971 to 46% in 1991, then again increased to 50% by 2008, while area under oilseeds increased from 4.9% in 1971 to 12% in 1991, then declined to 9%, and pulses area increased from 12.5% in 1971 to 22% in 2008. Area under HVCs increased from 8.1% in 1971 to 13% of GCA in 2008. Cropping intensity increased from 133 % in 1971 to 158% in 2008. Over all, food grain production increased from 5.6 million tons (mt) during triennium ending average (TE) 1973 to 7.4 mt in TE 2008, entirely contributed by increase in paddy production from 4.2 mt in TE 1973 to 6.0 mt in TE 2008. Pulses production stagnant at 0.8 mt and oilseed production is also stagnant at about 0.5 to 0.6 mt. This indicated the dominance and increased importance of paddy in the state. However, productivity of paddy still low, increased slowly from 964 kg/ha to 1335 kg/ha in Orissa, whereas it increased from 1312 kg/ha in period-I to 1940 kg/ha in Period-II for all India. Productivity of pulses declined (from 503 kg/ha to 441 kg/ha) and oilseeds stagnant (from 683 kg/ha to 669 kg/ha) between two periods. The productivity of all major crops was lower in Orissa than all India in both the periods. During Period-I, growth in production of food grains is lower in Orissa compared to all India, while growth in pulses and oilseeds is higher. During Period-II, the growth rates for all the crops (food grains; including paddy, pulses and oilseeds) in production, area and productivity are lower (and reduced) in Orissa than all India. This shows the decline or stagnation in Orissa agricultural sector during both the periods, but it is alarming during recent period. The over emphasis on paddy at the cost of pulses,

oilseeds and other HVCs resulted in stagnation in productivity of the later crops during period-II.

Soumitra Chatterjee et al. (2013) evaluated the temporal analysis of district wise agricultural crop performance scenario in West Bengal, India: They attempted to evaluate district wise growth in acreage, production of major crops grown in the state of West Bengal, India over last three decades (1980-81 to 2011-12) as well as to measure the crop wise level of instability in area and production. Also a comparative study on relative performance of districts in terms of individual crop and aggregation of major crops grown in the state has been performed subsequently, to identify the district wise overall crop-performance scenario for the past three decades. They concluded that there is a subsequent contraction in area under *aus* cultivation in West Bengal with the progress of time. *Aman* is still considered as the major rice grown in predominant rice belt of Bengal features stagnancy in acreage and production over time. *Boro* has gained an immense expansion in acreage in the first decade however fails to retain its pace and started declining in the later phases under study. Wheat area has been subsequently diminished over the year in almost all the districts of the state where jute has still been cultivated in the major jute belt of southern and northern part of Bengal. Potato growth has been spectacular in the first decade in Burdwan and Hooghly while reducing at later phases under study. Mustard has been grown in the traditional belt of Bengal (24-Parganas, Nadia and Murshidabad) while its area started declining as the period progresses. Overall crop performance scenario has featured that progressive districts in terms of agricultural development under gangetic alluvium tract of West Bengal have shown higher crop performance over the period under study. This might be due to improved fertility status of soil with a large number of progressive growers operating in terms of a better knowledge gaining, a better education and extension.

Saleem Abid et al. (2014) analyzed the Growth and Trend in Area, Production and Yield of Major Crops of Khyber

Pakhtunkhwa, Pakistan from 1980-81 to 2011-12 (32 years) of major crops (wheat, maize, rice and sugarcane) . The compound growth rate as well as trend analysis indicated that the area under wheat crop has decreased over the time due to shifting of area to other rabi crops. The production of wheat during 1981-85 to 2010-12 was increased due the corresponding increase in per hectare yield of wheat crop in Khyber Pakhtunkhwa. The results showed that area, production and yield of maize was increased over the time the reason is that more area was brought under hybrid and improved open pollinated maize varieties. The area under rice crop has decreased whereas their production increased due the corresponding increase in per hectare yield of rice crop. It was revealed from the results that area, production and yield of sugarcane crop was increasing at a rate of 0.24 percent, 0.85 percent and 0.60 percent per annum, respectively.

2.2 Changes in cropping pattern

Kebede et al. (2000) studied the diversification of agriculture in Haryana. Study revealed that cereals, commercial crop, vegetables and fruits were found to be relatively towards diversified as compared to pulses and oilseeds among the crops groups. Diversification towards high-tech innovative enterprises within the agriculture sector has been gaining momentum in the state.

Hazra (2001) studied the changes in cropping pattern at the all India level by considering the area share of crops and crop groups at four time points, respectively the triennium ending average of areas at 1966-1967,1976-1977,1986-1987. The study revealed that there was a shift from traditionally grown less remunerative crops to more remunerative crops. The crop shift took place due to government policies and thrust on some crops in a given time. Market infrastructure development and certain other price related support also induced the changes in cropping pattern.

Jayakumar and Velayudham (2002) studied the agricultural stagnation in Kerala and reported that agriculture, though

stagnant for the last many years, was still a major sector of Kerala economy. They observed that the area and production of food crops had been declining over the years, while the area, production and productivity of cash crops had increased. They concluded that the prevalence of obsolete technology in the state and the relative profitability influenced the farmers decision to allocate land under different crops and resulted in agricultural stagnation.

Viranderkumar et al. (2002) examined the changing cropping pattern in Himachal Pradesh. He reported that total cropped area increased by about 21 thousand hectares from 16.69 per cent to 17.06 per cent of the total geographical area during the period 1972-96. The area under wheat, as per cent of total cropped area, increased from 34.27 per cent to 37.66 per cent and that of maize went up from 28.11 per cent to 32.58 per cent. The magnitude of decline in percentage share in area in ragi and other millets was much higher than that of barley.

Kumar and Mittal (2003) examined changes in cropping pattern (crop diversification) that took place in various states of India in three decades during 1970's, 1980's, and 1990's and measures the aggregate changes in cropping pattern in terms of substitution and expansion effects. They also examined the degree of crop diversification in various farm size groups. They concluded that the changes in cropping pattern have been taking place as a result of substitution from low productivity crops to high productivity crops, some of these crops are paddy, wheat, maize, groundnut, rapeseed, mustard and sugarcane. Coarse cereals and pulses have shown a steady decline in the area. Regional pattern in crop specialization is increasing. They have stated that the small farms practiced multi-diversified farming and grow a number of crops even on fragmented plots, involving allocation of area under seasonal fruits, vegetables, etc. for maximizing their household income and employment in almost all regions of the country.

Goswami et al. (2003) in their attempt to study the change in cropping pattern in Mizoram noticed maximum growth rate in pulses (13.82 percent) followed by tapioca (9.46 percent). Area under sugarcane and cotton was showing a significant positive growth rate of 2.56 per cent.

Goswami and Challa (2004) studied the changes in cropping pattern for the period 1951 to 1998. The results showed that there was gradual shift in area from food crops to non-food crops indicating more diversification in recent times. The proportion of area under total cropped area reduced from 61.1 per cent in 1950-51 to 53.08 per cent in 1997-98. Reverse scenario was noticed in the case of total oilseeds where there was almost three-folds increase in area during the period under study.

Tingre et al. (2007) studied growth rate and cropping pattern changes in Amravati division of Vidarbha. They observed that growth rate of major cereals is declined and that of pulses is increased over a period of study. Crop diversification and cropping intensity were significantly increased in Amravati districts.

Dinesh et al. (2007) studied the crop diversification in Chhattisgarh and observed that the pattern of land use and cropping pattern has changed during pre-reform, reform and post reform periods. The area under forest had increased in Chattisgarh plains and Northern hills, while it has decreased in Bastar plateau. Land put to non-agriculture uses and cultivable waste land had increased in Chattisgarh plains while it has depleting very fast. On the other hand, paddy area has been continuously increasing in last three decades. The increase was occurred at the expense of coarse cereals and minor millets area. Wheat area was diverted to gram in post rainy season.

Alagh (2007) studied the growth and changes of Indian agriculture since the eighties. The study revealed that agricultural sector was traditionally regarded as having low price responses.

Cropping patterns were different in different area because of economic reasons or technological reasons but the change was slower.

Batla (2008) studied the regional dimensions of inter-crop diversification in India and observed that inter-crop area shifted in favour of high yielding crops like wheat, paddy, oilseeds, cotton and sugarcane, upto eighties and towards paddy, sugarcane, fruits-vegetables, fibres, plantations, condiments and spices during the nineties and early 2002. The area under wheat and paddy had expanded solely at the cost of low yield growth crops like coarse cereals and pulses due to price support and HYV programme. The high value commercial crops have benefited both from area shifts as well as fresh land brought under cultivation.

Tingre et al. (2008) studied the cropping pattern changes and crop diversification in Akola district of Vidarbha. The study revealed that majority of cereal crops showed negative and low growth rates of area during the study period. Soybean had attained important position in the cropping pattern. The trend of crop diversification and cropping intensity increased significantly.

Meenakshi and Indumathy (2009) studied the land utilization and cropping pattern in Tamil Nadu. The study revealed that there was a considerable reduction in cultivated area and hence output was affected to a great extent. The cropping pattern in the state had a high degree for maladjustment for the crops. Roughly 53 per cent of the cultivated area was being used for growing unsuitable crops.

Tingre et al. (2011) studied the cropping pattern changes and crop diversification in Wardha district of Maharashtra. The study was based on secondary data collected from different Government publications for a period of 32 years *i.e.* 1970-71 to 2001-02. The study has examined the growth rates of area, production and yield of major crops, changes in cropping pattern and the trend in crop diversification and cropping intensity in Wardha district of Vidarbha. The compound growth rates of area, production and yield of major crops were

estimated for two sub-periods viz., period I (1970-71 to 1985-86) and period II (1986-87 to 2001-02). The results showed that in Wardha district the area growth rates declined significantly for rice (-2.99 per cent), bajra (-5.64 per cent) and other crops were stagnant during period I. Whereas the growth rates of production declined significantly with respect to rice (-16.97 per cent) and bajra (-6.74 per cent). Except soybean, the yield growth rates of all the crops were stagnant during period II. In the cropping pattern dominating crops were cotton (32.72%), soybean (31.55%), pigeonpea (12.10%) and *Kharif* jowar (10.04%) constitute the major portion of cropping pattern (86.41 per cent). During the study period, the trend of crop diversification and cropping intensity increased significantly.

Ahmad Fahim Rahimi (2012) analyzed the changes in cropping pattern in Karnataka. The necessary secondary data was collected for a period of 30 years from 1979-80 to 2008-09. Tabular analysis, Growth rate, Concordance analysis and Multiple linear regression analysis were employed to analyze various aspects of the changes in cropping pattern. Plantation, condiments and spices, fruits and vegetables occupied a considerable share in gross cropped area over the periods. Barring cereals and minor millets and commercial crops most of the crops categories registered a positive annual growth rate in area during the study period. Area under soybean, maize, bengal gram, paddy, sugarcane, onion, and green gram has increased over the year while that of the jowar, horse gram, linseed, safflower, sweet potato and coriander has considerably declined in state. *Kharif* crops occupied considerable area in all the districts. Net cropped area showed decreasing trend while cropping intensity has increased in the state and in all the districts. The concordance coefficients revealed that the area share of crops in the study period were not in agreement with each other. Multiple regression analysis revealed that net and gross irrigated area, area under high yielding varieties, annual rainfall and land holdings were the factors responsible for the changes in cropping pattern.

Sheeba Andrews (2013) studied the dynamics of cropping pattern shifts in Kerala : sources and determinants and reported that the dynamics of crop shift from food to non-food/commercial crops and the reasons behind the shift mainly took place after the land reform measures. Thus, the underlying forces behind the crop shift has been identified as the government measures starting with land and labour policies and other institutional measures thereafter to support commercial oriented production. This has been analyzed through decomposition analysis and has been found that the area effect has been contributing more for increasing, production of commercial crops and decreasing production of food crops such as rice, tapioca and pulses. The large scale conversion of paddy land to coconut and rubber needs to be checked as the wetlands are getting destroyed in Kerala.

Kamalika Majumder (2014) examined the Nature and Pattern of Crop Diversification in West Bengal with respect to acreage and production distribution. The study revealed that from both the aspects of area and production over the time span of three decades the cropping pattern in West Bengal is increasingly dominated by boro paddy, oilseeds (including, rapeseed and mustard) and potato. Pulses, as a whole, have lost both in terms of acreage and production in West Bengal. The indices of diversification mostly indicate an increasing degree of crop diversification over time. These crops are either HYV or cash crops and hence are more remunerative over other crops. The oilseeds have another advantage. Besides being remunerative, they also require less irrigation which makes them ideal for cultivation in the areas with less rain or irrigation.

Shelar Suresh Kautik and Raut Vinod Ramdas (January 2015) analyzed the agricultural land use pattern in Nashik District. The study is based on secondary source of data obtained from the district statistical handbook. The study concluded that among the cereals, Bajara and Rice rank first and second respectively. Vegetable, Grapes are major cash crops of the district. The study of ranking indicated that

the farmers of Nashik District prefer food crops firstly and then they cultivate Grapes and vegetable cash crops to fulfill their economic needs due to the lower development of irrigation facilities. The study of crop combination revealed that monoculture is totally absent in the Nashik District and indicated that the lower development of technological factors and irrigation facility.

Chinky Sangral (April 2015) examined Changes in Cropping Pattern and Crop Diversification in Jammu and Kashmir. The study revealed that the area under vegetables and fruits increased at the cost of other food crops which showed a decreasing trend during the study period. A trend of shift from food grains to non food grains has been observed by the process of development which indicates an increasing tendency towards crop diversification. Within crop groups like cereals, there is an increase in the area under wheat and maize, whereas area under rice has been fluctuated. The area under other cereals had decline. Due to the increase in demand for fodder to feed the poultry, the area under fodder has shown an increase and a favourable price policy has resulted in an increase in area under wheat. The cereal crop shown a higher growth, non cereal crops and allied farm activities also recorded improved performance. Even though with the introduction of cropping pattern in the state, production of both food grains and non food grains have tremendously increases but comparatively production of food grains and non food grains had not been increased proportionately.

2.3 Crop diversification

Utpal Kumar De (2000) examined the levels of crop diversification in different districts of West Bengal during 1970-71 to 1994-95. Triennial average of area under crops has been calculated for the periods of area under crops has been calculated for the periods 1970-73, 1977-80, 1984-87, and 1991-94. The different crops diversification indices have been calculated from triennial average data to know the level of concentration at different points of time and their

change over the year. The author concluded that there exists wide spatio temporal variations in the acreage allocation under different crops. In general there has been a movements towards more commercial crops. The author suggested that the study of crop diversification may be utilized to find out its contribution to the changing income and also to examine its long term impact on the resource base viz., productivity of land, use of other resources, etc.

Joshi et al. (2004) studied the status of Agricultural diversification in South Asian countries for a period of two decades from 1980-81 to 1999-2000. For assessing the extent of diversity in crop, livestock and fisheries activities, they used Simpson index. The results of the study revealed that agricultural sector in South Asia is gradually diversifying in favour of high value commodities namely fruits, vegetables, livestock and fish products. Much of the diversification came, if at all, with only little support from the governments. Despite focusing effects towards food grain production in South Asian countries, a silent revolution is witnessed in high-value commodities. The author reported that production of fruits, vegetables, livestock and fish products have increased remarkably in most of the South Asian countries. During 1980's production increase was attributed to the rise in their yield levels. During 1990's production increase came from area augmentation. In Indian context the key determinants for high value commodities (Horticultural and Livestock) were markets and roads and were influencing the status of diversification other important determinant was the technology absorption in the region. Higher the technology adopting of cereals (Particularly irrigation) less was the diversification in favour of high value commodities. Diversification in favour of horticultural and livestock commodities was more pronounced in rainfed areas which was passed during the green revolution but now could take advantage of agricultural diversification. The rainfed areas were becoming a hub of non cereals due to their low water requirement and abundant labour supply. Besides, relative profitability of high value

commodities in relation to other crops also played important role in determining status of diversification.

Ruma Bhattacharyya (2008) studied the crop diversification: a search for an alternative income of the farmers in the state of West Bengal. The results of the study showed that agricultural sector of West Bengal is gradually diversifying towards high value commodities, namely fruits and vegetables and flowers. Detail investigations revealed that most of the diversification has come through individual efforts of the small farms with little support from the government. A silent revolution is taking place and area coverage of fruits vegetables and flowers has increased substantially during the last few years. The higher returns from the high value crops therefore supports commercialization and diversification of small farms within and outside agriculture and their proper integration with local and global markets. This is intended not only to liberate the small and marginal farmers from the poverty trap, but also to meet the country's growing demands for fruits, vegetables, which generally show rising trends with increasing levels of per-capita income in the economy. Diversification is more prominent in rainfed areas than in irrigated zones. In fact the rainfed areas are becoming the hub of non cereals due to their low water requirement and abundant labour supply.

Prahadeeswaran et al. (2009) studied changing pattern of crop diversification and evidences for commercialization of Agriculture. There are several indices, which explain either concentration or diversification of activities in given time and space by a single quantitative indicator. Important indices used to study the crop diversification are Herfindahl Index (HI), Simpson Index (SI), Ogive Index (OI), Entropy Index (EI), Modified Entropy Index (MEI), and Composite Entropy Index (CEI). Shiyani and Pandya (1998) and Sundaresan et al.(2002) had applied more than one of the above indices to study the diversification of agriculture in Gujarat and Coastal districts fo Tamil Nadu, respectively.

based on agriculture and occupied by different crops, had both a tendency to specialize and diversify. The technique crop diversification index identifies the areas having a tendency of crop diversification in the study area; it also aids to know the cropping pattern, crop concentration, crop variation etc. Variations of crop diversification in response to fast changing physical and socio-cultural conditions are studied for 1996-1997 and 2006-2007 employing Singh's (1976) index of crop diversification. For block level analysis the technique has been classified into various groups. Rice, jute wheat and mustard along with other pulses are the major crops diversified.

Hrideshwer Gupta (2013) examined the agricultural diversification in India. The study revealed that in year 2007-08, the agriculture sector had achieved an impressive growth of 5.8 percent. However; this high growth could not be maintained in the following two years and agriculture sector fell into the negative zone of -0.1 percent in 2008-09, although this was a year of a record 234.47 million tones food production. The decline in growth of agricultural GDP was primarily due to the fall in the production of agricultural crops such as oilseeds, cotton, Jute and Mesta and sugarcane. In 2009-10, despite experiencing the worst south-west monsoon since 1972 and subsequent significant fall in Kharif food grain production, the growth marginally recovered to 0.4 percent primarily due to a good Rabi crop. Thus concluded that the significance of agriculture in India arises also from the fact that the development in agriculture is an essential condition for the development of the national economy.

2.4 Advantageous crops

Takashi Kurosaki (2003) studied the economics of crop diversification in which he concluded that in order to examine the benefits of diversification, land concentration ratio in tahsils with comparative advantage is computed for selected years. The comparative advantage is approximated by the per acre gross revenue of each crop relative to the average revenue of each crop relative to

the average revenue of the remaining crops. If the ratio for a crop increases over time, it implies that area under the crop is being concentrated in tahsils that have comparative advantage in producing a crop over other crops.

Jadav Varsha Pandurang (2011) studied the economics of crop diversification in Amravati district. She concluded that in order to examine the benefits of diversification land concentration ratio in tahsils of Amravati district with comparative advantage is computed for the period of 1990-91 to 2009-10. The comparative advantage is approximated by the per acre gross revenue of each crop relative to the average revenue of the remaining crops. The results showed that soybean and cotton are the adventitious crops in the selected tahsils during the study period.

CHAPTER III

METHODOLOGY

The object of any investigation is to draw the useful conclusion in the light of objectives of the study in order to arrive the meaningful conclusion. It is essential to the investigator to adopt appropriate method and procedure, keeping in view, this chapter has devoted to explain the methodology adopted to fulfill the objectives of the study. The present study aimed at analyzing the changes in cropping pattern and crop diversification in different districts of Amravati division of Maharashtra.

3.1 Selection of Crops

The major food grain and non food grain crops of Amravati division were selected for the present study. Selected crops occupied more than 80 per cent gross cropped area of districts selected in Amravati division. Thus, present study was confined to major crops with an assumption that excluded crops do not affect cropping pattern and in turn would not vitiate main conclusions of the study. The eleven crops were selected purposively for present study like Rice, Wheat, Soybean, Cotton, Jowar, Bajra, Gram, Tur, Mung, Groundnut, Sugarcane.

3.2 Data Collection

For the present study the secondary data were collected from various published sources. Time series secondary data on the area, production, productivity of selected crops, farm harvest prices and other agricultural data were obtained from various published sources. To fulfill the 1st three objectives the data were collected for the period of 1970-71 to 2013-14 and to fulfill the 4th objective the data were collected for the period of last 10 years. The following publications were referred for recording the data in present study.

1. District socio-economic review- Buldana district, Akola district, Amravati district, and Yavatmal district (1970-71 to 2000-01).
2. www.indiastat.com
3. Seasons and crop reports, agriculture department, Maharashtra State (1970-71 to 2013-14).
4. Department of Agriculture, Maharashtra.
5. For estimating the land concentration ratios of selected crops data was collected from Agricultural Prices and Costs Scheme (APC), Department of Agricultural Economics and Statistics, Dr.PDKV, Akola.

3.3 Analytical tools and technique

3.3.1 Analysis of examination of the performance of major crops

a) Exponential model

For examining the performance of different crops growth rates of area, production, and productivity of major crops were estimated using exponential model.

$$Y = ab^t$$

Where,

Y = area, production, yield

a & b = parameters to be estimated from exponential model

$$\text{Compound Growth Rate} = [\text{Antilog}(\log b) - 1] \times 100$$

b) Coefficient of variation (C.V)

Coefficient of variation of area, production and yield were calculated by using the following formula

$$c. v. = \frac{\text{Standard deviation}}{\text{Mean}} \times 100$$

3.3.2 Analysis of changes of cropping pattern

The changes in cropping pattern were studied by simple tabular analysis for all the major selected crops. Cropping pattern in terms of percentage share of individual crops in gross cropped area in districts of Amravati division were worked out at different points of time.

3.3.3 Analysis for the extent of crop diversification

The extents of crop diversification were studied by using Herfindahl diversification index.

a) Herfindahl index (HI)

Herfindahl index was computed by taking the sum of squares of acreage proportion of each crop to the total cropped area.

$$HI = \sum_{i=1}^N P_i^2$$

Where,

N= The total number of crops.

P_i= Proportion of acreage under ⁱth crop to total cropped area.

The value of HI is bounded by zero (perfect diversification) and one (complete specification). The value of HI approaches zero as 'N' becomes large and takes value one when only one crop is cultivated.

3.3. 4 Analysis of Economics of crop diversification

Land concentration ratio:-

To examine the benefits of diversification, land concentration ratio in the selected districts of Amravati division with comparative advantages was computed based on the sample for last 10 years. The comparative advantage is here approximated by the per hectore net revenue of each crop relative to the average revenue of the remaining crops (Takashi Kurosaki, 2003).

(The sum of the areas under the crop of concern in districts that will be ranked the top four in terms of comparative advantage in yield disparity ranking) / (the sum of the areas under the crop of concern in districts that will be ranked the bottom four).

CHAPTER IV

SOCIO-ECONOMIC STATUS OF AMRAVATI DIVISION

4.1 Location of Amravati division

Amravati division falls under Vidarbha region of Maharashtra. It comprises of five districts namely Akola, Amravati, Buldhana, and Yavatmal. Amravati district lies between 20°32' and 21°46' North latitude and 76°-37' and 78°-27' East longitude. There is the boundary of the Wardha district on east, south Yavatmal district. Akola district is on west side and Baitul district of Madhya Pradesh on north side of Amravati district. The Buldhana district lies between 19°⁰,51' to 21°⁰,17' north latitudes and 76°⁰,38' to 76°⁰,40' East longitudes the district is surrounded by the spatula ranges in east side. The Yavatmal district lies between 19°⁰,26" and 28°⁰,42" of North Latitude while 77°⁰,18" and 79°⁰,18" of Eastern Longitude. It covers area of 13584 sq. km. accounting for 4.41 per cent of the total area of Maharashtra. The Akola District lies between 20° 17' and 21° 18' North latitudes and 76° 17' and 77° 14' East longitudes. It covers area of 5417 sq. km. accounting for 1.76 per cent of the total area of Maharashtra. Akola district is surrounded by Amravati district in North, part of Amravati and Yavatmal district in East, Washim and Yavatmal district to the South and Buldana district towards the West. Akola lies to its north, Amravati lies to its north-east, Hingoli lies to its south, Buldhana lies to its west and Yavatmal lies to its east. It covers area of 13584 sq.km accounting for 29.50 per cent of the total area of Amravati division and 4.4 percent area of state.

4.2 Administrative set up

Maharashtra State has six revenue divisions viz., Mumbai, Pune, Nasik, Aurangabad, Amravati and Nagpur. Vidarbha area includes Amravati and Nagpur revenue divisions comprising eleven districts viz., Buldhana, Akola, Washim, Amravati, Yavatmal, Wardha, Nagpur, Bhandara, Gondia, Chandrapur, and Gadchiroli.

Washim and Gondia are newly formed districts bifurcating Akola and Bhandara districts respectively. The present study is confined to Amravati division of Vidarbha region of Maharashtra comprising four districts viz. Akola, Amravati, Buldhana, and Yavatmal.

4.3 Agro-climatic conditions

4.3.1 Topography and soil

Amravati district is widely cultivated tract possessing rich deep black soil generally called as 'Black Cotton Soil'. The pH of soil is 7.5 to 8.5 on the side of Wardha River and Purna River, the tract is fertile. Near the hills on the Southern border, there is shallow and inferior soil. Cotton, Soybean, Gram and Red gram are the major crops grown in the region. Citrus (Orange) is the major fruit crop grown in the district.

The eastern part of Buldhana district lies in Purna valley, which itself is a part of Tapi river. The Purna which is the chief tributary of the river Tapi has formed fertile soil. The eastern Part of the district has medium type soil. The district has 363 meters above mean sea level. The soils of district are suite fertile. Rich black cotton soil is found in Eastern part of district. The central part has also good soils on the plateau. In the north, the soils are shallow with murum substratum; medium black soil is found in the rivers valleys.

Yavatmal district is a hilly region. The hills of Ajanta and Pusad are situated here. Pusad, Umardhed and Mahagaon talukas and some parts of Digras and Arni occupies this region. The Northern part of Yavatmal district is a plateau. It covers Darwaha, Ner and Yavatmal taluka and some parts of Arni and Digras taluka. The soils are severely eroded & shallow. . The soils of the district are 50% light (7.5 – 25 cm i.e. Entisol), 30% medium (26-50 cm i.e. Inceptisol) and 20% black cotton soils (91 – 100 cm i.e. Vertisol).

The northern part of the Akola district lies in Purna valley which itself is a part of Tapi river basin. River Purna has formed fertile

basin in Akola, Balapur and Murtizapur tahsils of Akola. The soil of the district is basically derived from volcanic trap rock and it is quite fertile. It is classified into categories as coarse soil found in south, medium black soil found in the plain and deep black soil found in river valley.

4.3.2 Climate and rainfall

Climate and temperature is different in different district of Amravati Division.

The climate of the Amravati District remains very hot in summer and cold in winter. The temperature in the month of May is generally high, average maximum and minimum temperature in 2011 on Amravati division was 40.1°C and 12.4°C respectively. Amravati division falls in medium and assured rainfall zone of Maharashtra state having an average annual rainfall 918.08mm during 2011. The rainfall is comparatively more in northern part than the south.

In some parts of the Buldana district i.e. khamhgaon, Jalgaon (Jamod) and Shegaon Tahsils the climate is severe i.e. very hot in summer which reaches upto 44°C in the months of May and much cold in the winter, during the month of December which comes down to 8-10°C. Buldana district falls in western zone of Vidarbha region having an average rainfall between 750-800 mm.

The climate of the Yavatmal district during winter is too cool, while in summer it is too hot. The average minimum and maximum temperature extremities observed throughout the year 2013-2014 were 10°C and 45.5°C, respectively. The district Yavatmal falls under Agro-climatic Zone No. 8 i.e. Moderate Rainfall Zone. Only small western part of Darwaha & Ner Tahsils falls under assured rainfall zone No. 7. The Average rainfall received in this Zone usually exceeds 900 m. m. The climate is hot and dry. More than 75% rainfall in this zone is received in Kharif season; hence Kharif cropping system predominates in the zone.

The climate of the Akola district during winter is too cool, while in summer it is too hot. The average minimum and maximum temperature extremities observed throughout the year were 10°C and 46.5°C, respectively. Akola district falls in assured rainfall zone of Maharashtra state having average rainfall between 750 to 1000 mm.

4.4 Demographic features

4.4.1 Population

As per the important demographic features of the district as per official census 2011, the Akola district population was 18,18,617 which constitute about 1.62 per cent of state population. Out of the total population 51.48 per cent were males and 48.52 per cent were females. The sex ratio was 942 females for every 1000 males. The density of the population for the district was 321 persons per sq.km. The population growth was recorded at 11.60 per cent when compared to 2001 census which was 20.58 per cent.

The Yavatmal district population was 2,772,348 which constitute about 2.47 per cent of state population. Out of the total population 1,419,965 (51.21%) were males and 1,352,383 (48.78 %) were females. The sex ratio was 952 females for every 1000 males. The density of the population for the district was 204 persons per sq.km. The population growth was recorded at 12.78 per cent when compared to 2001 census which was 18.35 per cent.

Table 4.1: Demographic particulars of Amravati division

District	Population lakhs			Density (person/km)	Sex Ratio No of female/1000 male			Literacy (%)			Population growth since 2001-2011
	Rural	Urban	Total		Rural	Urban	Total	Rural	Urban	Total	
Akola	10.96 (60.31)	7.21 (39.69)	18.17 (100)	321	931	951	942	85.22	91.07	87.55	11.60
Amravati	18.51 (64.10)	10.36 (35.90)	28.87 (100)	237	945	952	947	88.22	85.89	92.37	10.71
Buldana	20.38 (18.55)	5.49 (21.23)	25.87 (100)	268	926	938	928	80.36	88.37	82.09	15.92
Yavatmal	21.76 (81.59)	5.99 (18.41)	27.75 (100)	204	944	954	947	77.96	96.71	80.70	12.90

Source: Directorate of census operations in Maharashtra, 2011

4.4.2 Land Holding

The details of land holding of Amravati Division are presented in district wise in Table 4.2.

Table 4.2: Land holding of Amravati division

Sr. No.	Land holding (ha)	Land holders (%)	Area (%)
Akola			
1.	0-2	52.93	24.12
2.	2-5	32.68	33.61
3.	5-10	11.28	27.23
4.	10-20	2.02	12.98
5.	20-50	1.09	2.06
6.	Total holding	100	100
Amravati			
1.	0-2	34.56	37.80
2.	2-5	27.21	24.58
3.	5-10	22.74	21.76
4.	10-20	13.28	14.01
5.	20-50	2.21	1.85
6.	Total holding	100	100
Buldana			
1.	0-2	26.92	7.73
2.	2-5	36.32	23.80
3.	5-10	24.02	29.58
4.	10-20	11.40	30.01
5.	20-50	1.34	8.88
6.	Total holding	100	100
Yavatmal			
1.	0-2	4.15	0.87
2.	2-5	35.60	15.78
3.	5-10	34.35	28.22
4.	10-20	22.32	39.35
5.	20-50	3.58	15.78
6.	Total holding	100	100

Source: District Socio-economic Review

4.4.3 Land Utilization Pattern

The geographical area of the Akola district is 5,40,481 ha. During the year 2010-11 the cultivable land (i.e., net area sown, current fallows and other fallow lands) was 4,47,331 ha and it is accounted for 82.76 per cent of the total geographical area of the district.

The information in respect of land utilization pattern in Amravati district is the total geographical area 12217 ha during the year 2010-11.

The geographical area of the district is 13, 51,900 ha. During the year 20010-11 the cultivable land (i.e., net area sown, current fallows and other fallow lands) was 1186500 ha and it is accounted for 87.76 per cent of the total geographical area of the district.

The details of land use pattern of Amravati division are presented in Table 4.3.

Table 4.3: Land utilization pattern of Amravati division

		District wise Land Utilization Pattern in Amravati Division							
Sr. No.	Particular	Akola		Amravati		Buldana		Yavatmal	
		Area (Ha)	% to total area	Area (Ha)	% to total area	Area (Ha)	% to total area	Area (Ha)	% to total area
1.	Total geographical area	540481	100	12217	100	967100	100	1351900	100
2.	Area under forest	36414	6.73	3101	25.38	883	9.13	25430	1.88
3.	Barren and uncultivable land	18280	3.38	195	1.59	483	4.99	39400	2.91
4.	Permanent pastures and other grazing land	5292	0.97	531	4.35	13391	138.46	60800	4.49
5.	Land under miscellaneous tree crops	8098	1.49	70	0.57	10	0.10	60800	4.49
6.	Cultivable waste land	5958	1.10	93	0.76	263	2.72	25400	1.87
7.	Land put under non-agricultural use	5801	1.07	435	3.56	511	5.28	41600	3.07
8.	Current fallow	7911	1.46	136	1.12	174	1.80	299900	22.18
9.	Other Fallow	5262	0.97	143	1.18	272	2.81	28700	2.12
10.	Net sown area	447331	82.76	7513	61.49	6684	69.11	857900	63.45
11.	Area sown more than once	37086	6.86	2776	22.72	1695	17.53	79000	5.84
12.	Gross cropped area	484417	89.62	10289	84.21	8379	86.64	936900	69.30
13.	Cropping intensity (%)	108.29	-	136.95	-	125.36	-	101.06	-

Source: District Socio-economic Review

4.5 Cropping pattern

Cotton, *Kharif* sorghum, soybean and mung etc crops were grown in the Amravati Division followed by Tur, Gram, Wheat, Udid, Sunflower, Maize, Bajra and Sugarcane. The area under different crops grown in different district was furnished in the Table 4.4.

Table 4.4: Cropping pattern of Amravati division

Sr. No.	Crops	Area (ha)	Percentage to total
A. Akola			
1.	Wheat	18871	3.89
2.	Kharif Jowar	84922	17.53
3.	Bajra	1210	0.24
4.	Maize	2451	0.50
5.	Other cereals.	21	0.004
	Total cereals.	107367	22.16
6.	Gram	20087	4.14
7.	Tur	25634	5.29
8.	Mung	43334	8.94
9.	Udid	14082	2.90
10.	Other Pulses	1038	0.21
	Total Pulses	104308	21.53
	Total food grains	211675	43.69
11.	Sugarcane	335	0.06
12.	Cotton	192994	39.84
	Total Fibre crops	194166	40.08
13.	Soyabean	40613	8.38
14.	Sunflower	3550	0.73
15.	Groundnut	1332	0.27
16.	Other oilseeds	8497	1.75
	Total oilseeds	55877	11.53
17.	Total fruits and Vegetables	6924	1.42
18.	Other crops	15598	3.22
	Gross cropped area	484417	100.00
B. Amravati			
1.	Paddy	103	1.00
2.	Wheat	1318	12.80

3.	Jowar	245	2.39
4.	Other cereals	306	2.99
	Total cereals	1972	19.18
5.	Gram		
6.	Tur	562	5.46
7.	Other pulses	1087	10.56
	Total pulses	986	9.58
	Total Food Grain	2635	25.60
C.	Non Food Grain	4607	44.78
8.	Groundnut		
9.	Safflower	167	1.62
10.	Sunflower	163	1.58
11.	Soybean	148	1.44
12.	Total Oilseeds	1664	16.17
13.	Cotton	2142	20.81
14.	Sugarcane	3488	33.76
	Total Non Food Grain	52	0.51
	Gross cropped area	5682	55.22
C.		10289	100.00
Buldana			
1	Rice	368	4.39
2	Wheat	214	2.55
3	Jowar (kharif+Rabi)	151	1.80
4	Bajara	641	7.65
5	Maize	145	1.73
6	Other millet	472	5.63
	Total cereals	1991	23.76
7	Gram	131	1.56
8	Tur	382	4.56
9	Mung	765	9.12
10	Udid	704	8.40
12	Other pulses	43	2.49
	Total pulses	2025	24.16
	Total food grain	4016	47.92
13	Sugarcane	374	4.46
14	Chilli	60	0.72
15	Other spices	192	2.29
	Total spices	626	7.47

16	Fruits	61	0.73
17	Vegetables	37	0.44
18	Cotton	162	1.93
19	Other fiber crop	30	0.35
	Total fiber crop	288	3.46
20	Groundnut	126	1.50
21	Sesamum	34	0.41
22	Sunflower	38	0.45
22	Other oilseed crop	201	2.39
	Total oilseed crop	399	4.76
	Total non-food crops	3050	36.40
23	Gross cropped area	8379	100
D. Yavatmal			
1.	Wheat	19037	2.03
2.	Kharif jowar	68775	7.3
3.	Maize	401	0.042
4.	Other cereals.	47	0.005
	Total cereals	88485	9.44
5.	Gram	31228	3.33
6.	Tur	97031	10.35
7.	Mung	10931	1.16
8.	Udid	7364	0.78
9.	Other Pulses	1050	0.11
	Total Pulses	146574	15.64
	Total food grains	235059	25.08
10.	Sugarcane	5950	0.63
11.	Cotton	457357	50.95
12.	Soybean	228928	24.43
13.	Groundnut	18	0.001
14.	Other oilseeds	1560	0.16
	Total oilseeds	229059	24.44
15.	Total fruits and Vegetables	7253	0.77
16.	Gross cropped area	9,36,900	100.00

4.6 Crop Season and Crop Rotation

There are two important crop seasons i.e. *kharif* and *Rabi* where as in summer season land generally remains fallow and preparatory tillage operations are carried out. The manner in which crop rotations are commonly followed is presented in Table 4.5.

Table 4.5: Crop season and crop rotation in Amravati division

Sr. No.	Kharif	Rabi
1.	Cotton	-
2.	Cotton + Tur + Jowar	-
3.	Jowar	Gram
4.	Cotton + Mung + Udid	Wheat
5.	Cotton + Tur + Mung	Gram
6.	Jowar	Safflower / wheat
7.	Cotton + Tur	Safflower
8.	Cotton + Tur + Jowar + Mung	Sunflower
9.	Mung	Safflower
10.	Cotton + Mung	-
11.	Cotton + Soybean	Gram
12.	Soybean + Tur	Wheat / Gram
13.	Cotton + Jowar	-

Source: District Socio-economic Review

4.7 Input supply

Agricultural inputs like seed, manure, fertilizers, insecticides, pesticides etc. required to the farmers are made available to them through number of agricultural service centers established at district level and block levels.

Maharashtra State Seed Corporation and other private seed companies supply quality seeds to the farmers. The farm input are made available to the farmers by co-operative societies functioning at block level, Panchayat Samiti also provides inputs to the farmers.

Co-operative society supply input against the loan sanctioned by DCCB to individual cultivator.

4.8 Credit supply

The credit supply in Amravati division is done by Primary Agriculture Co-operative Credit Society, Non-agricultural credit Society, Panan Sanstha, Production Society and Social Service Society.

4.9 Markets

For the marketing of agricultural produce, agricultural market committees are functioning in the district. All the districts of Amravati division have facilities of regulated markets. These sub-markets are connected with roads and having facilities of banking, electricity etc.



Location of Amravati Division in Maharashtra



Fig. 4.1: Map of Amravati division

CHAPTER V

RESULTS AND DISCUSSION

This chapter reveals the results and discussion under the following heads and it is presented the result as per objectives of the study.

5.1 Performance of major crops

5.2 Changes in cropping pattern

5.3 Crop diversification

5.4 Advantageous crops

5.1 Performance of major crops

5.1.1 Growth rates of area, production and productivity in Amravati division

Performance of important crops of different districts in Amravati division can be ascertained through studying the growth in area of major crops. Compound growth rate of area of major crops were worked out for different districts of Amravati division i.e. Akola, Amravati, Buldhana, Yavatmal and as a whole Amravati division. The growth rates are worked out for four sub periods, viz., Period-I (1970-71 to 1979-80), Period-II (1980-81 to 1989-90), Period-III (1990-91 to 1999-2000), Period-IV (2000-01 to 2013-14), and overall period. The results were presented in Table 5.1, 5.2, 5.3, 5.4 and 5.5.

Amravati division

Compound growth rates of area, production and productivity of major crops in Amravati division are presented in Table 5.1.

Table 5.1 Compound growth rates of area, production and productivity of major crops in Amravati division

Sr.No	Crops	Area					Production				
		Period-I	Period-II	Period-III	Period-IV	Overall	Period-I	Period-II	Period-III	Period-IV	Overall
1	Rice	3.088**	-3.05**	-9.59***	-13.14***	-4.05***	13.85***	-9.20***	-7.36***	-16.29***	6.31***
2	Wheat	4.71***	-7.13***	2.18*	9.10***	-1.04	15.37***	-4.01***	1.93*	11.60***	1.57
3	Jowar	6.31***	-1.49	-6.49***	-9.84***	-3.77***	18.28***	1.47	-6.05***	-11.51***	-2.35**
4	Bajra	-0.67	-0.91	-6.67***	-12.73***	-5.21***	11.90***	8.59***	-4.48***	-9.62***	-3.22***
5	Gram	6.16***	11.56***	8.52***	10.24***	5.60***	7.42***	17.23***	8.15***	16.12***	8.96***
6	Tur	1.55	6.91***	0.95	0.54	2.45**	3.48***	10.30***	5.80***	0.35	2.86***
7	Mung	2.98**	9.46***	0.46***	-3.74***	2.08**	14.13***	16.47***	5.02***	0.20	4.81***
8	Other pulses	3.24**	8.11***	-1.14	-18.31***	-11.26***	0.08	18.10***	1.40	-14.15***	-10.11***
9	Sugarcane	5.20***	8.05***	-1.67	-6.33***	2.69***	5.79***	44.98***	-1.30	-5.89***	9.47***
10	Cotton	-0.02	0.43	0.16	-1.36	-0.90	6.56***	4.06***	-0.32	8.69***	2.99***
11	Soybean			1.78	10.60***	13.62***			36.86***	11.63***	14.25***
12	Ground nut	-0.21	-5.43***	-12.56***	-0.81	-7.11***	0.13	-2.81**	-7.04***	3.51***	-4.66***
13	Other oilseeds	-2.42**	15.29***	7.13***	9.60***	6.07***	-10.90***	11.56***	15.18***	11.48***	8.29***

Table continued 5.1

Table continued 5.1

Sr.No	Crops	Productivity				Overall
		Period-I	Period-II	Period-III	Period-IV	
1	Rice	9.39***	-6.71***	-0.35	-9.21***	1.58
2	Wheat	9.55***	2.57**	-0.64	2.37**	2.50**
3	Jowar	14.20***	2.82**	1.75	-1.81*	1.63
4	Bajra	4.99***	2.21*	1.28	2.03*	2.52**
5	Gram	1.52	5.12***	0.47	5.65***	3.07***
6	Tur	-0.68	3.36***	3.17**	0.14	0.78
7	Mung	11.25***	9.21***	3.44***	3.85***	3.08***
8	Other pulses	7.34***	8.62***	2.00*	-0.15	2.04**
9	Sugarcane	3.19**	32.86***	1.57	-7.61***	-12.83***
10	Cotton	6.83***	3.46***	-0.17	12.09***	4.14***
11	Soybean	-	-	4.81***	0.58	-0.46
12	Ground nut	-0.36	1.35	5.88***	4.11***	3.96***
13	Other oilseeds	0.45	-8.23***	7.73***	1.38	4.22***

***, **, * denote statistical significance at 1, 5 and 10 per cent level respectively.

Period-I (1970-71 to 1979-80); Period-II (1980-81 to 1989-90); Period-III (1990-91 to 1999-2000); Period-IV (2000-01 to 2013-14).

The compound growth rates of area of all cereals increased significantly except bajra which showed stagnancy during period-I. Among pulses all crops showed positive significant growth except tur which showed stagnancy in the growth rate under area. Sugarcane growth rate also increased significantly by 5.20 per cent during period-I. The growth rates of area under cotton and groundnut were stagnant and negative significant growth rate was observed in case of other oilseeds during period-I. on the other hand during period-II among the cereals rice and wheat showed negative growth rate by 3.05 per cent and 7.13 per cent. Rest of the crops showed positive significant growth rate except cotton which showed stagnancy and groundnut which showed negative significant growth rate of area by 5.43 per cent during period-II. During period-III and period-IV the growth rate for cereals were same i.e. negative significant growth for all cereals except in wheat which showed positive significant growth rate by 2.18 per cent in period III and 9.10 per cent in period-IV. Among pulses during period-III positive significant growth were observed in gram by 8.52 per cent and mung by 0.46 per cent, while tur and other

pulses showed stagnancy. Other oilseeds showed positive significant growth rate by 7.13 per cent and groundnut showed negative significant growth rate by 12.56 per, while sugarcane, cotton and soybean showed stagnancy in the growth rate of area during period-III. During period-IV gram showed positive significant growth rate 10.24 per cent while mung and other oilseeds showed negative significant growth rate by 3.74 per cent and 18.31 per cent. On the other hand stagnant growth rate was observed in tur, cotton and ground nut. The growth rate of area under soybean and other oilseeds increased significantly by 10.60 per cent and 9.60 per cent and it was declined significantly in case of sugarcane by 6.33 per cent during period-IV. During overall period growth rates of area were declined significantly in all the cereals. Among pulses the area growth rate for gram increased significantly by 5.60 per cent during the study period. The highest growth rates of gram were observed during period-II i.e. 11.56 per cent. The area growth for soybean increased significantly during overall period with 13.62 per cent. The growth rate of tur, mung, sugarcane and other oilseeds were also increased significantly by 13.38 per cent. The area growth rate under mung and groundnut declined significantly by 11.26 per cent and 7.11 per cent. The wheat and cotton crops showed stagnancy in growth rate of area during the overall period, respectively.

In case of production, during period-I all the crops showed positive significant growth rates of area except other pulses and ground nut which showed stagnancy. During period-II rice, wheat and groundnut showed negative significant growth rates of production by 9.20 per cent, 4.01 per cent and 2.81 per cent, respectively. Rest of the crops showed positive significant growth rates of production, except jowar which showed stagnancy. During period-III, among cereals all crops showed negative significant growth rates of production except wheat which showed positive significant growth rate by 1.93 per cent. Among pulses the growth rates of production of all crops increased significantly except other pulses which showed stagnancy. The growth rates of production of Sugarcane and cotton showed stagnancy during period-III while groundnut showed negative significant growth rate by 7.04 per cent. During period-III the

was declined significantly in case of rice and jowar by 9.21 per cent and 1.81 per cent. Among pulses, the growth rates of productivity of gram and mung increased significantly by 5.65 per cent and 3.85 per cent, while it was declined significantly in other pulses by 0.15 per cent. During period-IV, the growth rate of productivity of tur showed stagnancy. The growth rates of productivity of sugarcane were declined significantly by 7.61 per cent and were observed stagnant in soybean and other oilseeds. During period-IV, the growth rates of cotton and groundnut were increased significantly by 12.09 per cent and 4.11 per cent respectively. During overall period, the growth rates of wheat and bajra were increased significantly by 2.50 per cent and 2.52 per cent. Rice and jowar showed stagnancy during overall period. Among pulses except tur all crops showed increase in growth rate of productivity while tur showed stagnancy during overall period. The growth rate of productivity of sugarcane declined significantly by 12.83 per cent. The growth rate of productivity under cotton by 4.14 per cent, groundnut by 3.96 per cent and other oilseeds by 4.22 per cent were increased significantly during overall period. The growth rate of productivity of soybean showed stagnancy during overall period.

5.1.2 Growth rates of area, production and productivity of major in crops Akola district

The compound growth rates of area, production and productivity of major crops for Akola district are presented in Table 5.2.

During period-I, the growth rate of area of wheat was increased significantly by 3.06 per cent and for bajra it was declined significantly by 1.65 per cent. The growth rates of rice and jowar showed stagnancy during period-I. the growth rates area under all the pulses were increased significantly during period-I and among pulses other pulses showed highest growth rate by 11.48 per cent. The growth rates under cotton and other oilseeds also increased significantly by 1.91 per cent and 8.16 per cent, respectively. Sugarcane and groundnut showed stagnancy in the growth rates of area during period-I. During period-II, the growth rates of area under rice and wheat declined significantly by 5.01 per cent and

7.44 per cent. On the other hand jowar and bajra showed stagnancy in the growth rate of area. The growth rates of area under all pulses were increased significantly during period-II also. The growth rates of area of sugarcane and groundnut declined significantly by 5.63 per cent and 11.70 per cent, respectively and it was stagnant in case of cotton. During period-II the growth rate of other oilseeds were increased significantly by 14.67 per cent. During period-III the growth rates of area under all cereals crops were declined significantly except wheat which showed positive significant growth by 3.61 per cent. Among pulses gram showed positive significant growth rate by 9.82 per cent, while rest of the crops showed stagnancy. The growth rates of area under sugarcane and groundnut were declined significantly by 4.94 per cent and 14.27 per cent. Soybean growth rate of area was increased significantly by 43.13 per cent and it was stagnant in case of cotton during period-III. During period-IV, the growth rates of area under all cereal crops declined significantly except in wheat which showed positive significant growth rate by 8.79 per cent. Among pulses the growth rates area of gram and tur increased significantly by 12.25 per cent and 1.93 per cent, while mung and other pulses growth rates were declined significantly by 2.32 per cent and 19.09 per cent respectively during period-IV. The growth rates of area under sugarcane and cotton were declined significantly by 33.58 per cent and 4.84 per cent. During period-IV the growth rates of area of soybean, groundnut and other oilseeds increased significantly by 11.97 per cent, 9.04 per cent and 11.91 per cent respectively. During overall period growth rates of area were declined significantly in all the cereals. Among pulses the area growth rate for gram increased significantly by 4.48 per cent during the study period. The highest growth rates of gram were observed during period-IV i.e. 12.25 per cent. The area growth rate for soybean increased significantly during overall period with 20.02 per cent where the highest growth was observed in period-III with 43.13 per cent. The growth rate of other pulses, sugar cane, cotton, and groundnut were also declined significantly. The rest of the crop showed stagnancy in growth rate of area during overall period.

In case of production, the growth rates of all the cereals, pulses and cotton were increased significantly during period-I. The growth rate of production of other oilseeds were declined significantly by 11.07 per cent, while it was observed stagnancy in case of sugarcane and groundnut during period-I. During period II, the growth rates of production under rice and wheat declined significantly by 10.91 per cent and 4.58 per cent. On the other hand jowar growth rate of production increased significantly by 7.05 per cent and bajra showed stagnancy. The growth rates of production under all pulses were increased significantly during period-II also. The growth rates of production of groundnut declined significantly by 12.75 per cent. During period-II the growth rate of production sugarcane, cotton and other oilseeds were increased significantly by 29.12 per cent, 4.89 per cent and 17.87 per cent respectively. During period-III the growth rates of production under all cereals crops were declined significantly except wheat which showed positive significant growth rate by 4.28 per cent. Among pulses the growth rates of all crops were increased significantly except other pulses which showed stagnancy. The growth rates of production under sugarcane and groundnut were declined significantly by 5.42 per cent and 8.87 per cent. Soybean growth rate of area was increased significantly by 47.47 per cent and it was stagnant in case of cotton during period-III. During period-IV, the growth rates of production under all cereal crops declined significantly except in wheat which showed positive significant growth rate by 12.34 per cent. Among pulses the growth rate of production of gram increased significantly by 17.67 per cent, while tur and mung showed stagnancy. Other pulses growth rates of production were declined significantly by 11.75 per cent. The growth rate of production under sugarcane was declined significantly by 4.21 per cent. During period-IV the growth rates of production of cotton, soybean, groundnut and other oilseeds increased significantly by 3.75 per cent, 11.33 per cent, 15.60 per cent and 13.32 per cent respectively. During overall period growth rates were declined significantly in all the cereals except wheat which showed stagnancy. During overall period, growth rates of production were increased significantly in gram, tur, mung, sugarcane, soybean and other oilseeds by 7.95 per cent, 1.80 per cent, 4.29 per cent, 1.81 per cent, 20.52

per cent and 8.20 per cent respectively. During overall period cotton showed stagnancy in the growth rate of production.

In case of productivity, the growth rates of all the cereals were increased significantly during period-I. among pulses all crops showed increased significant growth rate except gram which showed stagnancy. The growth rates of sugarcane and cotton were also increased significantly by 3.28 per cent and 7.66 per cent during period-I. The growth rate of productivity of other oilseeds was observed stagnancy during period-I. During period-II the growth rates of all the crops were increased significantly except rice and groundnut which were declined by 8.38 per cent and 1.28 per cent respectively. During period-III, rice showed negative significant growth rate of productivity by 26.06 per cent, while the rest of the crops showed stagnancy. Among pulses, growth rates of all crops increased significantly except gram which showed stagnancy. The growth rates of soybean, groundnut and other oilseeds were also increased significantly by 4.95 per cent, 6.03 per cent and 5.72 per cent respectively while sugarcane and cotton showed stagnancy during period-III. During period-IV, the growth rate of productivity of rice was declined significantly by 23.09 per cent, while wheat and bajra showed positive significant growth rate by 2.95 per cent and 2.31 per cent. The growth rate of jowar showed stagnancy during period-IV. Among pulses except tur all crops showed positive significant growth rate of productivity except tur which showed stagnancy. The growth rates of productivity of cotton and groundnut increased significantly by 8.72 per cent and 3.12 per cent respectively while it was declined in case of sugarcane by 3.03 per cent. During period-IV the growth rates of soybean and other oilseeds were observed stagnant. During overall period, all crops showed significant growth rate of productivity except rice and sugar cane. The growth rate of rice and sugarcane were increased significantly by 14.56 per cent and 3.28 per cent during period-I and thereafter declined significantly by 6.07 per cent and 13.56 per cent during overall period. The highest productivity growth was observed in cotton by 4.17 per cent and the lowest yield growth in soybean by 0.40 per cent during overall period.

Table 5.2 Compound growth rates of area, production and productivity of major crops of Akola district

Sr.No	Crops	Area					Production				
		Period-I	Period-II	Period-III	Period-IV	Overall	Period-I	Period-II	Period-III	Period-IV	Overall
1	Rice	1.43	-5.01***	-28.54***	-21.25***	-12.61***	16.02***	-10.91***	-30.51***	-18.75***	-12.52***
2	Wheat	3.06**	-7.44***	3.61***	8.79***	-3.38***	12.12***	-4.58***	4.28***	12.34***	-0.28
3	Jowar	1.66	0.53	-8.28***	-9.54***	-5.01***	19.85***	7.05***	-7.08***	-11.03***	-2.51**
4	Bajra	-1.65***	-1.28	-2.65**	-16.12***	-6.13***	10.87***	1.34	-0.48	-14.25***	-4.12**
5	Gram	5.49***	11.57***	9.82***	12.25***	4.48***	5.87***	18.14***	7.42***	17.67***	7.95***
6	Tur	2.89**	6.41***	-0.90	1.93*	0.87	6.15***	12.19***	7.24***	1.72	1.80*
7	Mung	4.75***	10.24***	-1.11	-2.32**	1.63	14.27***	18.72***	2.73**	0.28	4.29***
8	Other pulses	11.48***	8.35***	-1.35	-19.09***	-13.25***	7.85***	21.54***	0.64	-11.75***	-11.81***
9	Sugarcane	-1.25	-5.63***	-4.94***	-33.58***	-3.33***	-1.53	29.12***	-5.42***	-4.21***	1.81*
10	Cotton	1.91*	-0.21	0.08	-4.84***	-3.18***	8.03***	4.89***	0.10	3.75***	1.07
11	Soybean	-	-	43.13***	11.97***	20.02***	-	-	47.47***	11.33***	20.52***
12	Ground nut	-0.08	-11.70***	-14.27***	9.04***	-9.39***	0.01	-12.75***	-8.87***	15.60***	-6.37***
13	Other oilseeds	8.16***	14.67***	1.93*	11.91***	7.17***	-11.07***	17.87***	7.76***	13.32***	8.20***

Table continued 5.2



Table continued 5.2

Sr. No	Crops	Productivity				
		Period-I	Period-II	Period-III	Period-IV	Overall
1	Rice	14.56***	-8.38***	-26.06***	-23.90***	-6.07***
2	Wheat	7.49***	3.10**	0.56	2.95**	3.09***
3	Jowar	11.54***	6.44***	0.86	-1.77	2.70***
4	Bajra	4.15***	4.28***	-0.22	2.31**	2.50**
5	Gram	0.36	5.88***	1.61	5.93***	3.31***
6	Tur	3.17**	5.39***	5.67***	-0.33	0.87
7	Mung	11.39***	10.46***	4.10***	2.33**	3.22***
8	Other pulses	5.62***	12.16***	4.60***	6.17***	2.08**
9	Sugarcane	3.28**	32.15***	1.15	-3.03**	-13.56***
10	Cotton	7.66***	5.20***	1.50	8.72***	4.17***
11	Soybean	-	-	4.95***	-0.11	0.40
12	Ground nut	-2.97**	-1.28	6.03***	3.12***	3.63***
13	Other oilseeds	1.24	2.80**	5.72***	1.60	5.65***

***, **, * denote statistical significance at 1, 5 and 10 per cent level respectively.

Period-I (1970-71 to 1979-80); Period-II (1980-81 to 1989-90); Period-III (1990-91 to 1999-2000); Period-IV (2000-01 to 2013-14).

5.1.3 Growth rates of area, production and productivity of major crops in Amravati district

The compound growth rates of area of major crops for Amravati district is presented in Table 5.3.

In Amravati district, the growth rates of area under all cereals crops increased significantly except bajra which showed stagnancy during period-I. Among pulses the growth rates of all crops were increased significantly and growth rate of sugarcane was also increased significantly by 8.02 per cent. The growth rates of area of cotton soybean, groundnut and other oilseeds showed stagnancy during period-I. During period-II the growth rates of wheat and bajra declined significantly by 6.31 per cent and 7.29 per cent, while it was observed stagnant in case of rice and jowar. The growth rates of area under all pulses crops, sugarcane, groundnut and other oilseeds were increased significantly during period-II. During period-II the growth rate of cotton was showed stagnancy. During period-III, the growth rates of area among all cereals declined significantly except wheat which showed stagnancy. Among pulses the growth rate of area of gram

was increased significantly by 9.09 per cent and it was declined in case of other pulses by 2.91 per cent respectively. The growth rates for tur and mung were showed stagnancy. The growth rates of area were increased significantly in sugarcane by 7.64 per cent and other oilseeds by 14.03 per cent while cotton and soybean were showed stagnancy during period-III. During period-IV, among cereals all the crops showed declined significant growth except wheat which showed positive significant growth rate by 14.01 per cent. Among pulses, positive significant growth rates were observed in case of gram by 9.21 per cent and declined significant growth rate in other pulses by 17.79 per cent, while it was stagnant in case of tur and mung during period-IV. The growth rates of area of other oilseeds were increased significantly by 6.90 per cent while the rest of the crops showed negative significant growth rate during period-IV. During overall period, the area growth of all cereals declined significantly except wheat which showed stagnancy. Among pulses the growth rate of area under gram increased significantly by 6.33 per cent, tur by 3.04 per cent and mung by 4.48 per cent. The growth rate of area under other pulses declined significantly by 8.11 per cent. During the overall period the area growth rate under sugarcane also increased by 4.61 per cent significantly. The area growth rate of cotton and soybean were stagnant during overall period.

In case of production, among cereals the growth rates of production under all cereals crops increased significantly during period-I. Among pulses the growth rates of gram and mung were increased significantly by 8.85 per cent and 18.88 per cent. On the other hand the growth rates of production under tur showed stagnancy and other pulses showed negative significant growth by 7.24 per cent. The growth rates of production of cotton soybean, cotton and groundnut were increased significantly by 12.63 per cent, 6.81 per cent and 3.35 per cent. The growth rates of production of other oilseeds were declined significantly by 9.63 per cent during period-I. During period-II, the growth rates of production of wheat and bajra were declined significantly by 6.04 per cent and 6.90 per cent, while it was stagnant in case of wheat and jowar. The growth rates of production of rest of the crops were increased significantly during period-II.

During period-III, among cereals the growth rates of production of wheat, jowar and bajra were declined significantly by 1.90 per cent, 3.62 per cent and 7.00 per cent while it was stagnant in case of rice. The growth rates of production of rest of the crops were increased significantly except in cotton and groundnut which were declined by 5.86 per cent and 6.80 per cent respectively. During period-IV, the growth rates of production under all cereals crops declined significantly except wheat which showed positive significant growth by 18.59 per cent during period-I. Among pulses, the growth rates of all crops were increased significantly except in other pulses which declined significantly by 13.80 per cent. The growth rate of production of sugarcane was also declined significantly by 19.05 per cent. The growth rates of production of cotton and other oilseeds were increased significantly by 8.06 per cent and 10.15 per cent while the growth rates of soybean and groundnut showed stagnancy during period-IV. The growth rate of bajra increased significantly by 9.77 percent during overall period. The growth rate of production under wheat was stagnant and rest of the cereal crops declined significantly. Among pulses all crops showed positive significant growth in production except other pulses which showed negative significant growth production by 7.59 per cent. During overall period the growth rate of production under sugarcane and cotton were increased significantly by 11.14 per cent and 1.98 per cent. The soybean and groundnut growth rate of production were declined by 4.97 per cent and 6.22 per cent significantly during the overall period.

In case of growth rate of productivity in Amravati district, among cereals the growth rates of productivity under all cereals crops increased significantly during period-I. Among pulses mung and other pulses growth rates were increased significantly by 12.34 per cent and 4.21 per cent while it showed stagnancy in case of gram and tur during period-I. The growth rates of productivity of rest of the crops were increased significantly during period-I except in other oilseeds which were declined by 3.70 per cent. During period-II, the growth rates of productivity of wheat were increased significantly during period-II and it was declined significantly by 6.62 per cent in rice while it was stagnant in case of jowar

and bajra. The growth rates of productivity of rest of the crops were increased significantly during period-II except in groundnut and other oilseeds which showed stagnancy during period-II. During period-III, the growth rates of productivity of rice and jowar were increased significantly by 4.47 per cent and 3.11 per cent while it was stagnant in case of wheat and bajra. Among pulses the growth rates of tur and mung were increased significantly by 3.57 per cent and 3.25 per cent while gram and other pulses showed stagnancy during period-III. The growth rates of productivity of rest of the crops were increased significantly during period-III except in cotton which declined significantly by 5.54 per cent during period-III. During period-IV, the growth rates of productivity under cereals crops declined significantly except wheat which showed positive significant growth by 4.02 per cent and bajra which showed stagnancy during period-I. Among pulses, the growth rates of all crops were increased significantly except in tur which showed stagnancy. The growth rate of productivity of sugarcane was declined significantly by 8.34 per cent while the rest of the crops showed positive significant growth rates during period-IV. All cereals showed stagnancy except wheat during overall period. The productivity growth rate of wheat was observed increased significantly by 2.59 per cent. Among pulses except tur all pulse crops showed significant increased productivity growth rate during overall period. During period-II and period-III the yield growth rate of tur increased significantly by 10.46 per cent and 10.49 per cent but showed stagnancy in the productivity growth during the overall period by 1.61 per cent. The growth rate of productivity under cotton during overall period increased significantly by 4.08 per cent highest significant productivity growth of cotton was observed during period-IV by 13.01 per cent. The growth rate of productivity under soybean declined significantly by 4.42 per cent during overall period even there significant positive growth rate of productivity during period-III and period-IV by 4.10 per cent and 3.14 per cent. The productivity growth rate of groundnut also increased significantly by 3.99 per cent during overall period.

Table 5.3 Compound growth rates of area, production and productivity of major crops of Amravati district

Sr.No	Crops	Area					Production				
		Period-I	Period-II	Period-III	Period-IV	Overall	Period-I	Period-II	Period-III	Period-IV	Overall Period
1	Rice	3.12**	1.11	-6.35***	-8.78***	-2.16**	14.26***	-6.04***	-1.52	-11.70***	-1.99*
2	Wheat	6.30***	-6.31***	-1.65	14.01***	-1.42	15.98***	-1.76	-1.90*	18.59***	1.16
3	Jowar	28.70***	-0.76	-6.18***	-11.54***	-2.35**	21.25***	-0.53	-3.62***	-14.63***	-2.04**
4	Bajra	0.93	-7.29***	-12.50***	-15.09***	-9.59***	12.25***	-6.90***	-7.00***	-15.57***	-7.66***
5	Gram	7.27***	12.52***	9.09***	9.21***	6.33***	8.85***	16.86***	10.05***	14.43***	9.77***
6	Tur	1.99*	10.24***	0.10	1.59	3.04***	-0.17	18.72***	3.69***	3.32***	4.24***
7	Mung	4.50***	21.30***	-0.03	-1.21	4.48***	18.88***	24.31***	4.25***	3.27***	6.82***
8	Other pulses	6.00***	18.29***	-2.91**	-17.79***	-8.11***	-7.24***	23.95***	5.88***	-13.80***	-7.59***
9	Sugarcane	8.02***	18.07***	7.64***	-19.38***	4.61***	12.63***	57.11***	7.43***	-19.05***	11.14***
10	Cotton	-0.89	0.32	-0.97	-5.82***	-1.66	6.81***	5.19***	-5.86***	8.06***	1.98*
11	Soybean	-	-	-1.11	-1.70	-0.73	-	-	2.73**	1.38	-4.97***
12	Ground nut	-0.99	1.89*	-13.80***	-4.46***	-7.95***	3.53***	3.35**	-6.80***	0.51	-6.22***
13	Other oilseeds	0.35	19.20***	14.03***	6.90***	9.63***	-9.63***	21.19***	20.91***	10.15***	11.98***

Table continued 5.3

Table continued 5.3

Sr. No	Crops	Productivity				
		Period-I	Period-II	Period-III	Period-IV	Overall
1	Rice	10.50***	-6.62***	4.47***	-4.09***	0.16
2	Wheat	10.20***	4.26***	-0.69	4.02***	2.59**
3	Jowar	17.44***	0.23	3.11**	-3.49***	1.33
4	Bajra	1.87*	0.74	1.00	-14.93	0.67
5	Gram	0.56	3.77***	0.41	4.78***	3.15***
6	Tur	-1.03	10.46***	3.57***	1.71	1.61
7	Mung	12.34***	10.49***	3.25**	4.53***	2.54**
8	Other pulses	4.21***	4.77***	1.77	4.58***	1.92*
9	Sugarcane	3.23**	32.58***	2.38**	-8.34***	-12.62***
10	Cotton	7.16***	4.74***	-5.54***	13.01***	4.08***
11	Soybean	-	-	4.10***	3.14***	-4.42***
12	Ground nut	4.56***	1.09	9.65***	4.75***	3.99***
13	Other oilseeds	-3.70***	1.67	6.03***	3.04**	4.33***

***, **, * denote statistical significance at 1, 5 and 10 per cent level respectively.

Period-I (1970-71 to 1979-80); Period-II (1980-81 to 1989-90); Period-III (1990-91 to 1999-2000); Period-IV (2000-01 to 2013-14).

5.1.4 Growth rates of area, production and productivity of major crops in Buldhana district

The compound growth rates of area of major crops for Buldhana district of Amravati division are presented in Table 5.4.

In respect to Buldhana district, among cereals the growth rates of area were increased significantly except in bajra which showed stagnancy during period-I. Among pulses, growth rates of area were increased significantly in gram by 12.45 per cent and mung by 3.89 per cent respectively while it was stagnant in case of tur and other pulses during period-I. The growth rates of area of cotton and other oilseeds were declined significantly by 2.27 per cent and 2.36 per cent, while the rest of the crops showed stagnancy during period-I. During period all cereals growth rates were declined significantly except in bajra which showed positive significant growth rate by 1.99 per cent. The growth rates of area of

all pulses were increased significantly except mung which showed stagnancy. The growth rates of area of other oilseeds increased significantly by 27.44 per cent and in groundnut it showed negative significant growth rate of 8.18 per cent, while sugarcane and cotton showed stagnancy during period-II. Among cereals the growth rate of area under wheat increased significantly by 2.51 per cent while all cereals growth rates were declined significantly. The growth rates of area of all pulses were increased significantly except other pulses which showed stagnancy. The area growth rate of sugarcane and groundnut were declined significantly by 14.60 per cent and 8.87 per cent. The growth rate of area of soybean and other oilseeds were increased significantly by 106.43 per cent and 4.01 per cent during period-III. The area growth rate of cotton was stagnant during the period-III. Among cereals the growth rate of area under wheat increased significantly 6.67 per cent while all cereals growth rates were declined significantly during period-IV. The growth rates of area of gram by 9.70 per cent and tur by 2.22 per cent were increased significantly and it was declined in the case of mung by 8.47 per cent and 18.37 per cent respectively. The area growth rate of sugarcane and groundnut were declined significantly by 12.69 per cent and 5.22 per cent. The growth rate of area of soybean and other oilseeds were increased significantly by 13.42 per cent and 11.42 per cent and it was stagnant in case of cotton during period-IV. During overall period, among cereals the growth rate of area under wheat showed stagnancy while all cereals growth rates were declined significantly. The growth rates of area of all pulses were increased significantly except other pulses which showed negative significant growth rate by 12.68 per cent. During overall period, the area growth rate of sugarcane and groundnut were declined significantly by 3.05 per cent and 8.69 per cent. The growth rate of area of soybean increased significantly by 32.34 per cent during overall period and highest growth rate of area was observed during period-III by 106.43 per cent. The area growth rate of cotton was stagnant during the overall period.

In case of production, in Buldhana district, the growth rates of all the cereals and pulses and cotton were increased significantly during

period-I. The growth rate of production of groundnut was declined by 2.43 per cent and it was stagnant in case of sugarcane and other oilseeds during period-I. During period-II, the growth rates of all the cereals were declined significantly except bajra which showed stagnancy. The growth rates of rest of all the crops showed positive significant growth except groundnut which showed negative significant growth rate by 4.82 per cent. During period-III, among cereals all crops showed negative significant growth rates of production except wheat which showed positive significant growth rate by 3.65 per cent. Among pulses the growth rates of production of all crops increased significantly except other pulses which showed stagnancy. The growth rates of production of Sugarcane and groundnut showed negative significant growth rate by 14.45 per cent and 7.30 per cent during period-III. During period-III, the production growth rate of soybean, cotton and other oilseeds were increased significantly by 108.16 per cent, 4.45 per cent and 5.27 per cent respectively. During period-IV the growth rate of production under wheat has increased significantly by 7.22 per cent and rest of the cereal crops showed negative significant growth rate. Among pulses the growth rate of production of gram by 15.86 per cent and tur by 3.35 per cent were increased significantly, while it was declined significantly by 4.24 per cent in mung, by 13.47 per cent in other pulses and by 14.44 per cent in case of sugarcane respectively. The growth rates of production of cotton, soybean, groundnut and other oilseeds were increased significantly by 10.19 per cent, 15.70 per cent, 1.86 per cent and 14.62 per cent respectively during period-IV. The growth rates of all cereals were declined significantly except wheat, which showed positive significant growth rate by 2.99 per cent during overall period. Among pulses all crops showed positive significant growth rate of production during overall period, except other pulses which showed significant declined growth rate by 11.68 per cent. The production growth rate of sugarcane, cotton and soybean were increased significantly by 3.41 per cent, 3.93 per cent and 33.80 per cent. The growth rate of production was declined significantly by 6.30 per cent during overall period.

In case of productivity, among cereals the growth rates of productivity under all cereals crops were increased significantly during period-I. Among pulses mung and other pulses growth rates were increased significantly by 10.85 per cent and 12.21 per cent while it showed stagnancy in case of gram and significant declined growth rate in case of tur by 14.91 per cent during period-I. The growth rates of productivity of sugarcane by 2.97 per cent and cotton by 8.43 per cent were increased significantly during period-I. The growth rates of productivity of groundnut were declined by 4.16 per cent while other oilseeds showed stagnancy during period-I. During period-II, the growth rates of productivity of wheat were increased significantly by 2.93 per cent and it was declined significantly by 8.72 per cent in rice in bajra by 6.13 per cent, while it was stagnant in case of jowar. The growth rates of productivity of rest of the crops were increased significantly during period-II except in other oilseeds which were declined by 14.22 per cent during period II. During period-III, the growth rates of productivity bajra were increased significantly by 2.02 per cent while it was stagnant in case of rest of the cereals crops. Among pulses the growth rates of mung was increased significantly by 3.28 per cent while rest of pulses crops showed stagnancy in the growth rate of productivity during period-III. The growth rates of productivity of rest of the crops were stagnant except in cotton which was increased significantly by 3.84 per cent during period-III. During period-IV, the growth rates of productivity of bajra was increased significantly by 3.72 per cent and it was declined significantly in case of rice by 29.93 per cent while wheat and jowar showed stagnancy. Among pulses, the growth rates of all crops were increased significantly except in tur which showed stagnancy and it was declined significantly by 5.42 per cent. The growth rate of productivity of sugarcane was declined significantly by 2.25 per cent while the rest of the crops showed positive significant growth rates during period-IV. Among cereals wheat and bajra showed positive significant growth rate by 2.65 per cent and 2.81 per cent during overall period, while the growth rate of productivity of jowar showed stagnancy. The productivity growth rate of rice was declined significantly by 11.60 per cent.

Table 5.4 Compound growth rates of area, production and productivity of major crops in Buldhana district

Sr.No	Crops	Area					Production				
		Period- I	Period- II	Period- III	Period- IV	Overall	Period- I	Period- II	Period- III	Period- IV	Overall
1	Rice	3.72***	-2.09*	-25.01***	-14.42***	-13.81***	7.86***	-9.65***	-24.30***	-14.42***	-13.27***
2	Wheat	4.89***	-10.86***	2.51**	6.67***	0.26	16.30***	-8.24***	3.65***	7.22***	2.99***
3	Jowar	4.74***	-2.92**	-5.79***	-10.53***	-4.14***	18.01***	-1.20	-4.80***	-10.66***	-2.27**
4	Bajra	1.47	1.99*	-10.11***	-7.12***	-3.06***	16.45***	16.89***	-8.21***	-3.65***	-1.19
5	Gram	12.45***	12.02***	7.47***	9.70***	6.51***	13.32***	16.90***	7.30***	15.86***	9.43***
6	Tur	1.15	4.43***	2.54**	2.22**	2.71***	15.44***	9.40***	5.94***	3.35***	2.49**
7	Mung	3.89***	1.24	3.50***	-8.47***	1.81**	16.75***	5.43***	9.97***	-4.24***	4.66***
8	Other pulses	0.11	4.33***	0.13	-18.37***	-12.68***	6.14***	14.29***	0.51	-13.47***	-11.68***
9	Sugarcane	0.63	0.01	-14.60***	-12.69***	-3.05***	-0.28	34.41***	-14.45***	-14.44***	3.41***
10	Cotton	-2.27*	0.31	0.16	1.57	-0.12	6.13***	2.50**	4.45***	10.19***	3.93***
11	Soybean	-	-	106.43***	13.42***	32.34***	-	-	108.16***	15.70***	33.80***
12	Ground nut	1.78	-8.18***	-8.87***	-5.22***	-8.69***	-2.43**	-4.82***	-7.30***	1.86*	-6.30***
13	Other oilseeds	-2.36**	27.44***	4.01***	11.42***	4.23***	-1.14	9.32***	5.27***	14.62***	6.52***

Table continued 5.4

Table continued 5.4

Sr.No	Crops	Productivity				
		Period-I	Period-II	Period-III	Period-IV	Overall
1	Rice	4.91***	-8.72***	0.35	-29.93***	-11.60***
2	Wheat	9.59***	2.93**	-0.25	0.52	2.65**
3	Jowar	15.67***	1.78	1.18	-0.15	1.68
4	Bajra	6.13***	-3.36***	2.02*	3.72***	2.81**
5	Gram	1.17	4.41***	3.28**	5.63***	2.93**
6	Tur	-14.91***	2.74**	1.44	1.33	0.98
7	Mung	10.85***	10.23***	1.64	4.61***	3.27**
8	Other pulses	12.21***	9.54***	0.39	-5.42***	-0.24
9	Sugarcane	2.97**	39.39***	1.09	-2.25*	-12.85***
10	Cotton	8.43***	2.16*	3.84***	14.07***	4.59***
11	Soybean	-	-	0.26	2.01*	1.16
12	Ground nut	-4.16***	3.68***	1.69	4.29***	3.87***
13	Other oilseeds	1.49	-14.22***	1.21	2.87**	3.24**

***, **, * denote statistical significance at 1, 5 and 10 per cent level respectively.

Period-I (1970-71 to 1979-80); Period-II (1980-81 to 1989-90); Period-III (1990-91 to 1999-2000); Period-IV (2000-01 to 2013-14).

The growth rate of productivity under gram and mung were increased significantly by 2.93 per cent and 3.27 per cent. The productivity growths in rest of the pulse crops were stagnant during the overall period. During the overall period the productivity growth rate of cotton was also increased significantly by 4.59 per cent. The soybean growth rate in productivity was stagnant during overall period.

5.1.5 Growth rates of area, production and productivity of major crops in Yavatmal district

The compound growth rates of area of major crops for Yavatmal district are presented in Table 5.5.

In respect of Yavatmal district in Amravati division, the growth rates of area among the cereals all the crops showed increased significant growth except bajra which showed negative significant growth by 2.74 per cent during period-I. The growth rates of area under all pulses crops showed stagnancy except other pulses which increased significantly by 12.52 per cent. The area growth rates under other oilseeds were declined

significantly by 9.11 per cent. The growth rates of area under sugarcane were increased significantly by 16.21 per cent, while cotton and groundnut showed stagnancy during the period-I. The growth rates of area all the cereals were declined significantly except bajra which showed stagnancy during period-II. The growth rates of rest of all the crops showed positive significant growth except groundnut which showed negative significant growth rate by 11.07 per cent and cotton which showed stagnancy during period-II. During period-III, among cereals all crops showed negative significant growth rates of area except wheat which showed positive significant growth rate by 4.16 per cent. Among pulses the growth rates of area of gram by 6.46 per cent and tur by 2.15 per cent were increased significantly while mung and other pulses showed stagnancy. The growth rates of sugarcane and cotton were also showed stagnancy during period-III. The growth rates of area of groundnut showed negative significant growth rate by 16.59 per cent. During period-III, the area growth rate of soybean and other oilseeds were increased significantly by 46.35 per cent and 9.57 per cent respectively. During period-IV, the growth rate of area under wheat has increased significantly by 8.85 per cent and rest of the cereal crops showed negative significant growth rate. Among pulses the growth rate of area of gram by 10.00 per cent was increased significantly, while it was declined significantly by 1.97 per cent in tur, by 7.40 per cent in mung, by 17.42 per cent in other pulses and by 2.42 per cent in case of sugarcane respectively. The growth rates of area of soybean and other oilseeds were increased significantly by 12.01 per cent and 10.21 per cent respectively. The area growth rates of cotton and groundnut showed stagnancy during period-IV. During the overall period, the growth rate of area among the cereals all the crops showed negative significant growth except wheat which showed stagnancy. The growth rate of area under gram, tur, sugarcane and soybean were increased significantly by 5.32 per cent, 2.81 per cent, 5.64 per cent and 20.46 per cent during overall period. The area growth rate under groundnut declined significantly by 5.78 per cent. The growth rate of area under mung and cotton showed stagnancy during the overall period.

In case of production growth rate in Yavatmal district, all the crops growth rates were increased significantly except tur which showed stagnancy, while declined significantly in groundnut by 2.33 per cent and other oilseeds by 17.73 per cent during period-I. During period-II, among cereals rice and wheat growth rates of production were declined by 12.05 per cent and 4.29 per cent, while it was increased significantly in bajra by 2.29 per cent and stagnant in case of jowar. The growth rates of production were increased significantly in rest of the crops except in groundnut which declined significantly by 9.27 per cent during period-II. The growth rates of production of all cereals declined significantly except wheat which showed stagnancy during period-III. Among pulses all the crops showed positive significant growth rate of production except other pulses which showed negative significant growth by 4.13 per cent. The growth rates of production of groundnut showed negative significant growth rate by 8.23 per cent. During period-III, the production growth rates of soybean and other oilseeds were increased significantly by 59.16 per cent and 26.01 per cent respectively. The growth rates of production of sugarcane and cotton showed stagnancy during period-III. During period-IV, the growth rate of production under wheat has increased significantly by 11.10 per cent and rest of the cereal crops showed negative significant growth rate. Among pulses the growth rate of production of gram by 16.45 per cent was increased significantly, while it was declined significantly by 4.10 per cent in tur, by 4.01 per cent in mung, by 15.21 per cent in other pulses and by 2.20 per cent in case of sugarcane respectively. The growth rates of production of cotton by 10.11 per cent, soybean by 9.03 per cent, and groundnut by 4.42 per cent and other oilseeds by 7.96 per cent were increased significantly respectively during period-IV. The growth rate in wheat increased significantly by 2.09 percent and rest of the cereal crops were declined significantly during overall period. The growth rate of production under gram, tur and mung increased significantly by 8.43 per cent, 2.76 per cent and 3.13 per cent. The production growth rate of other pulses declined by 10.13 per cent during overall period. The growth rate of production under sugarcane, cotton and soybean were increased significantly by 12.38

per cent, 3.83 per cent and 18.8 per cent. Groundnut showed negative significant growth rate by 3.10 per cent during overall period.

In case of productivity growth rates of all the crops were increased significantly except groundnut which showed stagnancy during period-I. During period-II, the growth rates of productivity of rice were declined by 4.67 per cent while it was stagnant in the case of wheat. The growth rates of productivity of rest of the cereals crops were increased significantly during periods-II. Among pulses all the crops showed positive significant growth rate except tur which showed stagnancy during period-II. The growth rates of rest of the crops increased significantly except other oilseeds which were declined by 3.69 per cent. During period-III, the growth rates of productivity jowar and bajra were increased significantly by 3.10 per cent and 2.22 per cent, while it was stagnant in case of rice and it was declined significantly in case of wheat by 2.71 per cent. Among pulses the growth rates of gram was declined significantly by 4.53 per cent while tur by 2.14 per cent and mung by 5.01 per cent were increased significantly and in case of other pulses showed stagnancy in the growth rate of productivity during period-III. The growth rates of productivity of soybean, groundnut and other oilseeds were increased significantly by 7.25 per cent, 6.69 per cent and 15.01 per cent respectively during period-III. The growth rates of productivity of sugarcane and cotton were stagnant during period-III. During period-IV, the growth rates of productivity of wheat and bajra were increased significantly by 2.08 per cent and 3.10 per cent while it was declined significantly in case of rice by 12.26 per cent and jowar by 2.59 per cent. Among pulses, the growth rates of gram by 5.88 per cent and mung by 3.62 per cent were increased significantly while it was declined significantly by 2.17 per cent in tur and by 39.04 per cent in other oilseeds. The growth rate of productivity of sugarcane showed stagnancy during period-IV. The growth rates of productivity of soybean and other oilseeds were declined significantly by 2.67 per cent and 2.04 per cent, while it was increased significantly in cotton by 9.41 per cent and groundnut by 1.98 per cent during period-IV. All the cereal crops showed stagnancy except bajra during overall period.

Table 5.5 Compound growth rates of area, production and productivity of major crops in Yavatmal district

Sr.No	Crops	Area					Production				
		Period-I	Period-II	Period-III	Period-IV	Overall	Period-I	Period-II	Period-III	Period-IV	Overall
1	Rice	3.82***	-7.43***	-6.40***	-32.34***	-7.08***	14.50***	-12.05***	-4.47***	-29.97***	-6.04***
2	Wheat	14.52***	-5.04***	4.16***	8.85***	0.97	19.39***	-4.29***	0.20	11.10***	2.09**
3	Jowar	10.32***	-2.95***	-5.54***	-8.42***	-2.89***	15.56***	0.85	-7.83***	-10.79***	-2.70***
4	Bajra	-2.74**	-0.29	-4.13***	-25.48***	-7.12***	8.98***	2.29**	-2.41**	-21.62***	-4.85***
5	Gram	0.22	8.54***	6.46***	10.00***	5.32***	3.20***	16.00***	3.23**	16.45***	8.43***
6	Tur	0.28	6.13***	2.15*	-1.97*	2.81***	-0.78	6.36***	6.60***	-4.10***	2.76***
7	Mung	0.02	9.64***	1.46	-7.40***	-0.19	9.49***	15.35***	3.04**	-4.01***	3.13***
8	Other pulses	12.52***	7.18***	-1.71	-17.42***	-11.18***	5.40***	15.44***	-4.13***	-15.21***	-10.13***
9	Sugarcane	16.21***	13.41***	0.64	-2.42**	5.64***	18.25***	51.46***	1.48	-2.20**	12.38***
10	Cotton	0.12	1.18	1.12	0.63	0.33	5.99***	3.48***	1.00	10.11***	3.83***
11	Soybean	-	-	46.35***	12.01***	20.46***	-	-	59.16***	9.03***	18.89***
12	Ground nut	-0.95	-11.07***	-16.59***	1.28	-5.78***	-2.33**	-9.27***	-8.23***	4.42***	-3.10***
13	Other oilseeds	-9.11***	10.42***	9.57***	10.21***	5.73***	-17.73***	6.35***	26.01***	7.96***	8.41***

Table continued 5.5

Table continued 5.5

Sr. No	Crops	Productivity				Overall
		Period-I	Period-II	Period-III	Period-IV	
1	Rice	10.17***	-4.67***	1.21	-12.26***	-1.34
2	Wheat	10.52***	0.23	-2.71***	2.08*	1.59
3	Jowar	11.29***	3.92***	3.10**	-2.59**	0.66
4	Bajra	6.00***	4.85***	2.22*	3.10***	2.59**
5	Gram	3.78***	6.83***	-4.53***	5.88***	2.85***
6	Tur	2.21*	0.20	2.14**	-2.17*	0.36
7	Mung	11.83***	4.67***	5.01***	3.62***	3.22***
8	Other pulses	9.24***	7.71***	1.51	-39.04***	-2.13**
9	Sugarcane	3.27**	31.39***	1.79	0.68	-12.94***
10	Cotton	5.10***	2.06**	-0.55	9.41***	3.42***
11	Soybean	-	-	7.25***	-2.67***	-1.25
12	Ground nut	-1.39	2.08**	6.69***	1.98***	3.93***
13	Other oilseeds	3.51***	-3.69***	15.01***	-2.04***	4.77***

***, **, * denote statistical significance at 1, 5 and 10 per cent level respectively.

Period-I (1970-71 to 1979-80); Period-II (1980-81 to 1989-90); Period-III (1990-91 to 1999-2000); Period-IV (2000-01 to 2013-14).

The growth rate of productivity under bajra increased significantly by 2.59 per cent. The productivity growth rate of gram and mung increased significantly by 2.85 per cent and 3.22 per cent. The growth rate of productivity under other pulses and sugarcane declined significantly during the overall period by 2.13 per cent and 12.94 per cent. Cotton and groundnut showed increased significant growth rate of productivity by 3.42 per cent and 3.93 per cent. The growth rate of productivity of soybean showed stagnancy during overall period.

5.1.6 Coefficient of variation

5.1.6.a Coefficient of variation in area, production and productivity of major crops in Amravati division

Results on coefficient of variation of area are presented in Table 5.6. As revealed from table, coefficient of variation was highest in other oilseeds i.e. 85.27 per cent during overall period. During the first period, coefficient of variation of area was highest in case of jowar i.e. 23.75 per cent, while in second period, it was highest in gram i.e. 42.90 per cent, during third period, it was highest in groundnut i.e. 39.93 per cent and during fourth period, it was highest in other pulses i.e. 187.21 per cent.

Table 5.6 Coefficient of variation in area, production and productivity of major crops in Amravati division

Sr. No	Crops	Area					Production					Productivity				
		Period-I	Period-II	Period-III	Period-IV	Overall	Period-I	Period-II	Period-III	Period-IV	Overall	Period-I	Period-II	Period-III	Period-IV	Overall
1	Rice	10.04	13.84	30.02	50.49	71.71	43.84	46.54	30.92	55.35	108.82	37.05	34.39	21.83	47.41	54.11
2	Wheat	16.51	27.23	22.73	43.61	38.24	44.88	28.05	30.24	57.60	55.26	32.71	16.16	20.14	20.28	34.91
3	Jowar	23.75	5.35	21.13	40.31	44.96	51.76	26.21	31.60	44.92	53.82	53.79	26.40	24.23	20.02	33.64
4	Bajra	15.29	23.74	21.91	62.82	54.17	39.76	85.84	38.79	60.71	85.69	33.47	24.35	31.80	20.71	38.87
5	Gram	19.55	42.90	31.53	44.07	77.31	33.93	76.03	45.68	60.09	115.20	21.28	27.83	28.01	26.92	45.55
6	Tur	5.75	24.80	6.66	7.96	31.10	21.84	35.36	26.75	15.56	39.73	22.57	16.96	25.30	16.91	21.91
7	Mung	19.21	36.60	14.01	27.27	41.40	37.94	45.15	31.34	65.66	73.76	35.33	29.07	29.35	43.32	49.58
8	Other pulses	15.29	24.56	12.06	187.21	77.90	41.85	52.65	21.47	187.33	98.97	23.99	32.82	18.69	18.42	35.19
9	Sugarcane	19.66	33.56	16.28	47.71	54.84	25.39	73.79	17.35	44.34	77.97	12.74	60.54	8.04	224.45	114.09
10	Cotton	6.32	3.70	6.29	10.84	15.87	30.83	32.78	33.71	40.54	51.63	30.84	31.55	34.30	65.07	87.46
11	Soybean	-	-	71.27	39.93	69.56	-	-	87.71	57.05	82.24	-	-	21.73	36.23	30.20
12	Ground nut	6.10	22.18	39.93	40.64	79.65	31.98	27.34	35.94	47.84	71.21	34.55	26.98	25.54	26.51	66.53
13	Other oilseeds	11.59	18.23	24.45	36.89	85.27	38.75	44.15	45.31	55.11	119.49	16.43	88.63	28.85	36.36	65.92

Period-I (1970-71 to 1979-80); Period-II (1980-81 to 1989-90); Period-III (1990-91 to 1999-2000); Period-IV (2000-01 to 2013-14).

Among the periods under study, the overall period has high coefficient of variation of value of production of 119.49 per cent in case of other oilseeds, 51.76 per cent in case of jowar during first period. During the second period, it was highest in case of bajra i.e. 85.84 per cent, during the third period, it was highest in gram i.e. 45.68 per cent and during fourth period other pulses was 187.33 per cent.

As seen from Table 5.6 that, coefficient of variation of productivity for sugarcane was highest during overall period and period-IV by 114.09 per cent and 224.45 per cent, respectively. Thus, it is clear from the study that, value of coefficient of variation of productivity of sugarcane in period-IV was higher than other periods. The coefficient of variation of productivity during period-I was higher in jowar i.e. 53.79 per cent, during period-II it was highest in other oilseeds i.e. 88.63 per cent and during third period it was highest in case of cotton i.e. 34.30 per cent.

5.1.6.b Coefficient of variation in area, production and productivity of major crops in Akola district

As seen from Table 5.7, that coefficient of variation of area for groundnut was highest during period-III and overall period by 55.99 per cent and 110.56 per cent. Thus, it is clear from the study that value of coefficient of variation of area of groundnut in overall period was higher than other periods. The coefficient of variation of area during period-I and period-IV was higher in other pulses i.e. 49.46 per cent and 214.45 per cent. Thus, it is clear that the value of coefficient of variation of area was highest in case of other pulses. During period-II it was highest in case of sugarcane i.e. 59.63 per cent.

The value of coefficient of variation of production for other oilseeds was higher in overall period i.e. 126.12 per cent. During the first period the coefficient of variation of production was highest in case of jowar i.e. 54.81 per cent, during period-II it was in sugarcane i.e. 62.77 per cent, during period-III it was in rice i.e. 61.35 per cent and 218.12 per cent in other pulses during period-IV respectively.

Table 5.7 Coefficient of variation in area, production and productivity of major crops in Akola district

Sr. No	Crops	Area					Production					Productivity				
		Period-I	Period-II	Period-III	Period-IV	Overall	Period-I	Period-II	Period-III	Period-IV	Overall	Period-I	Period-II	Period-III	Period-IV	Overall
1	Rice	5.71	19.97	49.28	125.85	75.86	51.38	49.19	61.35	74.86	52.82	47.66	36.70	43.16	25.56	42.09
2	Wheat	15.77	25.36	24.51	51.79	55.31	43.18	20.50	27.56	87.97	67.01	32.41	15.52	16.47	27.97	47.01
3	Jowar	19.50	6.41	25.53	37.91	53.74	54.81	41.33	34.56	44.51	65.84	69.40	37.92	20.60	27.71	43.16
4	Bajra	23.92	29.28	14.87	65.98	62.47	44.97	40.37	34.12	68.41	66.22	31.94	29.12	30.93	17.54	38.04
5	Gram	19.15	40.91	37.63	46.92	68.36	35.01	66.93	52.15	70.33	116.00	29.23	29.39	29.52	38.60	53.56
6	Tur	9.63	24.37	7.69	11.13	26.79	29.26	41.56	31.36	29.16	43.05	26.04	20.25	31.87	25.67	27.47
7	Mung	19.09	42.29	24.30	18.26	58.55	38.56	61.63	45.89	52.34	84.99	37.25	37.28	35.37	42.12	52.75
8	Other pulses	49.46	26.77	22.06	214.45	92.54	54.49	60.28	42.29	218.12	122.88	20.56	39.89	31.19	41.45	46.72
9	Sugarcane	21.83	59.63	39.95	105.32	91.97	26.93	105.25	41.22	107.02	125.26	12.76	62.77	5.31	42.04	114.90
10	Cotton	19.34	3.64	8.59	21.04	40.02	34.88	35.57	42.18	31.54	46.76	34.99	35.05	39.42	38.90	63.68
11	Soybean	-	-	98.83	43.58	82.91	-	-	117.37	57.10	93.46	-	-	21.05	38.13	32.49
12	Ground nut	9.02	38.90	55.99	49.06	110.56	41.67	56.20	36.15	66.66	117.76	43.38	41.10	25.45	29.77	66.57
13	Other oilseeds	23.99	53.53	32.75	45.02	88.10	37.91	65.96	59.05	63.59	126.12	42.64	51.47	32.32	39.31	73.35

Period-I (1970-71 to 1979-80); Period-II (1980-81 to 1989-90); Period-III (1990-91 to 1999-2000); Period-IV (2000-01 to 2013-14).

Among the periods under study the overall period has high coefficient of variation of value of productivity of 114.90 per cent, 62.77 per cent during period-II and during overall period in case of sugarcane. Thus, it is clear from the study that value of coefficient of variation of productivity of sugarcane for the overall period was higher than other periods. During the period-I the coefficient of variation value was highest in case of jowar i.e. 69.40 per cent, during the period-II it was highest in rice i.e. 43.16 per cent and during the period-IV it was highest in mung i.e. 42.12 per cent, respectively.

5.1.6.c Coefficient of variation in area, production and productivity of major crops in Amravati district

Results on coefficient of variation of area are presented in Table 5.8. As revealed from table, coefficient of variation was highest in other oilseeds i.e. 100.79 per cent during overall period and period-I i.e. 58.97 per cent. During the second period, coefficient of variation of area was highest in case of sugarcane i.e. 69.45 per cent, during third period highest in bajra i.e. 46.45 per cent and during fourth period highest in other pulses i.e. 173.98 per cent.

Among the periods under study the overall period has high coefficient of variation of value of production value of 125.78 per cent, 92.75 per cent during first period, and 68.19 per cent during the third period in case of other oilseeds. Thus, it is clear from the study that value of coefficient of variation of production of other oilseeds for the overall period was higher than other periods. During the second period coefficient of variation of value was highest in case of sugarcane i.e. 100.22 per cent and during the third period it was highest in other pulses i.e. 169.54 per cent.

As seen from Table 5.8, that coefficient of variation of productivity for sugarcane were highest during period-II , period-IV and overall period by 62.68 per cent, 319.54 per cent and 114.83 per cent. Thus, it is clear from the study that value of coefficient of variation of productivity of sugarcane in period-IV was higher than other periods. The coefficient of variation of productivity during period-I was higher in jowar i.e. 46.19 per cent and during period-III it was highest in case of cotton i.e. 39.21 per cent.

Table 5.8 Coefficient of variation in area, production and productivity of major crops in Amravati district

Sr. No	Crops	Area					Production					Productivity				
		Period -I	Period- II	Period- III	Period - IV	Overall	Period- I	Period- II	Period- III	Period- IV	Overall	Period - I	Period - II	Period- III	Period- IV	Overall
1	Rice	17.55	8.74	22.69	40.24	31.37	42.39	35.51	21.75	53.85	43.89	38.37	34.38	26.66	47.90	37.76
2	Wheat	19.12	20.15	31.93	58.34	46.15	46.52	19.35	31.39	70.71	65.47	34.90	21.63	17.01	21.28	35.83
3	Jowar	35.46	4.61	22.22	44.85	42.88	56.11	24.41	20.49	54.18	49.60	46.19	23.43	17.27	22.58	30.98
4	Bajra	16.82	29.92	46.45	70.68	84.63	38.44	35.95	41.34	64.21	75.95	44.57	19.09	35.40	34.02	43.38
5	Gram	21.08	39.69	28.91	39.74	77.41	40.29	76.41	40.41	56.00	112.32	30.53	33.16	31.51	24.73	47.03
6	Tur	8.09	21.26	3.58	12.89	38.50	20.31	38.06	25.17	23.51	56.69	21.20	19.09	22.74	21.15	38.33
7	Mung	53.10	67.56	28.07	24.36	56.14	44.45	99.24	23.02	111.99	111.27	36.97	48.26	26.44	75.05	62.93
8	Other pulses	18.58	49.05	20.57	173.98	85.93	90.81	70.59	35.87	169.54	104.21	33.97	34.59	26.21	29.09	37.85
9	Sugarcane	38.83	69.45	36.43	85.90	95.60	38.49	100.22	44.42	96.90	113.81	13.05	62.68	13.59	319.54	114.83
10	Cotton	3.42	3.55	6.63	28.64	22.82	33.33	36.48	38.84	49.97	50.99	33.76	35.09	39.21	59.07	82.00
11	Soybean	-	-	60.14	33.02	54.10	-	-	74.28	52.18	98.73	-	-	22.22	39.08	53.74
12	Ground nut	12.85	16.19	41.02	52.63	70.50	31.54	29.79	38.36	43.59	69.86	37.27	21.02	30.17	28.32	66.49
13	Other oilseeds	58.97	55.78	44.34	31.75	100.79	92.75	70.48	68.19	51.30	125.78	34.81	32.07	25.11	38.59	61.61

Period-I (1970-71 to 1979-80); Period-II (1980-81 to 1989-90); Period-III (1990-91 to 1999-2000); Period-IV (2000-01 to 2013-14).

5.1.6.d Coefficient of variation in area, production and productivity of major crops in Buldhana district

As seen from Table 5.9, that coefficient of variation of area for rice was highest during period-III and overall period by 76.58 per cent and 84.29 per cent. Thus, it is clear from the study that value of coefficient of variation of area of rice in overall period was higher than other periods. The coefficient of variation of area during period-I it was highest in case of gram i.e. 39.83 per cent and during period-IV was higher in other pulses i.e. 208.82 per cent respectively.

The value of coefficient of variation of production in case of bajra was highest during the overall period i.e. 153.66 per cent and during period-II i.e. 144.98 per cent. During period-I the coefficient of variation value was highest in jowar i.e. 55.50 per cent, during period-III it was highest in rice i.e. 79.89 per cent and 217.24 per cent in case of other pulses during period IV, respectively.

In case of productivity the value of coefficient of variation for other oilseeds was highest during overall period and period-II i.e. 132.98 per cent and 187.44 per cent. During period-I the coefficient of variation value was highest in tur i.e. 61.25 per cent, during period-III it was highest in other pulses i.e. 33.86 per cent and 203.16 per cent in case of rice during period-IV respectively.

Table 5.9 Coefficient of variation in area, production and productivity of major crops in Buldhana district

Sr. No	Crops	Area					Production					Productivity				
		Period-I	Period-II	Period-III	Period-IV	Over all	Period-I	Period-II	Period-III	Period-IV	Overall	Period-I	Period-II	Period-III	Period-IV	Overall
1	Rice	18.76	23.41	76.58	20.58	84.29	41.24	64.09	79.89	208.58	101.62	35.78	52.24	25.67	203.16	72.67
2	Wheat	16.84	52.28	27.11	35.16	40.57	46.71	58.40	39.86	45.74	61.94	32.96	23.51	26.17	23.79	40.34
3	Jowar	17.98	10.62	20.42	45.11	46.40	55.50	28.53	43.90	45.13	56.44	58.09	27.76	32.50	20.63	36.90
4	Bajra	17.85	45.81	34.76	38.38	50.26	44.25	144.98	49.86	35.41	153.66	33.58	42.19	31.41	29.21	45.92
5	Gram	39.83	49.88	37.38	45.18	83.27	46.58	82.92	66.16	68.37	122.84	24.97	30.73	27.71	33.10	45.87
6	Tur	4.64	26.57	11.24	14.53	34.46	44.60	37.92	35.66	29.34	41.74	61.25	30.39	33.86	29.77	37.59
7	Mung	16.64	17.26	23.26	36.62	40.80	45.85	62.31	33.38	52.93	69.06	37.36	38.53	32.69	43.72	52.75
8	Other pulses	6.96	13.53	8.94	203.82	71.53	22.68	49.54	34.50	217.24	98.74	36.80	41.29	33.48	65.74	53.45
9	Sugarcane	17.15	68.87	55.25	72.65	69.08	24.02	103.70	56.17	67.61	115.92	12.28	84.72	10.04	20.67	122.53
10	Cotton	10.88	6.40	8.38	13.60	11.38	32.03	38.06	29.83	43.86	66.19	33.25	37.79	31.56	125.30	158.49
11	Soybean	-	-	80.81	48.01	91.53	-	-	78.02	71.62	113.91	-	-	20.61	41.65	37.44
12	Ground nut	11.14	28.25	30.59	88.02	78.41	43.34	39.96	46.34	62.28	78.73	41.73	36.02	29.85	44.87	77.62
13	Other oilseeds	24.26	56.43	35.26	41.68	67.18	46.15	39.06	42.16	67.52	122.62	16.46	187.44	26.22	41.72	132.98

Period-I (1970-71 to 1979-80); Period-II (1980-81 to 1989-90); Period-III (1990-91 to 1999-2000); Period-IV (2000-01 to 2013-14).

5.1.6.e Coefficient of variation in area, production and productivity of major crops in Yavatmal district

Results on coefficient of variation of area are presented in Table 5.10. As revealed from table, coefficient of variation was highest in other oilseeds i.e. 100.06 per cent during overall period. The value of coefficient of variation for area was highest in sugarcane i.e. 48.53 per cent during period-I. During the second period and third period the coefficient of variation of area was highest in case of gram i.e. 42.47 per cent and 68.12 per cent and during fourth period it was highest in case of other pulses i.e. 171.13 per cent respectively.

Among the periods under study the overall period has high coefficient of variation of value of production value of 119.47 per cent, 86.05 per cent during first period and 80.77 per cent during the third period in case of other oilseeds. Thus, it is clear from the study that value of coefficient of variation of production of other oilseeds for the overall period was higher than other periods. During the second period coefficient of variation of value was highest in case of sugarcane i.e. 72.86 per cent and during the period it was highest in other pulses i.e. 169.54 per cent.

In case of productivity, the coefficient of variation value was highest in sugarcane i.e. 114.93 per cent during overall period and 62.47 per cent during period-II. Thus, it is clear from the study that value of coefficient of variation of productivity of sugarcane for the overall period was higher than other periods. During the period-I the coefficient of variation value was highest in case of jowar i.e. 53.47 per cent, during the period-III it was highest in other oilseeds i.e. 66.67 per cent and during the period-IV it was highest in case of other pulses i.e. 66.62 per cent respectively.

Table 5.10 Coefficient of variation in area, production and productivity of major crops in Yavatmal district

Sr. No	Crops	Area					Production					Productivity				
		Period-I	Period - II	Period- III	Period- IV	Over all	Period - I	Period - II	Period- III	Period- IV	Overall	Period - I	Period - II	Period- III	Period - IV	Overall
1	Rice	12.65	30.31	24.48	112.04	53.99	45.36	56.84	30.85	131.76	64.98	35.91	27.28	21.63	64.42	33.43
2	Wheat	38.55	26.71	17.79	46.31	41.79	51.84	30.98	33.28	65.06	63.12	33.86	15.41	26.47	25.07	30.66
3	Jowar	32.51	10.99	18.88	36.68	42.19	46.93	24.98	33.28	48.23	52.32	53.47	27.42	36.43	23.70	36.15
4	Bajra	15.57	17.79	15.09	100.21	54.77	36.60	38.26	35.49	104.18	62.70	33.15	30.81	30.61	22.49	39.39
5	Gram	8.35	42.47	68.12	51.40	89.54	30.56	45.92	47.93	65.11	81.48	32.79	37.75	33.19	30.13	71.06
6	Tur	4.91	18.86	11.58	10.91	36.11	42.05	23.97	26.11	27.02	43.84	24.39	13.28	20.42	23.23	21.18
7	Mung	22.42	40.87	17.61	84.53	54.04	35.07	53.94	38.75	128.62	107.28	39.88	45.80	33.05	38.28	52.25
8	Other pulses	16.47	24.66	7.99	171.13	71.28	71.39	46.65	43.18	166.57	100.24	31.09	31.87	31.38	66.62	62.70
9	Sugarcane	48.53	38.82	16.81	50.86	71.03	52.14	72.86	18.61	46.41	82.43	13.00	62.47	9.84	11.22	114.93
10	Cotton	1.22	5.05	5.80	12.30	10.27	29.57	32.51	31.40	48.17	69.26	29.21	30.69	33.32	43.15	64.71
11	Soybean	-	-	87.97	46.17	85.90	-	-	110.46	52.17	83.51	-	-	35.62	39.72	37.77
12	Ground nut	8.35	42.47	68.12	51.40	89.54	30.56	45.92	47.93	65.11	81.48	32.79	37.75	33.19	30.13	71.06
13	Other oilseeds	35.36	38.37	44.43	41.52	100.06	86.05	31.76	80.77	52.79	119.47	28.14	19.75	66.67	39.78	74.54

Period-I (1970-71 to 1979-80); Period-II (1980-81 to 1989-90); Period-III (1990-91 to 1999-2000); Period-IV (2000-01 to 2013-14)

5.2 Cropping pattern

The cropping pattern of a particular region emerges and also changes through the interaction of physical, social, economic, technological and infrastructural factors. The decisions of a farmer regarding cropping pattern are based on monetary returns, availability of production technologies, accessibility of resources and many others. During the last four decades, considerable changes have been occurred in the agricultural scenario. These changes have results in to a drastic change in the cropping pattern of the region. So, it is essential to examine the magnitude and direction of changes in the cropping pattern over four decades.

The changes in the cropping pattern have been examined for Amravati division as a whole and four districts of Amravati division i.e. Buldhana, Amravati, Akola and Yavatmal. The changes in the cropping pattern were estimated for the period 1970-71 to 2013-14. The area under selected crops and the relative share of each crop in the gross cropped area at different points of time have been used to study the changes in cropping pattern.

5.2.1 Changes in cropping pattern in Amravati division

The changes in cropping pattern in Amravati division during 1970-71 to 2013-14 are presented in Table 5.11.

Figures shown in first period i.e. 1970-71 revealed that jowar and cotton contributed 30.09 and 43.66 percent of gross cropped area. In the span of 43 years cropping pattern has changed substantially. The proportion of jowar was 30.09 percent in the year 1970-71 and it has reduced to 4.63 percent in 2013-14. In case of cotton, its share over gross cropped area has reduced to 23.91 per cent in 2013-14 from 43.66 percent in 1970-71 which is still emerged as the major crop in the division. The constant proportion of area under tur over gross cropped was highest in 2000-01 i.e. 9.91 percent. The proportion of area under wheat and other pulses was constant for the entire period. Rice, bajra, other cereals, sugarcane and other oilseeds contributed very negligible proportion of area over gross cropped area. Proportion of area under gram over gross

cropped area has increased from 1.77 per cent in 1970-71 to 7.32 percent in 2013-14. Proportion of area under soybean has increased from 1.07 per cent in 1990-91 to 34.09 per cent in 2013-14. The percentage change over base period 1990-91 of soybean is 3551.27 per cent which indicates increase of acreage under this crop. The area of rice, jowar, bajra, other cereals, mung, other pulses, sugarcane, cotton, groundnut, other oilseeds and other crops have been shifted to soybean. There is positive change in wheat by 22.80 per cent, gram by 216.60 per cent tur by 27.25 per cent and mung by 9.46 next to soybean over base period 1990-91. The gross cropped area has increased by 15.02 per cent over base period 1990-91.

Table 5.11 Changes in cropping pattern in Amravati division

(Area in '00' ha)

Sr. No	Crops	Years					Percentage change over base period (1990-91)
		1970-71	1980-81	1990-91	2000-01	2013-14	
1	Rice	327 (1.09)	342 (1.03)	339 (0.92)	163 (0.42)	48 (0.11)	-85.84
2	Wheat	1270 (4.23)	1558 (4.70)	1070 (2.92)	746 (1.91)	1314 (3.11)	22.80
3	Jowar	9031 (30.09)	9458 (28.53)	8826 (24.05)	5723 (14.69)	1954 (4.63)	-77.86
4	Bajra	362 (1.21)	399 (1.20)	358 (0.98)	230 (0.59)	75 (0.18)	-79.05
5	Other cereals	91 (0.30)	125 (0.38)	87 (0.24)	292 (0.75)	38 (0.09)	-56.32
6	Gram	531 (1.77)	418 (1.26)	976 (2.66)	1084 (2.78)	3090 (7.32)	216.60
7	Tur	1254 (4.18)	1504 (4.54)	3027 (8.25)	3860 (9.91)	3852 (9.13)	27.25
8	Mung	795 (2.65)	1194 (3.60)	1967 (5.36)	2043 (5.24)	2153 (5.10)	9.46
9	Other pulses	1255 (4.18)	1442 (4.35)	2304 (6.28)	2286 (5.87)	1955 (4.63)	-15.15
10	Sugarcane	23 (0.08)	34 (0.10)	150 (0.41)	155 (0.40)	69 (0.16)	-54.00
11	Cotton	13105 (43.66)	12673 (38.22)	14249 (38.83)	13101 (33.62)	10091 (23.91)	-29.18
12	Soybean	-	-	394 (1.07)	5351 (13.73)	14386 (34.09)	3551.27
13	Groundnut	1280 (4.26)	1042 (3.14)	747 (2.04)	258 (0.66)	209 (0.50)	-72.02
14	Other oilseeds	26 (0.09)	652 (1.97)	1159 (3.16)	356 (0.91)	88 (0.21)	-92.41
15	Other Crops	663 (2.21)	2314 (6.98)	1040 (2.83)	3322 (8.52)	2882 (6.83)	177.12
	Gross cropped area	30013 (100.00)	33155 (100.00)	36693 (100.00)	38970 (100.00)	42204 (100.00)	15.02

(Figures in the parenthesis are percentages over gross cropped area).

Note: Base period 1990-91 had taken for all the crops according to soybean cropping.

5.2.2 Changes in cropping pattern in Akola district

The changes in cropping pattern in Akola district of Amravati division during 1970-71 to 2013-14 are presented in Table 5.12.

Table 5.12 revealed that cotton and jowar were observed as major crops of the district during 1970-71, constituting 71.8 per cent of total cropped area. In the span of 43 years, cropping pattern has changed substantially in the district. The proportion of area under cotton was 41.38 per cent in the year 1970-71, has reduced by 15.41 per cent on 2013-14. In case of jowar, its share in gross cropped area has fallen to the level of 4.51 per cent in 2013-14 from 30.00 per cent in 1970-71. The proportion of area under jowar decreased drastically after 1990-91. The proportion of area under tur over gross cropped area is found to be constant for the period 1970-71 to 2013-14. Decreasing proportions of area were observed in respect of wheat, groundnut and rice. On the other hand increasing proportions of area under gram was observed. A desirable trend in the share of other pulses was observed and it has risen from 5.50 per cent in the year 1970-71 to 14.46 per cent in 2013-14. Soybean emerged as one of the major crop of the district, occupies 40.08 per cent of gross cropped area. The percentage change over base period 1990-91 of soybean is 9168.00 per cent which indicates increase of acreage under this crop. The area of rice, wheat, jowar, bajra, mung, sugarcane, cotton, groundnut, other oilseeds and other crops have been shifted to soybean. There is positive change in other cereals by 325.00 per cent, gram by 195.31 per cent, tur by 48.09 per cent by and other pulses by 111.11 per cent next to soybean over base period 1990-91. The gross cropped area has increased by 11.86 per cent over base period 1990-91.

Table 5.12 Changes in cropping pattern in Akola District

(Area in "00" ha)

Sr.No	CROP	Years					Percentage change over base period
		1970-71	1980-81	1990-91	2000-01	2013-14	
1	Rice	81 (1.00)	78 (0.86)	70 (0.67)	20 (0.18)	0 (0.00)	-100
2	Wheat	499 (6.18)	404 (4.47)	274 (2.65)	225 (2.07)	199 (1.72)	-27.37
3	Jowar	2421 (30.00)	2365 (26.21)	2753 (26.63)	1546 (14.24)	522 (4.51)	-81.04
4	Bajra	64 (0.79)	117 (1.29)	55 (0.53)	50 (0.46)	39 (0.33)	-29.09
5	Other cereals	11 (0.13)	14 (0.15)	4 (0.03)	23 (0.21)	17 (0.14)	325.00
6	Gram	133 (1.64)	129 (1.43)	320 (3.09)	397 (3.65)	945 (8.17)	195.31
7	Tur	365 (4.52)	393 (4.35)	761 (7.36)	881 (8.11)	1127 (9.74)	48.09
8	Mung	210 (2.60)	409 (4.53)	733 (7.09)	652 (6.00)	564 (4.87)	-23.06
9	Other pulses	444 (5.50)	571 (6.33)	792 (7.66)	1581 (14.56)	1672 (14.46)	111.11
10	Sugarcane	5 (0.06)	4 (0.04)	27 (0.26)	34 (0.31)	0 (0.00)	-100.00
11	Cotton	3375 (41.83)	3378 (37.44)	3617 (34.99)	3335 (30.71)	1782 (15.41)	-50.73
12	Soybean	-	-	50 (0.48)	1108 (10.20)	4634 (40.08)	9168.00
13	Ground nut	260 (3.22)	180 (1.99)	99 (0.95)	25 (0.23)	45 (0.38)	-54.55
14	Other oilseeds	25 (0.31)	146 (1.61)	377 (3.64)	130 (1.19)	16 (0.13)	-95.76
15	Other Crops	175 (2.16)	833 (9.23)	404 (3.90)	850 (7.82)	0 (0.00)	-100.00
	Gross cropped area	8068 (100.00)	9021 (100.00)	10336 (100.00)	10857 (100.00)	11562 (100.00)	11.86

Figures in the parenthesis are percentages over gross cropped area.

Note: Base period 1990-91 had taken for all the crops according to soybean cropping.

5.2.3 Changes in cropping pattern in Amravati district

The changes in cropping pattern in Amravati district of Amravati division during 1970-71 to 2013-14 are presented in Table 5.13.

In the span of 44 years cropping pattern has changed substantially. The proportion of area under jowar by 3.32 per cent, cotton by 17.61 per cent and groundnut per cent has been reduced while tur by 9.08 per cent, gram by 8.48 per cent, mung by 4.79 per cent and soybean

Table 5.13 Changes in cropping pattern in Amravati District

(Area in "00" ha)

Sr.No	Crops	Years					Percentage change over base period
		1970-71	1980-81	1990-91	2000-01	2013-14	
1	Rice	91 (1.29)	115 (1.49)	143 (1.63)	89 (0.87)	47 (0.44)	-67.13
2	Wheat	320 (4.54)	462 (5.98)	308 (3.52)	134 (1.30)	180 (1.70)	-41.56
3	Jowar	1601 (22.74)	1824 (23.61)	1792 (20.48)	1188 (11.55)	352 (3.32)	-80.36
4	Bajra	57 (0.81)	76 (0.98)	37 (0.42)	9 (0.09)	0 (0.00)	-100.00
5	Other cereals	57 (0.81)	98 (1.27)	53 (0.61)	53 (0.52)	14 (0.13)	-73.58
6	Gram	69 (0.98)	113 (1.46)	295 (3.37)	366 (3.56)	899 (8.48)	204.75
7	Tur	371 (5.27)	358 (4.63)	831 (9.50)	996 (9.68)	962 (9.08)	15.76
8	Mung	95 (1.35)	152 (1.97)	682 (7.80)	616 (5.99)	508 (4.79)	-25.51
9	Other pulses	83 (1.18)	94 (1.22)	97 (1.11)	335 (3.26)	14 (0.13)	-85.57
10	Sugarcane	2 (0.03)	2 (0.03)	17 (0.19)	35 (0.34)	3 (0.03)	-82.35
11	Cotton	3614 (51.33)	3507 (45.40)	3730 (42.64)	3091 (30.04)	1867 (17.61)	-49.95
12	Soybean	-	-	310 (3.54)	1803 (17.52)	3664 (34.57)	1081.94
13	Ground nut	409 (5.81)	316 (4.09)	292 (3.34)	66 (0.64)	38 (0.36)	-86.99
14	Other oilseeds	1 (0.01)	2 (0.03)	21 (0.24)	72 (0.70)	2 (0.02)	-90.48
15	Other Crops	271 (3.85)	606 (7.84)	140 (1.60)	1436 (13.96)	2050 (19.34)	1364.29
	Gross cropped area	7041 (100.00)	7725 (100.00)	8748 (100.00)	10289 (100.00)	10600 (100.00)	21.17

Figures in the parenthesis are percentages over gross cropped area.

Note: Base period 1990-91 had taken for all the crops according to soybean cropping.

by 34.57 per cent have been increased by the end of the year 2013-14. In case of cotton, its share over gross cropped area has reduced to 17.61 per cent in 2013-14 from 51.33 percent in 1970-71 which is still emerged as the major crop in the division. The constant proportion of area under other pulses over gross cropped was highest in 2000-01 i.e. 3.26 percent. Soybean crop is being cultivated to the extent of 34.57 per cent of gross cropped area. The percentage change over base period 1990-91 of

soybean is 1081.94 per cent which indicates increase of acreage under this crop. The area of rice, jowar, bajra, other cereals, mung, other pulses, sugarcane, cotton, groundnut and other oilseeds have been shifted to soybean. There is positive change in gram by 204.75 per cent, other crops by 1364.29 per cent, tur by 15.76 per cent next to soybean over base period 1990-91. The gross cropped area has increased by 21.17 per cent over base period 1990-91.

5.2.4 Changes in cropping pattern in Buldhana district

The changes in cropping pattern in Buldhana district of Amravati division during 1970-71 to 2013-14 are presented in Table 5.14.

In the span of 44 years cropping pattern has changed substantially. As evident from the table the proportions of area under cotton, rice, jowar, other pulses and groundnut have been decreased, while gram, tur and soybean have been increased during the study period. In case of cotton, its share over gross cropped area has reduced to 24.01 per cent in 2013-14 from 37.78 percent in 1970-71 which still emerged as the major crop in the division. The proportion of area under jowar over gross cropped has reduced from 36.24 percent in 1970-71 to 6029 per cent in 2013-14. Rice, bajra, other pulses and sugarcane contributed very negligible proportion i.e. 0 per cent, 0.37 per cent, 0.18 per cent and 0.01 per cent. Proportion of area under tur over gross cropped area has increased from 0.62 per cent in 1970-71 to 7.07 percent in 2013-14 and in case of gram it was increased from 3.68 per cent in 1970-71 to 8.32 per cent in 2013-14. Proportion of area under soybean has increased from 0.06 per cent in 1990-91 to 34.06 per cent in 2013-14 which emerged as a major crop in the district. The percentage change over base period 1990-91 of soybean is 64540.00 per cent which indicates increase of acreage under this crop. The area of rice, jowar, bajra, other cereals, mung, other pulses, sugarcane, cotton, groundnut and other crops other oilseeds have been shifted to soybean. There is positive change in gram by 237.61 per cent, wheat by 97.32 per cent, tur by 21.78 per cent next to soybean over base

period 1990-91. The gross cropped area has increased by 12.71 per cent over base period 1990-91.

Table 5.14 Changes in cropping pattern in Buldhana District

(Area in "00" ha)

Sr.No	Crops	Years					Percentage change over base period
		1970-71	1980-81	1990-91	2000-01	2013-14	
1	Rice	32 (0.47)	27 (0.35)	38 (0.45)	2 (0.02)	0 (0.00)	-100
2	Wheat	293 (4.32)	508 (6.53)	299 (3.55)	216 (2.68)	590 (6.22)	97.32
3	Jowar	2460 (36.24)	2516 (32.35)	2054 (24.39)	1444 (17.92)	597 (6.29)	-70.93
4	Bajra	104 (1.53)	114 (1.47)	139 (1.65)	79 (0.98)	35 (0.37)	-74.82
5	Other cereals	11 (0.16)	8 (0.10)	28 (0.33)	20 (12.49)	7 (0.07)	-75.00
6	Gram	250 (3.68)	134 (1.72)	234 (2.78)	183 (2.27)	790 (8.32)	237.61
7	Tur	42 (0.62)	284 (3.65)	551 (6.54)	788 (9.78)	671 (7.07)	21.78
8	Mung	258 (3.80)	401 (5.16)	270 (3.21)	284 (3.52)	211 (2.22)	-21.85
9	Other pulses	510 (7.51)	519 (6.67)	924 (10.97)	229 (2.84)	212 (2.23)	-77.06
10	Sugarcane	11 (0.16)	15 (0.19)	34 (0.40)	12 (0.15)	1 (0.01)	-97.06
11	Cotton	2565 (37.78)	2225 (28.61)	2654 (31.52)	2198 (27.27)	2279 (24.01)	-14.13
12	Soybean	-	-	5 (0.06)	1681 (20.86)	3232 (34.06)	64540.00
13	Ground nut	253 (3.73)	272 (3.50)	175 (2.08)	69 (0.86)	26 (0.27)	-85.14
14	Other oilseeds	0 (0.00)	503 (6.47)	732 (8.69)	138 (1.71)	7 (0.07)	-99.04
15	Other crops	0 (0.00)	251 (3.23)	283 (3.36)	535 (6.64)	832 (8.77)	193.99
	Gross cropped area	6789 (100.00)	7777 (100.00)	8420 (100.00)	8059 (100.00)	9490 (100.00)	12.71

Figures in the parenthesis are percentages over gross cropped area.

Note: Base period 1990-91 had taken for all the crops according to soybean cropping.

5.2.5 Changes in cropping pattern in Yavatmal district

The changes in cropping pattern in Yavatmal district of Amravati division during 1970-71 to 2013-14 are presented in Table 5.15.

Figures shown in first period i.e. 1970-71 revealed that cotton contributed 43.76 per cent of gross cropped area. In the span of 43 years cropping pattern has changed substantially. The proportion of jowar was 31.41 percent in the year 1970-71 and increased in the second period to 31.89 percent in the year 1980-81 but it has reduced to 4.58 percent in 2013-14. In case of cotton, its share over gross cropped area has reduced to 39.49 per cent in 2013-14 from 43.76 percent in 1970-71 which is still emerged as the major crop in the division. There is decrease in the area under proportion of the bajra, other pulses and groundnut during the study period i.e. from 1.69 percent in 1970-71 to 0.01 percent in 2013-14 of bajra and 2.69 per cent in 1970-71 to 0.54 per cent in 2013-14 of other pulses and 4.41 per cent in 1970-71 to 0.95 per cent in 2013-14 of groundnut. Rice, bajra, other oilseeds and sugarcane contributed very negligible proportion of area over gross cropped area. Proportion of area under gram, tur and mung over gross cropped area has increased from 0.97 per cent in 1970-71 to 4.32 percent in 2013-14 of gram, 5.87 per cent in 1970-71 to 10.35 per cent in 2013-14 and 2.86 per cent in 1970-71 to 8.24 per cent in 2013-14. Proportion of area under soybean has increased from 0.32 per cent in 1990-91 to 27.07 per cent in 2013-14 which emerged as one of the major crops of the district. The percentage change over base period 1990-91 for the soybean is 9748.00 per cent which indicate increase of acreage under this crop. The area of rice, jowar, bajra, other cereals, other pulses, sugarcane, cotton, groundnut and other crops have been shifted to soybean. There is positive change in gram by 259.06 per cent, mung by 208.51 per cent, other oilseeds by 117.24 per cent, wheat by 82.54 per cent and tur by 23.53 per cent next to soybean over base period 1990-91. The gross cropped area has increased by 14.83 per cent over base period 1990-91.

Table 5.15 Changes in cropping pattern in Yavatmal District

(Area in "00" ha)

Sr. No	Crops	Years					Percentage change over base period
		1970-71	1980-81	1990-91	2000-01	2013-14	
1	Rice	123 (1.52)	122 (1.41)	88 (0.96)	52 (0.53)	1 (0.01)	-98.86
2	Wheat	158 (1.95)	184 (2.13)	189 (2.06)	171 (1.75)	345 (3.27)	82.54
3	Jowar	2549 (31.41)	2753 (31.89)	2227 (24.24)	1545 (15.82)	483 (4.58)	-78.31
4	Bajra	137 (1.69)	92 (1.07)	127 (1.38)	92 (0.94)	1 (0.01)	-99.21
5	Other cereals	12 (0.15)	5 (0.06)	2 (0.02)	15 (0.15)	0 (0.00)	-100.00
6	Gram	79 (0.97)	42 (0.49)	127 (1.38)	138 (1.41)	456 (4.32)	259.06
7	Tur	476 (5.87)	469 (5.43)	884 (9.62)	1195 (12.24)	1092 (10.35)	23.53
8	Mung	232 (2.86)	232 (2.69)	282 (3.07)	491 (5.03)	870 (8.24)	208.51
9	Other pulses	218 (2.69)	258 (2.99)	491 (5.34)	141 (1.44)	57 (0.54)	-88.39
10	Sugarcane	5 (0.06)	13 (0.15)	72 (0.78)	74 (0.76)	65 (0.62)	-9.72
11	Cotton	3551 (43.76)	3563 (41.28)	4248 (46.23)	4477 (48.85)	4163 (39.45)	-2.00
12	Soybean	-	-	29 (0.32)	759 (7.77)	2856 (27.07)	9748.28
13	Ground nut	358 (4.41)	274 (3.17)	181 (1.97)	98 (1.00)	100 (0.95)	-44.75
14	Other oilseeds	0 (0.00)	1 (0.01)	29 (0.32)	16 (0.16)	63 (0.60)	117.24
15	Other crops	217 (2.67)	624 (7.23)	213 (2.32)	501 (5.13)	0 (0.00)	-100.00
	Gross cropped area	8115 (100.00)	8632 (100.00)	9189 (100.00)	9765 (100.00)	10552 (100.00)	14.83

Figures in the parenthesis are percentages over gross cropped area.

Note: Base period 1990-91 had taken for all the crops according to soybean cropping.

5.3 Crop diversification in selected districts of Amravati division

The analysis of changes in cropping pattern indicates that diversification took place in selected districts of Amravati division. The level of crop diversification varies in selected districts of Amravati division because of varied agro-climatic conditions and resource endowment of the farms. Hence an attempt was made to examine the level of crop diversification in selected districts of Amravati division at different points of time.

Herfindahl index was used to measure the level of crop diversification in present study.

5.3.1 Measurement of crop diversification by Herfindahl Index

Herfindahl Index is also a measure of concentration. The value of Herfindahl Index varies from zero to one. It takes the value one when there is complete specialization and value zero when there is perfect diversification. Accordingly it is presented in Table 5.16.

The Table 5.16 revealed that in Akola, Amravati, Buldhana and Yavatmal districts of Amravati division and as a whole Amravati division, the value of Herfindahl Index were found low i.e. less than 0.5 it means in all selected districts diversification took place. The diversification from subsistence crop to more commercial crops were took place in these districts. Therefore, from the foregoing analysis that, the hypothesis has been proved respectively crop diversification are took place over a period of time.

Table 5.16 Measurement of crop diversification by Herfindahl index

Year	Akola	Amravati	Buldhana	Yavatmal	Amravati division
1970-71	0.26	0.30	0.21	0.26	0.25
1980-81	0.24	0.26	0.21	0.30	0.25
1990-91	0.18	0.19	0.17	0.25	0.19
2000-01	0.17	0.17	0.17	0.21	0.18
2013-14	0.18	0.19	0.15	0.21	0.18

5.4 Advantageous crops

5.4.1 Advantageous crops in different districts of Amravati division

In order to examine the benefits of diversification, land concentration ratios of selected districts of Amravati division were computed and presented in Table 5.17 to 5.20.

Table 5.17 Land concentration ratios of major crops in Akola district

YEAR	JOWAR	COTTON	SOYBEAN	TUR
2004-05	0.55	4.67	0.29	0.52
2005-06	0.63	2.72	0.44	0.86
2006-07	0.39	6.82	0.33	0.30
2007-08	0.43	4.16	0.64	0.40
2008-09	0.38	8.19	0.29	0.22
2009-10	0.18	2.48	1.12	0.84
2010-11	0.07	3.08	1.50	0.48
2011-12	0.27	5.24	0.93	0.14
2012-13	0.11	2.40	1.84	0.49
2013-14	0.02	2.02	2.35	0.53

Land concentration ratios of major crops in Akola district were presented in Table 5.17. From the table, it is seen that, the land concentration ratio of soybean showed increasing trend over a period of study. It means soybean is most advantageous crop in Akola district over other selected crops i.e. jowar, cotton and tur in Akola district in Amravati division.

Table 5.18 Land concentration ratios of major crops in Amravati district

YEAR	JOWAR	COTTON	SOYBEAN	TUR
2004-05	0.22	4.52	0.37	0.86
2005-06	0.27	1.31	1.43	1.23
2006-07	0.27	1.64	1.83	0.69
2007-08	0.18	2.03	1.86	0.56
2008-09	0.11	1.81	1.36	1.16
2009-10	0.10	1.12	1.99	1.27
2010-11	0.08	1.52	3.03	0.47
2011-12	0.10	1.63	2.31	0.66
2012-13	0.05	2.38	2.03	0.48
2013-14	0.01	2.12	2.05	0.64

Land concentration ratios of major crops in Amravati district were presented in Table 5.18. From the table, it is seen that, the land concentration ratio of cotton showed increasing trend over a period of study. It means cotton is most advantageous crop in Amravati district over other selected crops i.e. jowar, soybean and tur in Amravati district of

Amravati division. Similarly, in the last decade soybean also showed increasing trend in land concentration ratios. Therefore soybean is also a advantageous crop during the last decade.

Table 5.19 Land concentration ratios of major crops in Buldhana district

YEAR	JOWAR	COTTON	SOYBEAN	TUR
2004-05	0.51	2.36	1.09	0.52
2005-06	0.43	2.32	1.44	0.38
2006-07	0.24	3.12	1.26	0.41
2007-08	0.15	3.82	1.27	0.31
2008-09	0.20	7.90	0.46	0.26
2009-10	0.17	2.72	1.08	0.78
2010-11	0.08	2.71	2.15	0.26
2011-12	0.14	3.21	1.80	0.20
2012-13	0.11	1.74	3.27	0.20
2013-14	0.02	2.10	3.32	0.18

Land concentration ratios of major crops in Buldhana district were presented in Table 5.19. From the table, it is seen that, the land concentration ratio of soybean showed increasing trend over a period of study. It means soybean is most advantageous crop in Buldhana district over other selected crops i.e. jowar, cotton and tur in Buldhana district in Amravati division for the study.

Table 5.20 Land concentration ratios of major crops in Yavatmal district

YEAR	JOWAR	COTTON	SOYBEAN	TUR
2004-05	0.24	3.93	0.48	0.85
2005-06	0.25	1.12	1.69	1.22
2006-07	0.13	3.36	1.01	0.65
2007-08	0.08	6.47	0.63	0.39
2008-09	0.09	8.76	0.42	0.35
2009-10	0.07	3.58	0.80	0.86
2010-11	0.04	7.19	0.62	0.37
2011-12	0.08	7.67	0.65	0.25
2012-13	0.05	5.13	1.03	0.32
2013-14	0.02	5.40	1.02	0.32

Land concentration ratios of major crops in Yavatmal district were presented in Table 5.20. From the table, it is seen that, the land concentration ratio of cotton showed increasing trend over a period of study. It means cotton is most advantageous crop in Yavatmal district over other selected crops i.e. jowar, soybean and tur in Yavatmal district of Amravati division. Similarly in the last five years i.e. 2009-10 to 2013-14 soybean also showed increasing trend in land concentration ratios. Therefore soybean is also an advantageous crop during the last five years.

CHAPTER VI

SUMMARY AND CONCLUSIONS

The study of crop diversification and changes in cropping pattern assumes a great significance as it is one of the important path for balanced development of agriculture to meet the human requirements. The adoption of better cropping pattern optimally suited to the technological changes is an important one for augmenting agricultural growth. Cropping pattern has been dynamic to cope up the changing scenario and to meet the ever changing demand of growing population. Limited availability of land to rising population and declining yields, forced farmers to search for alternative ways for raising farm income. With the passage of time farmers became increasingly commercialized and started farming for maximizing their output. Now the realization prevails amongst the farmers for long term returns and they are in search of optimum cropping pattern which can fulfill their aspirations. So in this context, an effort has been made to examine the change in cropping pattern, extent of crop diversification and economics of crop diversification in Amravati division. The specific objectives of this study were as under.

- 1) To study the performance of major crops in different districts of Amravati division.
- 2) To study the changes in cropping pattern in different districts of Amravati division.
- 3) To study the crop diversification in different districts of Amravati division.
- 4) To work out the advantageous crops in different districts of Amravati division.

The present study based on secondary data collected from different government publications. The time series data on area, production and yield of Amravati division were collected for the period 1970-71 to 2013-14.

The crops selected for the study were Rice, Wheat, Soybean, Cotton, Jowar, Bajra, Gram, Tur, Mung, Groundnut, and Sugarcane.

Various statistical techniques were used to achieve the objectives of study. In order to examine the performance of different crops in Amravati division and four districts of Amravati division i.e. Akola, Amravati, Buldhana, Yavatmal, compound growth rates and coefficient of variation have been computed at different points of time. In order to examine the changes in cropping pattern in selected districts of Amravati division, the percentage share of individual crops with respect to gross cropped area has been worked out at different points of time. In order to study the extent of crop diversification in selected districts of Amravati division diversification indices have been computed at different points of time. In order to work out the advantageous crops, land concentration ratios with comparative advantage was computed for selected crops at different points of time. The results of the study are summarized as below.

6.1 Performance of major crops in different districts of Amravati division

Compound growth rates of area, production and yield of major crops in Amravati division revealed that, during overall period growth rates of area were declined significantly in all the cereals. Among pulses the area growth rate for gram increased significantly by 5.60 per cent during the study period. The area growth for soybean increased significantly during overall period with 13.62 per cent. The growth rate of tur, mung, sugarcane and other oilseeds were also increased significantly by 13.38 per cent. The area growth rate under mung and groundnut declined significantly by 11.26 per cent and 7.11 per cent. The wheat and cotton crops showed stagnancy in growth rate of area during the overall period respectively.

In case of production, during overall period growth rates of rice were increased by 6.31 per cent while wheat showed stagnancy. On the other hand it was declined significantly in jowar by 2.35 per cent and 3.22 per cent. During overall period, growth rates of production were increased significantly in gram, tur, mung, sugarcane, cotton, soybean and other

oilseeds. The growth rates of production were declined significantly in other pulses by 10.11 per cent and groundnut by 4.66 per cent during overall period.

In case of productivity, during overall period, the growth rate of wheat and bajra increased significantly by 2.50 per cent and 2.52 per cent. Rice and jowar showed stagnancy during overall period. Among pulses except tur all crops showed increase in growth rate of productivity while tur showed stagnancy during overall period. The growth rate of productivity of sugarcane declined significantly by 12.83 per cent. The growth rate of productivity under cotton by 4.14 per cent, groundnut by 3.96 per cent and other oilseeds by 4.22 per cent were increased significantly during overall period. The growth rate of productivity of soybean showed stagnancy during overall period.

6.2 Changes in cropping pattern in different districts of Amravati division

The analysis of cropping pattern changes in Amravati division revealed that cotton, jowar and soybean were the major crops of Amravati division. Soybean is emerging as one of the major crop of the division. The district wise proportions of area under soybean in 2013-14 were Akola (40.08%), Amravati (34.57%), Buldhana (34.06%), Yavatmal (27.07%). The area under jowar is found to be decreasing in all districts (i.e. Study area) of Amravati division.

6.3 Crop diversification in different districts of Amravati division.

In majority of districts of Amravati division i.e. Akola, Amravati, Buldhana and Yavatmal, crop diversification has significantly increased during the study period. The diversification from subsistence crop to more commercial crops were took place in these districts.

6.4 The advantageous crops in different districts of Amravati division

Increasing land concentration ratio of soybean from year 2000-01 to 2013-14. So, Soybean is more advantageous crop in Akola and

Buldhana districts of Amravati division and cotton is advantageous crop in Amravati and Yavatmal due to increase in prices of the crops.

Conclusion

- 1) Area under jowar has reduced by (77.86 per cent) in Amravati Division from 1990-91 to 2013-14.
- 2) Proportion of area under cotton has reduced (29.18 per cent) in Amravati division.
- 3) Area growth rate of soybean were positively significant in Akola, Amravati, Buldhana, and Yavatmal districts at 1% level of significance.
- 4) Soybean is more advantageous crop over other crops in Akola, Amravati, yavatmal and Buldhana district in Amravati division.
- 5) Cotton is more advantageous over jowar, soybean and tur in Amravati and Yavatmal district of Amravati division.
- 6) Over a period of study cropping pattern has changed and crop diversification has increased significantly in Amravati division.

Policy Implication

The following policy implications are brought out from important findings of present study.

- 1) Crop diversification has increased over the period of study in all the selected districts of Amravati division. This should be noted while deciding the policy on cropping plan for these districts.
- 2) Area under cotton decreased over the period because of the uncertain price policy. Cotton cultivation stabilized in the Amravati division as it is cash crop of farmers. There is need of long range concrete and assured procurement policy.

CHAPTER VII

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