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Determinants of Stagnation in Productivity of Important Crops in Maharashtra

S. S. Kalamkar

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Foreword

India made significant advances towards achieving its goals of rapid agricultural growth, improving food security, and reducing rural poverty during last four decades. Sustained growth in foodgrains production enabled India to become self sufficient in foodgrains, eliminating the threat of famines and acute starvation in the country. India has experienced considerable changes in crop mix, yield and production since the inception of the green revolution during mid 1960s. Though the long term growth in agriculture sector has been impressive, the signs of productivity deceleration had started emerging since 1990s onwards. It is important to note that the growth in the recent past as well as during the last three decades has been attributed due to the adoption of innovative technologies. Thereafter, the impacts of technology has slowed down mainly because of soil fatigue resulting in decline in fertilizers use efficiency and slow pace of development of irrigation infrastructure particularly in arid and semi-arid areas. Capital formation by public sector until early 1980s which was quite satisfactory in agriculture started declining thereafter, which hindered growth of agriculture. The slow growth of agriculture recorded in the recent years has been a matter of concern among the policy makers, as agricultural growth plays a crucial role in improving rural employment and reducing rural poverty. It calls for an examination of the issues related to the trends in agricultural productivity, particularly with reference to individual crops in the recent years and the determinants of stagnation in productivity of important crops. In view of this, it was considered necessary by the Ministry of Agriculture, Government of India to undertake a study entitled, 'Determinants of Stagnation in Productivity of Important Crops in Maharashtra'.

Using secondary data, the study examined various aspects of agricultural development of the state with a view to find out its present status. While examining the growth in agriculture sector during last four and half decades, the study has underlined some of the important programmes introduced to improve the performance of agriculture. The study also brought out the major constraints that hinder the growth of Maharashtra's agriculture. After having analyzed the districtwise growth performance of agriculture, the study suggests that the state should focus mainly on irrigation and watershed development, horticultural development and development of drought resistant cum high yielding varieties suitable to agro climatic conditions. It is also necessary to increase the plan expenditure on agriculture and allied activities and agricultural extension system needs to be strengthened. Further, there is a need for regionally differentiated strategies for future growth. The findings and policy suggestions of the study are expected to be useful to the policy makers for formulating region specific policies focusing on agricultural development in Maharashtra.

I congratulate Dr. S. S. Kalamkar for carrying out this important research project at our Institute.

March 25, 2010
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List of Abbreviations

ACGR	- Annual Compound Growth rate
AGR	- Annual Growth Rate
ASMO	- Area Sown More than Once
CGR	- Compound Growth rate
CI	- Cropping Intensity
CV	- Coefficient of Variation (%)
DMI	- Drip Method of Irrigation
DPAP	- Drought Prone Area Programme
DRDA	- District Rural Development Authority
EGS	- Employment Guarantee Scheme
FHP	- Farm Harvest Price
FYP	- Five Year Plan
GCA	- Gross Cropped Area
GDP	- Gross Domestic Product
GIA	- Gross Irrigated Area
GVO	- Gross Value of Output
Ha	- Hectare
HDI	- Human Development Index
HYV	- High Yielding Variety
IADP	- Integrated Agricultural Development Plan
II	- Irrigation Intensity
INM	- Integrated Nutrient Management
IPM	- Integrated Pest Management
mha	- Million hectares
MMI	- Medium and Minor Irrigation
MSP	- Minimum Support Price
NCA	- Net Cropped Area
NDC	- National Development Council
NDP	- Net Domestic Product
NHM	- National Horticulture Mission

NIA	- Net Irrigated Area
NPK	- Nitrogen, Potassium and Potash
NSA	- Net Sown Area
NSDP	- Net State Domestic Product
NWDPRA	- National Watershed Development Programme for Rainfed Areas
PPP	- Public Private Partnership
Prod	- Production
Prodvty.	- Productivity (kg/ha)
RKVY	- Rashtriya Krishi Vikas Yojana
SAU	- State Agricultural Universities
SRR	- Seed Replacement Ratio
WPI	- Wholesale Price Index

Chapter I

Introduction

1.1 Introduction:

In most of the developing economies, agriculture is the core sector providing livelihood to a significant proportion of the population, especially in rural areas. Since this sector faces the largest brunt of underemployment, unemployment and poverty, a growing agriculture and allied sector is expected to contribute vastly to overall growth and poverty alleviation. Increasing the productivity capacity of agriculture through higher productivity has been an important goal in developing countries. It has been suggested that due to limited scope for expansion of arable land, there is a need to increase yields to their technically highest levels through appropriate investment in basic infrastructure, human development, and research and extension services (Chavas, 2006; Zepada, 2006). Some of these issues are very relevant for a country like India where agriculture continues to be the core sector of the economy, on which over two third of our population is dependent for their livelihood.

India is still an agricultural economy in the beginning of 21st century and according to 2001 census, near about 73 per cent of people live in the rural area, primarily depending on agriculture for their livelihood. Agriculture is the main stay of Indian economy because of its high share in employment and livelihood creation notwithstanding its reduced contribution to the nation's Gross Domestic Product (GDP). The share of agriculture in GDP has registered a steady decline from 36.4 percent in 1982-83 to 17.8 percent in 2007-08. Yet this sector continues to support more than half a billion people providing employment to 52 percent of the workforce. Agricultural sector also contributed 12.2 percent of national exports in 2007-08. Therefore in the predominantly agricultural country like ours, the performance of the agricultural sector influences the growth of the Indian economy (GOI, 2009). Agricultural development is important not only because of its high potential to raise the income and employment to poverty stricken rural masses but also due to its capacity to provide food, raw material and ever expanding market for industrial good for speedy development of overall economy (Kalamkar, 2004a). Agriculture forms the backbone of Indian economy and despite large industrialization in last fifty years; agriculture still occupies a place of pride. In spite

of rapid urbanization during last few decades, India's rural population still accounts for about three fourths of the total population. It is observed that growth in agriculture contributed to poverty alleviation and employment generation in the rural areas and achievements of higher rates of economic growth and therefore, prosperity of the rural economy is closely linked to agriculture and allied activities.

India made significant advances towards achieving its goals of rapid agricultural growth, improving food security, and reducing rural poverty during last four decades. Despite rapid population growth, India has made impressive strides on the agricultural front by taking the country out of serious food shortages. Sustained foodgrains production growth enabled India to achieve foodgrains self sufficiency, eliminating the threat of famines and acute starvation in the country (World Bank, 2004). Much of the credit of this success should go to the several million small farming families that form the backbone of Indian agriculture and Indian economy (Kumar and Mittal, 2006). Up to mid-sixties, owing to various constraints, not only low value crops were dominating in the cropping pattern but both production and productivity of crops were also very low. But, the situation has totally changed after the introduction of Green Revolution in Indian agriculture, which was introduced during the mid-sixties. India has experienced considerable changes in crop mix, yield and production since the inception of the green revolution. The introduction of Borlaug new seed-fertilizer technology during the mid sixties led to large increases in the yield levels of wheat, rice and later oilseeds and cotton (Bhalla, 2007). India has made lot of progress in agriculture after mid sixties in terms of growth in output, yields and area under many crops. It has gone through a green revolution, a white revolution, a yellow revolution and a blue revolution. The main source of long-run growth was technological augmentation of yields per unit of cropped area. This resulted in tripling of foodgrain yields, and foodgrain production increased from 51 million tonnes in 1950–51 to 230.78 million tonnes in 2007–08. Production of oilseeds, sugarcane, and cotton have also increased more than four-fold over the period, reaching 29.76 million tonnes, 348.0 million tones and 25.9 million bales, respectively, in 2007–08 (GOI, 2009). Constructive policies/ programmes introduced by the central and state governments during different plan periods have been considered as one of the main reasons for the substantial improvement in the production of various agricultural commodities (Deshpande and Narayanamoorthy, 2002). Today, India is the largest producer of milk, fruits,

cashew nuts, coconuts and tea in the world, the second largest producer of wheat, vegetables, sugar and fish and the third largest producer of tobacco and rice. However, Indian agriculture suffers from a mismatch between food crops and cash crops, low yields per hectare except for wheat, volatility in production and wide disparities of productivity over regions and crops.

The performance of agriculture growth in India during last four decades could be broadly classified in to a few major phases (Deshpande *et al.*, 2004). The first phase covering period up to mid-1960s, widely known as pre-green revolution period, was marked by growth achieved through area expansion. The agricultural production of all crops registered an annual growth of 3.15 per cent with the growth rate in area of 1.58 per cent and productivity of 1.21 per cent (Table 1.1). Despite major achievement in the initiatives taken by the government, the foodgrain production was not adequate to meet the needs of growing population, particularly from year 1961. The imports of foodgrains increased steeply from 3.5 million tones in 1961 to 10.36 million tones in 1966. The possibility of increasing production by bringing more additional area under cultivation was limited. Hence, it was felt necessary to look for alternatives to meet the demand of increasing population in the near future. The situation worsened by the droughts in two successive years in mid-sixties. As a response the Green Revolution was ushered in through adoption of high yielding varieties seeds (wheat and rice) and increased use of chemical fertilizers under irrigated conditions. During this phase the country witnessed to a significant growth in foodgrain production, at the rate of 2.15 and 2.85 percent per annum during 1967-68 to 1980-81 and 1980-81 to 1989-90, respectively (Table 1.1). The growth in these periods was characterized by productivity-led growth. Soon the negative externalities of the technological changes began surfacing in various forms (Deshpande *et al.*, 2004, Bhalla, 2007). Agricultural growth in India during the late 1970s and early 1980s was propelled by the green revolution technologies. But, the productivity gains from green revolution technologies in India have essentially ended.

The growth in the agriculture sector and non-agriculture sector has been quite modest during 90s. Growth in agriculture after mid-nineties was totally different than before mid-nineties mainly because of three continuous climatically abnormal years at the end of nineties. The purchased input based crop production and protection system did not yield expected proportionate increase in production

(now a well known yield stagnation phenomenon). The decade of nineties showed mixed performance for the agricultural sector. Initially, the agricultural sector showed positive signs of growth but soon under the pressure of inter-sectoral growth pulls the investment trends in the agricultural sector showed signs of deceleration. The situation was further impacted by signing of the WTO agreement on agriculture and that placed additional factor in front of the policy planners. A clear picture of intensifying stress in the agriculture sector was emerging and that took very ugly culmination in a few regions.

Table 1.1: Growth Rates of Area, Production and Productivity of Major Crop Groups in India: 1949-50 to 2007-08 (per cent per annum)

Crop Groups		1949-50 to 1964-65	1967-68 to 1980-81	1980-81 to 1989-90	1990-91 to 1999-00	2000-01 to 2007-08
Foodgrains	Area	1.35	0.38	-0.23	-0.07	-0.44
	Production	2.82	2.15	2.85	2.02	0.68
	Productivity	1.36	1.33	2.74	1.52	1.20
Non-Foodgrains	Area	2.44	0.94	1.12	1.18	-0.03
	Production	3.74	2.26	3.77	2.69	3.06
	Productivity	0.89	1.19	2.31	1.09	3.07
All Crops	Area	1.58	0.51	0.10	0.27	-0.33
	Production	3.15	2.19	3.19	2.29	1.64
	Productivity	1.21	1.28	2.56	1.33	1.96

Source: GOI (2008).

As mentioned earlier, though the overall growth in agriculture sector had been encouraging, the signs of productivity deceleration had started emerging since 90s onwards. There has been a consistent decline in growth of the agriculture sector since 1990 onward as compared to 1980s. It was 4 per cent per annum during the 1980s on an average, which came down to 3.2 per cent during 1990s and -5.0 per cent during 1999-2000 to 2002-2003, with minor improvements estimated during 2003-04. This has serious implications on the nutritional status and food security of our country (Mathur, *et al.*, 2006). During the Tenth Five Year Plan, agriculture growth was 2.5 per cent compared to 9 percent in the manufacturing sector and 15 per cent in the transport and communication sector. The secular decline in the share of agricultural sector in GDP has continued, with a decline from 24 per cent in 2001-02 to about 17.8 per cent in 2007-08. These figures indicate that a smaller share of GDP is getting distributed among a larger number of people who depend on agriculture for their livelihood. The growth in productivity of all crops was

showing declining trend across the regions by the end of 2004-05. Wheat, which is an important constituent of National Food Security, showed a declining trend in productivity. While rice and *ragi* seem to have reached yield plateau after 1992-93. This seems to be a matter of serious concern, especially in view of a growth strategy from globalization and trade angles. A declining growth rate of investment in agricultural, declining efficiency in input-use, no major technological breakthrough and falling prices, all have contributed to the lower agricultural growth in the country.

The Mid Term Appraisal for the Tenth Five Year Plan had drawn attention to the loss of dynamism in agriculture and allied sectors after the mid 1990s. In the last decade, there has been a sharp deceleration in Indian agriculture with the growth rate of agricultural GDP slipping from 3.62 percent during 1984-85 to 1995-96 to less than 2 percent in the period from 1995-96 to 2004-05 (see Table 1.2). Further, state-wise trends indicate that the largest slumps occurred those areas/states that are predominantly rainfed (Planning Commission, 2008). This deceleration, although most marked in rainfed areas, occurred in almost all states and covered all major sub-sectors. These results clearly show the signs of acute distress and stagnation in productivity in the sector. Consequently, growth of agricultural GDP has been well below the target of 4 per cent set in 9th and 10th Five Year Plan periods.

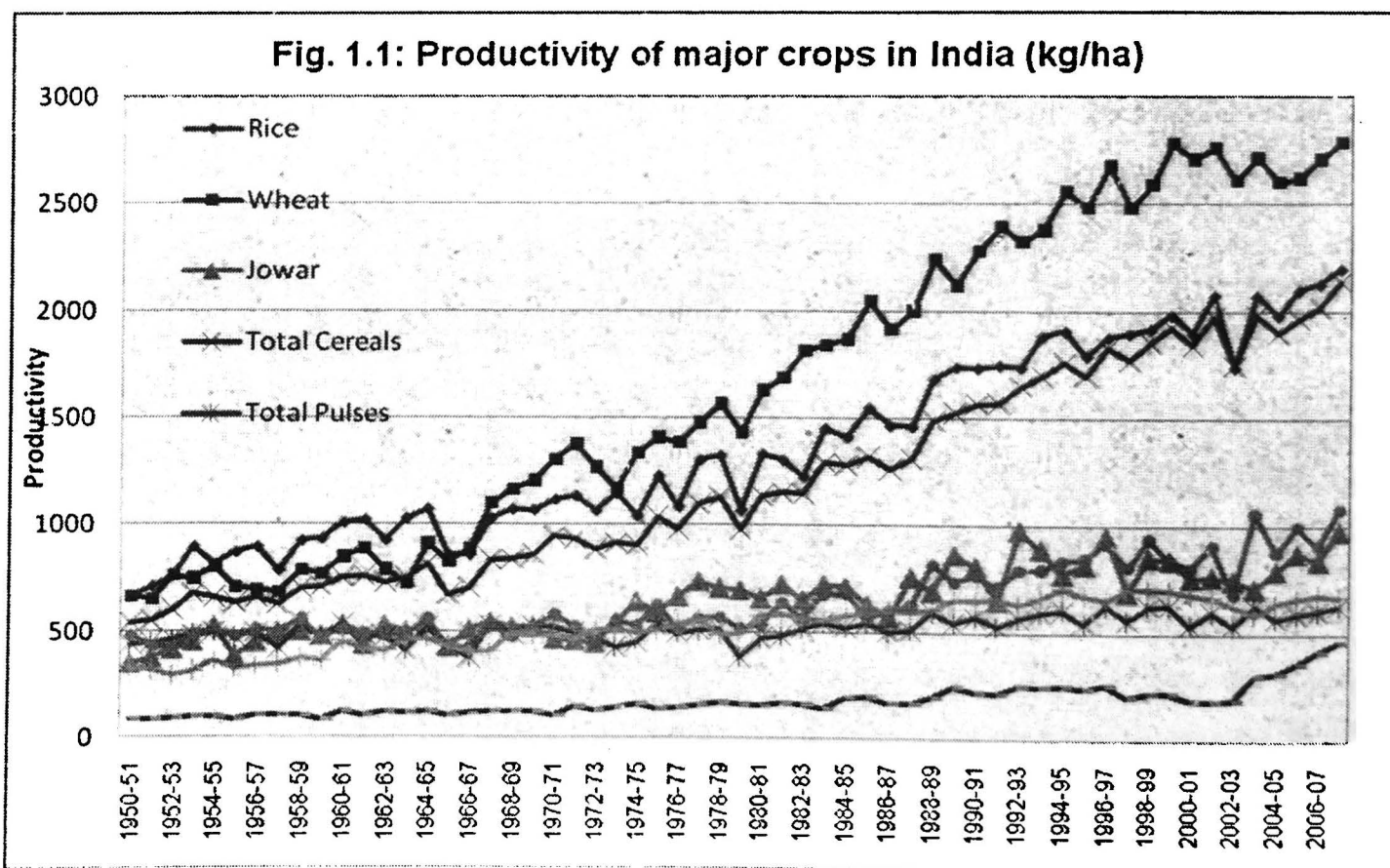
Table 1.2: Growth rate of National State Domestic Products (NSDP) from Agriculture

State	Growth rate in NSDP Agriculture (% per annum)		Rainfed (%)
	1984-85 to 1995-96	1995-96 to 2004-05	
Punjab	4.00	2.16	3
Haryana	4.60	1.98	17
Utter Pradesh	2.82	1.87	32
Tamil Nadu	4.95	-1.36	49
West Bengal	4.63	2.67	49
Bihar	-1.71	3.51	52
Andhra Pradesh	3.18	2.69	59
Gujarat	5.09	0.48	64
Rajasthan	5.52	0.30	70
Orissa	-1.18	0.11	73
Madhya Pradesh	3.63	-0.23	74
Karnataka	3.92	0.03	75
Maharashtra	6.66	0.10	83
Kerala	3.60	-3.54	85
Assam	1.65	0.95	86
All India	3.62	1.85	60

Note: States are ranked by percentage of rainfed area.

Source: Planning Commission, GOI, 2008.

The stagnation in productivity was quite visible (see, Figure 1.1) and while this was being discussed in some forums and the results of the 59th round of NSSO (2005) on the 'Situation Assessment of Farmers' came as eye openers. These results clearly showed the signs of acute distress and stagnation in productivity in the sector (Bhalla, 2006; Deshpande and Prabhu 2005), and further evidence of the worsening situation of farming households can be seen from the results, which shows that 48.6 percent of the farmers' households in India are in debt, and about 41 percent farmers' households in the country did not like farming because it is non profitable, risky and its lack of social status. The green revolution phase displayed a high yield growth per unit of input, and the first post-green revolution phase (from later 1960s to mid 1980s) was marked by the continued growth in returns from land through the intensification in use of chemical inputs and machine labours. However, the second post-green revolution phase (beginning the mid 1980s) was characterized by high input use and decelerating productivity growth (Kumar and Mittal, 2006). It calls for an examination of the issues related to the trends in agricultural productivity, particularly with reference to individual crops in the recent years and the determinants of stagnation in productivity of important crops.



While the growth oriented policies introduced by the government have been continuing though with some modifications across plan periods, the overall growth rate of agriculture has decelerated during the nineties as compared to the eighties

at all-India level owing to certain constraints (see, Table 1.3). As rightly mentioned in the National Agriculture Policy (GOI, 2000), "The pattern of growth of agriculture has, however, brought in its wake, uneven development across regions and crops as also across different sections of farming community and is characterized by low levels of productivity and degradation of natural resources in some areas. Capital inadequacy, lack of infrastructural support and demand side constraints such as controls on movement, storage and sale of agricultural products, etc. have continued to affect the economic viability of agricultural sector". Since agricultural growth plays a crucial role in improving rural employment and reducing rural poverty, the slow growth of agriculture has been a matter of concern among the policy makers in the recent years. In addition to our own domestic constraints, the problems arising out of WTO commitments and the influence of international policies pose a lot of challenges to the agricultural sector of the country than ever before. One of the major challenges of the 11th Five Year Plan will be to reverse the deceleration in agricultural growth from 3.2 percent observed between 1980 and 1996-97 to a trend average of around 2.0 percent subsequently. This deceleration is the root cause of the problem of rural distress that has surfaced in many parts of the country and reached crisis levels in some. Low farm incomes due to inadequate productivity growth have often combined with low prices of output and with lack of credit at reasonable rates, to push many farmers into crippling debt (Planning Commission, 2006a).

The problem of unstable productivity in agriculture is of no less importance than the problem of growth in agriculture (Nadkarni and Deshpande, 1982). Sustained growth in agricultural production and productivity is essential for overall stability of the Indian economy. But that is not enough. The aggregate growth rate in agriculture has remained fairly stable and unchanged in the first two decades of the post green revolution periods (Sawant and Achutan, 1995). Green Revolution provided the much needed food security to the vast population of the Indian nation but in spite of being one of the top producers of almost all agricultural commodities, the productivity is still very low compared to many other countries in the world. The fatigue in the post-green revolution era has now attained serious dimensions. For achieving the required production targets to feed more than 1.5 billion in 2050, it is imperative to develop strategies that can sustain higher levels of production without an adverse affect on the environment. In order to maximize the production from the

Table 1.3: Compound Growth-Rate of Area, Production and Yield of Principle Crops in India (Base: TE 1981-82=100)

A – Area; P – Production; Y – Yield
(Percent per annum)

Crop	1949-50 to 1964-65			1967-68 to 2007-08			1980-81 to 1989-90			1990-91 to 1999-2000			2000-01 to 2007-08*			1949-50 to 2007-08		
	A	P	Y	A	P	Y	A	P	Y	A	P	Y	A	P	Y	A	P	Y
Rice	1.21	3.5	2.25	0.5	2.48	2.01	0.41	3.62	3.19	0.68	2.02	1.34	-0.14	1.87	2	0.67	2.53	1.85
Wheat	2.69	3.98	1.27	1.22	3.75	2.5	0.46	3.57	3.1	1.72	3.57	1.83	1.29	1.36	0.08	1.88	4.83	2.89
Jowar	0.99	2.51	1.49	-1.99	-0.67	1.35	-0.99	0.28	1.29	-3.53	-3.07	0.48	-2.9	0.34	3.37	-1.2	0.14	1.36
Bajra	1.08	2.34	1.24	-0.82	1.36	2.2	-1.05	0.03	1.09	-1.46	0.95	2.44	0.31	4.53	4.21	-0.33	1.68	2.01
Maize	2.67	3.88	1.18	0.56	2.55	1.97	-0.2	1.89	2.09	0.94	3.28	2.32	3.5	5.84	2.26	1.12	2.61	1.47
Coarse Cereals	0.9	2.25	1.23	-1.41	0.62	1.91	-1.34	0.4	1.62	-2.12	-0.02	1.82	-0.41	3.25	4.25	-0.8	0.96	1.64
Total Cereals	1.25	3.21	1.77	-0.07	2.48	2.18	-0.26	3.03	2.9	0.04	-0.02	1.59	0.16	1.95	3.1	0.32	2.69	2.02
Gram	1.64	2.66	1.0	-0.39	0.35	0.75	-1.41	-0.81	0.61	1.26	2.96	1.68	4.7	5.51	0.77	-0.56	0.17	0.74
Tur	0.57	-1.34	-1.9	1.03	1.04	0.01	2.3	2.87	0.56	-0.66	0.89	1.55	0.91	3.66	2.74	0.89	0.8	-0.09
Other Pulses	2.06	1.28	-0.77	0	1.02	1.01	0.02	3.05	3.03	-1.61	-1.58	0.04	0.76	1.59	0.82	0.3	0.84	0.54
Total Pulses	1.72	1.41	-0.18	0.02	0.75	0.7	-0.09	1.52	1.61	-0.6	0.59	0.93	1.91	3.42	1.65	0.08	0.56	0.5
Foodgrains	1.35	2.82	1.36	-0.05	2.25	1.99	-0.23	2.85	2.74	-0.07	2.02	1.52	0.48	2.09	2.82	0.27	2.35	1.77
Sugarcane	3.28	4.26	0.95	1.71	2.72	0.99	1.44	2.7	1.24	-0.07	2.73	1.05	1.89	2.2	0.3	1.78	2.87	1.07
Groundnut	4.01	4.34	0.31	-0.25	0.85	1.1	1.67	3.76	2.06	-2.31	-1.25	1.08	-0.23	3.17	3.41	0.47	1.35	0.87
Sesamum	0.14	-0.32	-0.46	-1.08	1.1	2.2	-0.52	3.2	3.74	-5.52	-4.84	0.72	1.03	3.98	2.91	-0.58	0.86	1.45
R & M	2.97	3.35	0.37	2.01	4.47	2.41	1.95	7.28	5.22	0.71	0.78	0.07	6.03	8.17	2.02	1.96	4.1	2.1
Nine Oilseeds	2.53	3.12	0	1.45	3.16	1.67	2.47	5.36	2.49	0.17	1.42	1.42	3.38	7.23	3.7	1.33	2.74	1.29
Total Oilseeds	2.67	3.2	0.3	1.19	3.11	1.63	1.51	5.2	2.43	-0.86	1.63	1.15	2.71	6.69	4.91	1.15	2.72	1.25
Cotton	2.47	4.55	2.04	0.4	2.95	2.54	-1.25	2.8	4.1	2.71	2.29	-0.41	1.45	17.48	15.79	0.35	2.66	2.3
Total Fibers	2.71	4.56	1.88	0.27	2.77	2.46	-1.5	2.46	3.98	2.45	2.21	-0.27	1.09	15.23	14.14	0.3	2.49	2.16
Non Foodgrains	2.44	3.74	0.89	1.26	3.06	1.61	1.12	3.77	2.31	1.18	2.69	1.09	2.46	5.09	3.87	1.22	2.92	1.4
All Crops	1.58	3.15	1.21	0.29	2.56	1.86	0.1	3.19	2.56	0.27	2.29	1.33	1.06	3.17	3.88	0.51	2.57	1.54

Notes: *Growth rates are based on Fourth advance estimates for 2007-08, \$ - Growth rates for the period from 1970-71, Nine oilseeds include groundnut, castor seed, Sesamum, rapeseed & mustard, Linseed, nigerseed, safflower, sunflower & soybean.

Source: GOI (2008), <http://agricoop.nic.in>.

available resources and prevailing climatic conditions, need-based, location specific technology needs to be generated. At the same time, frontline trials of various research departments provide clear evidence of large gaps between what can be attained at the farmers' field with adoption of available technology as compared to what is obtained with existing practices. Exploiting this potential must be main source of yield growth in the Eleventh Plan because overcoming technology fatigue will take time. Moreover, since yield gaps vary considerably from crop to crop and from region to region, the strategy must enable specific plan for each agro climatic region. Table 1.4 shows, constraints vary considerably even by very aggregate zones. This will also require much stronger links between research, extension, and farmers (Planning Commission, GOI, 2007).

Table 1.4: Region Specific Factors Causing Low Productivity in India

Agro-climatic Region	States/Parts of States	Region-specific Constraints
Western Himalayan Region -I	J&K, HP, Uttaranchal	Severe soil erosion, degradation due to heavy rainfall/floods and deforestation, low SRRs, poor input delivery, inadequate communication infrastructure and marketing
Eastern Himalayan Region II	Assam, NE States, Sikkim	Aluminium toxicity and soil acidity, soil erosion and floods, shifting cultivation, low SRRs, non availability of electricity, poor roads, poor input delivery system and communication infrastructure
Lower and middle gangetic plains regions-III and IV	West Bengal, Bihar, Eastern UP	Flood/water logging, improper drainage, salinity/alkalinity, arsenic contamination, low SRRs, non availability of electricity, high population growth, poor road infrastructure and communication infrastructure
Upper and trans-gangetic plains region-V and VI	Western UP, Punjab, Haryana	Groundwater depletion, decreasing total factor productivity, micronutrient deficiency, non-availability of electricity, and high population density
Eastern plateau and hills region VII	Orissa, Jharkhand, Chhattisgarh	Moisture stress, drought, and soil acidity, iron toxicity, low SRRs, non availability of electricity, high population growth, poor road, poor input delivery and communication infrastructure

Source: Planning Commission (2007) (as cited in Planning Commission, 2008, p 9).

Declining Per Capita Foodgrains Availability in India:

Achieving food security has been the overriding goal of agricultural policy in India. Indian agriculture has witnessed tremendous changes during the last three decades following the adoption of green revolution technology during late 1960s'. However, per capita per day availability of food grains is almost stagnant. The per capita availability of foodgrains has fallen substantially during the last decade of reforms, and the maximum decline has taken place during the last five years. The population and foodgrains production growth, per capita availability of foodgrains is presented in Table 1.5. Although there is wide variability from one year to the next, broad trends can still be picked up from this figure showing multi-decadal data. The early years of bounty from the green revolution period were followed by more gradual increases leading up to a peak of 186.2 kg/person/year at national level in 1990-91. Since then, however, food security has steadily declined, throughout what is popularly referred to as the years of liberalization and 'reforms'. As per 2001 data, per capita availability of foodgrains is typical of availability seen in the late 1970s and early 1980s, which was at lower stage of about 152 kg. It is due to the fact that during the last decade, the foodgrains production grew at the rate of 1.60 percent per annum at national level. High growth rate during 1970-71 to 1980-81 was due to the low production base (due to drought). The annual growth rate of food production including non-cereal food increased from 2.51 per cent during the 1960s to 2.24 per cent in the subsequent decade and further to 2.89 per cent during the 1980s. Between 1960 and 1980, food production barely kept pace with the population but in the 1980s per capita food production increased at a satisfactory rate of 1.6 per cent per annum. India achieved near self-sufficiency in the availability of foodgrains by the mid-seventies. The trend rate of foodgrain production improved from 2.5 per cent during the 1960s to 2.9 per cent in the eighties (Bhalla and Singh 2001). It is particularly noteworthy that India could build enough buffer stocks to cope with year-to-year variations in foodgrain production. The annual fluctuations in the per capita availability of foodgrain declined in the eighties and nineties when compared to the previous period (Rao and Radhakrishna, 1997). There seems to have been some diversification in food production in the 1980s on account of the impressive growth of output of oilseeds, non-foodgrain and livestock products.

Table 1.5: Population Growth and Per Capita Foodgrains Availability in India

Year	Population (crore)	Average annual growth rate (%)	Rural Pop. (%)	Cereals Production (million Tones)	Foodgrains availability (kg/day/person)	Growth rate of foodgrains prod. (%)
1951	36.11	1.25	82.7	42.42	144.1	-
1961	43.92	1.96	82.0	69.32	171.1	4.20 ^a
1971	54.82	2.22	80.1	96.60	171.1	2.51 ^b
1981	68.52	2.20	76.7	118.96	166.0	2.24 ^b
1991	84.63	2.14	74.3	162.13	186.2	2.89 ^a
2001	102.70	1.95	72.2	185.20	151.9	1.80 ^a
2007	112.20	1.49	n.a.	203.07	160.4	1.40

Note: a and b are significant at 1 and 5 percent level of significance respectively, n.a. Not Available
 Source: GOI (2008), CMIE (2009a), <http://agricoop.nic.in>.

Though India was successful in achieving self-sufficiency by increasing its food production and also improved its capacity to cope with year-to-year fluctuations in food production, it could not solve the problem of chronic household food insecurity as there are millions of food insecure and undernourished people in India. The latest '*Report on the State of Food Insecurity in Rural India 2008*' released by the World Food Programme and the M S Swaminathan Research Foundation (MSSRF) warns that high economic growth rates have failed to improve food security in India leaving the country facing a crisis in its rural economy. India is home to more than 230 million undernourished people, which is 21 percent of the national population. With about 251 million below the poverty line, India accounts for about one-fifth of the world poor. Thus, slowing growth in food production, rising unemployment and declining purchasing power of the poor in India are combining to weaken the rural economy. This seems to be a matter of serious concern, especially in view of food security of the nation as well as a growth strategy from globalization and trade angles.

1.2 Need for the Present Study:

A historical meeting of the National Development Council (NDC) was called by the Prime Minister specially to discuss the problems of agricultural sector. The NDC appointed sub-committees for finding solutions to the current problems in agricultural sector and sub-committee headed by Shri Naveen Patnaik, Chief Minister of Orissa state looked into the problems of stagnation in productivity. The sub-committee submitted its report and opined that the causes of stagnation in the agricultural sector are region specific and hence policy interventions have to be chalked out keeping in view the regional specifications (Planning Commission, 2007).

Table 1.6: Contribution of Maharashtra to India's Total Production of Different Crops

Crops	Maharashtra's share in total production (%)				
	1970-71	1980-81	1990-91	2000-01	2006-07
Jowar	19.2	42.5	50.9	52.97	52.73
Bajra	10.2	14.2	16.1	16.09	12.59
Maize	0.56	2.18	1.51	2.52	7.62
Coarse Cereals	8.6	18.8	22.9	23.0	18.10
Gram	1.7	3.5	6.7	9.11	14.53
Tur	14.4	18.4	17.4	29.39	35.50
Total Pulses	5.8	7.8	10.1	14.38	16.20
Total Foodgrain	5.0	7.5	6.9	5.15	5.82
Groundnut	11.3	12.2	13.2	7.33	8.23
Soybean	NA	NA	7.3	24.00	32.66
Sunflower	9.47 ^a	57.1	34.5	27.09	16.26
Safflower	71.43	73.43	79.76	60.40	70.42
Total Oilseeds	7.8	7.8	10.1	11.38	3.72
Cotton	10.1	18.1	19.1	18.93	20.42
Sugarcane	11.4	15.3	15.9	16.76	22.10
Onion	NA	27.2	24.8	35.74	15.53
Chili	15.58	15.13	9.39	6.17	5.05*
Cashewnut	NA	4.97 ^b	10.3	21.78	31.77

Notes – Figures are in percent, ^a relates to 1973-74; ^b relates to 1982-83, * related to 2005-06

Sources: CMIE (various issues) and GOI (*Agricultural Statistics at a Glance*, various issues)

Maharashtra is an important state of India so far as its contribution to the agriculture development of the country is concerned. Maharashtra is one of largest states in India, both in terms of gross cropped area (GCA) and population. While accounting both for 9.4 percent of India's population and geographical area, the state accounts for about 12 percent in India's gross cropped area (GCA) in 2005-06. Maharashtra state occupies relatively better position in terms of contribution to the total production of different commodities at all India level (see, Table 1.6). It is one of the progressive states in the country but it has been reported to be a deficit state for long when one considers to major pursuit of economic activity, that is agriculture. The soil, topography, rainfall and climate in Maharashtra are in general not very conducive to agriculture, resulting relatively low yields of crops in the state as compared with those in India. The productivity gains achieved by the crops during seventies and eighties have not sustained over time and agricultural sector of the state has been facing a number of different problems. The low irrigation facility has been one of the serious problems of the state. About 83 percent of cultivated area is under rainfed condition as of today. Due to low irrigation facility, not only low value crops are cultivated predominantly in the state but the

productivity of most of the crops is also very low as compared to the national average. Cultivation of low value crops coupled with the low productivity of crops reduce the income of the farmers, which adversely affect the standard of living of both farming and non-farming (landless agricultural labourers) rural communities. Since rainfed crops are generally affected by varied rainfall (moisture stress), productivity of different crops is very low in the state as compared to the all India average. Mono-cropping pattern (example, sugarcane) followed in certain regions of the state has also affected the productivity of crop.

The important issue in Maharashtra's agriculture is poor growth of agriculture, which is the main outcome of low irrigation and productivity of crops. Though significant development has taken place in horticultural sector during the last decade, it has not made any significant impact on the growth rate of agriculture. While the share of agricultural and allied sector's contribution to state's income declined from 31.1 percent in 1960-61 to 15.2 percent in 2007-08 (GOM, 2008), the growth rate of the agricultural sector (state domestic product) decelerated from 3.7 percent per annum during eighties (1980-81 to 1990-91) to 2.7 percent per annum during nineties (1990-91 to 2000-01) and then increased significantly during 2000-01 to 2007-08 (see, Table 1.7 and 1.8). The sectoral composition of the state income (at current prices) in 2007-08 indicates that the share of primary, secondary and tertiary sector was 15.2 percent, 25.0 percent and 59.8 percent respectively. The slow growth of agriculture as compared to other sectors is a serious issue from the point of view of rural employment and poverty, both of which are heavily dependent on agricultural growth. Hence the present study tries to examine the district-wise growth and the stagnation in the important agricultural crops of state of Maharashtra. Further, it also seeks to find out the causes and remedial policies to deal with the stagnation. The broad objectives of the study are:

Table 1.7: Sectoral Composition of the State Income (at current prices) (in percent)

Year	Sectoral Composition of State Income of Maharashtra (%)		
	Primary	Secondary	Tertiary
1960-61	31	23	46
1970-71	22	29	49
1980-81	24	30	46
1990-91	21	32	47
2000-01	17	25	58
2006-07	15	26	59
2007-08	15	25	60

Source: GOM, 2008 (Economic Survey, 2007-08).

Table 1.8: Sectoral growth in NSDP in Maharashtra (at 1980-81 prices)

(Percent per annum)

Year	Maharashtra						
	Agriculture	Allied	Agriculture and Allied	Primary	Secondary	Tertiary	NSDP
1980-81 to 1990-91	3.8 ^a	2.8 ^b	3.7 ^a	3.7 ^b	6.2 ^a	6.9 ^a	5.9 ^a
1990-91 to 2000-01	2.9 ^a	1.0 ^c	2.4 ^b	2.7 ^b	3.6 ^a	6.9 ^a	5.1 ^a
2000-01 to 2007-08	5.3 ^a	-1.4	4.9 ^a	4.9 ^a	7.4 ^a	8.8 ^a	7.8 ^a
1980-81 to 2007-08	3.6 ^a	1.3 ^a	3.3 ^a	3.4 ^a	4.9 ^a	7.4 ^a	5.9 ^a

Notes: NSDP - Net State Domestic Product; ^a, ^b and ^c are significant at 1, 5 and 10 percent level respectively;

Source: Computed from Economic Survey of Maharashtra (various issues).

1.3 Objectives:

The specific objectives of the study are:

1. To analyze the growth pattern of production and productivity of important crops across the district and State.
2. To study the regional variations in productivity of important crops (specially bringing out the districts with differentiated growth behaviour) and to map out the regions with acute stagnation
3. To trace the determinants for changes in productivity and stagnation of important crops
4. To suggest district level interventions to overcome the problems of stagnation

1.4 Methodology:

This study has been carried out for Maharashtra state, mainly using available secondary level information. The time period for the study is from 1960-61 to 2004-05. Data for this study have been mainly compiled from various published sources, viz., Season and Crop Report of Maharashtra State (various years), Districtwise Agricultural Statistical Information of Maharashtra State, Economic Survey of Maharashtra and India, Districtwise Agricultural Database for Maharashtra: 1960-61 to 1997-98 (published by Economic and Political Weekly Research Foundation, Mumbai), Reports of the Commission on Agricultural Costs and Prices (CACP) and various documents published by the Ministry of Agriculture, Government of India, New Delhi, various Committee and Commission Reports, websites such as <http://agricoop.nic.in>, <http://agri.mah.nic.in>, <http://www.censusindia.net>, etc. Recent data on Maharashtra's agricultural development have been directly compiled from the Office of the Commissionerate

of Agriculture, Government of Maharashtra, Pune. For the data analysis, the simple statistical tools like average, percentages, exponential /annual growth rates and regression etc. calculated. The study concentrates on division-wise/districtwise analysis of major crops in Maharashtra. In order to know the importance of crops in the economy of the farmers and its importance in inter-regional and across crops, Crop Concentration Ratio (CCR) is computed as follows (for details, please see Deshpande, *et al.*, 2004).

$$\text{Crop Concentration Ratio} = \frac{\text{Share of the area under the crop in the State/district}}{\text{Share of the area under the crop in the Country/State}}$$

In order to know the determinants of stagnation in productivity of important crops in the state, Total Factor Productivity was calculated. For the estimation of Total Factor Productivity, a widely used Tornqvist-Theil Index was used (TFP methodology is further discussed in detail in Chapter III). The logarithmic form of index is given below.

$$\ln\left(\frac{TFP_t}{TFP_{t-1}}\right) = \frac{1}{2} \sum_j (R_{jt} + R_{j,t-1}) \ln\left(\frac{Q_{jt}}{Q_{j,t-1}}\right) - \frac{1}{2} \sum_i (S_{it} + S_{i,t-1}) \ln\left(\frac{X_{it}}{X_{i,t-1}}\right)$$

where, R_{jt} is the share of output j in total value of output or revenue at time t

Q_{jt} is output j at time t

S_{jt} is the share of input j in total input cost at time t

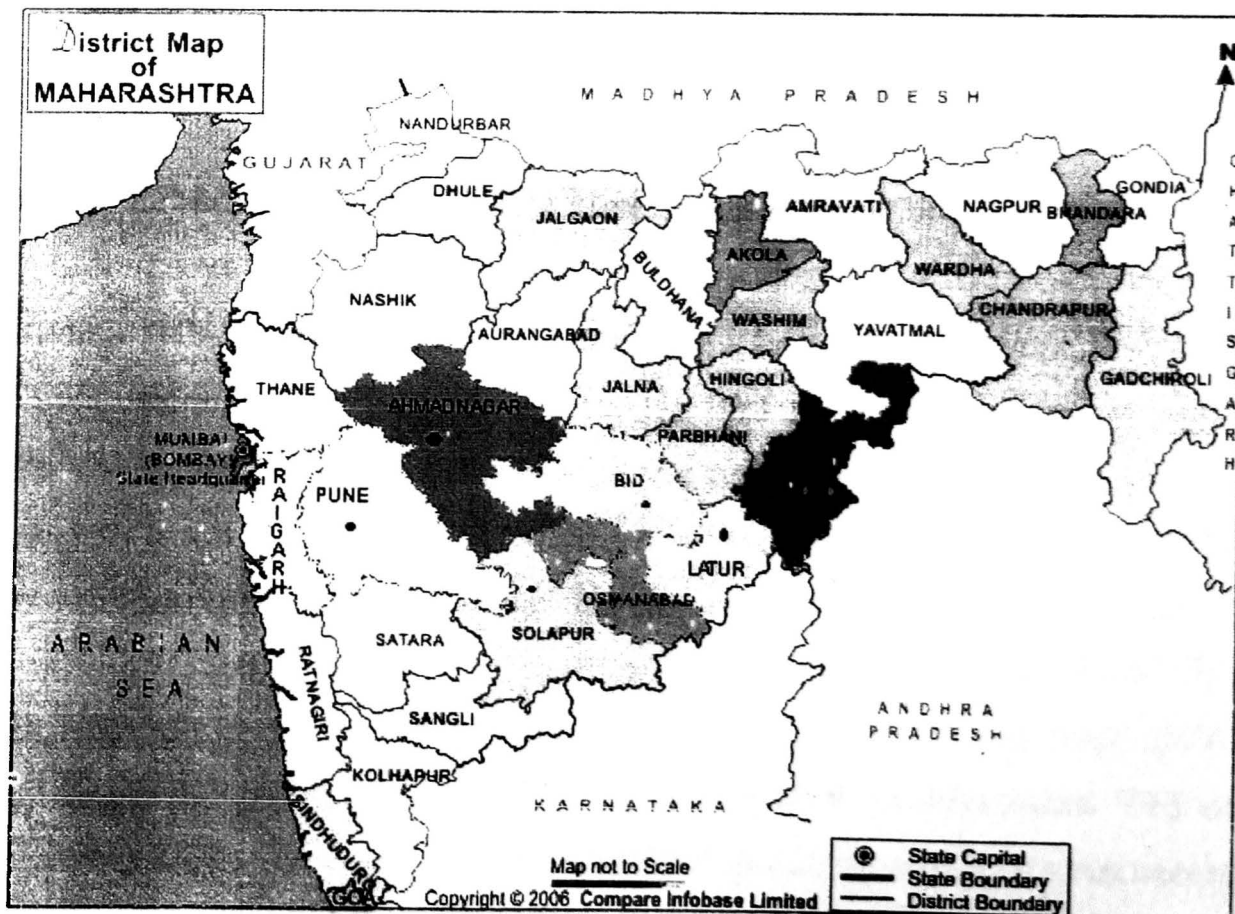
X_{it} is input i at time t

On the right hand side, the first part of the equation provides output index and the second part provides input index. By specifying the index equal to 100 in a particular year, output, input and TFP indices were obtained. After calculation of TFP index, the factors affecting TFP at different phases of agricultural development are determined by using regression analysis. The independent variables utilized in the analysis for the state includes the Capital Outlay on Agricultural Research and Education (COARE), number of regulated markets (MKTS), proportion of Rural Literate (LITERACY), Rainfall June to August (JUAURAIN), Annual Rainfall (YEARRAIN), Year which is linear trend variable (YEAR). Dependent variable is the log of the TFP index. All variable specified in logarithms, except those variables defined in percentage terms, which enter linearly (LITERACY).

1.5 Organization of the Study:

The study has five chapters. Chapter one, which is an introductory chapter, presents a brief account on growth in production and productivity of major crops during last five decades and issues related to stagnant/ declining productivity of major crops in India, along with objectives and methodology of the study. Chapter two deals with recent agricultural developments in the state, wherein districtwise rainfall pattern; irrigation status; land use pattern; changing structure of landholding among different groups; changing cropping patterns; growth in area, production and productivity of important crops; changing inputs use; cost structure of principle crops trends in agricultural prices and capital formation in agriculture of the state have been discussed in detail. Chapter three presents the measurement of growth and stagnation in crop productivity, which includes review of literatures/studies on measurement of growth and fluctuations and methodology for measuring the stagnation in productivity across the crops/districts. Chapter four presents the district-wise trends in area, production and productivity of major crops in Maharashtra State. The rate and growth of inputs used is also presented in same chapter. Chapter V analyses the determinants for changes in production, productivity and stagnation in major agricultural crops in Maharashtra. The last chapter presents the conclusions and policy implication brings out of study.

Map 1: District Map of Maharashtra



Recent Developments in Agriculture in the Maharashtra State

2.1: Introduction

Indian agriculture has witnessed tremendous changes during the last three decades following the adoption of green revolution technology during late 1960s'. The green revolution technology was initially adopted on a large scale in the regions well endowed with irrigation. As this technology possessed vast potential for increase in productivity, it led to impressive growth in agricultural output in the regions where it was adopted. Because of the spread of green revolution was highly skewed in favour of certain states and regions, this led to high growth in agricultural output in selected regions while other regions suffered from stagnancy or poor growth in agricultural output (Chand and Chauhan, 1999). The spread of new technology and then pattern of growth of agriculture has, however, brought in its wake uneven development across regions and crops (Deosthali and Nikam, 2004; GOI, 2005) and technological change resulted in widening the regional as well as interpersonal disparities (Bhalla and Alagh, 1979). Initially impact of green revolution was confined to wheat and rice only and regions with good irrigation facilities. As a consequence, much of the growth, which took place after introduction of the HYVs, was confined to a limited number of states like Punjab, Haryana, Utter Pradesh and coastal Andhra Pradesh (Dantwala, 1986; Bhalla and Singh, 2001). With marked regional diversities in agro-climatic environment, resource endowment and population density is likely to be characterized by uneven economic and agricultural development among the various regions/states. These regional differences in agricultural development tend to get accentuated further because of varying levels of investment in rural infrastructure and in different adoption of technological innovations (Bhalla and Singh, 1997). The state of Maharashtra, which occupies relatively better position in terms of its contribution to the total production of different commodities in the county, regional differences in agricultural development has remained a subject of concern for policy makers and administrators of the state.

Maharashtra is economically among the most developed states in the country, but it is not counted among the advanced states in India in terms of agricultural production, though most of the state's workforce still depends on agriculture. Though the new seed fertilizer technology was introduced in Maharashtra in mid-sixties, it has arrived in full swing in the early part of seventies. During the last four decades, the agricultural sector of Maharashtra has undergone lot of changes. Though agricultural performance improved during the last forty years, its progress was not sustained and showed wide fluctuations. The important characteristics of Maharashtra agriculture is the instability in crop production and significant regional variations in the performance of agriculture in the state (Dev, 1996). The recent farmer suicides in Vidarbha and Marathawada have once again highlighted regional disparity in Maharashtra. The agrarian crisis in Vidarbha has spun almost out of control. There are a number of factors which limit the growth of agriculture over the years in the state. It is, therefore, necessary to look into the factors affecting agricultural growth in Maharashtra.

Present Scenario:

Maharashtra is the second largest state in India both in terms of population and geographical area, accounts for 9.4 percent each in 2001. The state contributes about 13 per cent of the National Income and per capita state income is higher than the national Income, ranks after Haryana among all the Indian states during the year 2007-08 (GOM, 2009). The state ranks second in terms of the Centre for Monitoring Indian Economy (CMIE) index and 4th in terms of Human Development Index (HDI) with considerable variations among the districts and regions. Maharashtra produces country's 19 percent of industrial output, 15 percent of service sector output and about 13 percent of GDP (Planning Commission, 2005). As seen earlier, the sectoral composition of the state income has undergone considerable changes during 1960-61 to 2007-08. Over these 47 years, the share of agriculture and allied activities has declined steadily from 31.1 per cent to 15.2 per cent; the share of industry sector has remained between 23.2 and 25.0 per cent, while the share of services sector has increased from 45.7 per cent to 59.8 per cent. Though Maharashtra is one of the industrialized states in the country, agriculture and allied activities are still predominant in the state. Agriculture continues to be the major source of income for most of the population. As per the

population census 2001, 55.41 per cent population is dependent on agriculture for livelihood. Thus, Maharashtra's economy continues to be predominantly agrarian. Indeed, the share of state's rural labour force employed in agriculture was as high as 80.08 per cent even in 2001, near about half (38.39 per cent) of the agricultural workers being labourers. Thus, the crucial dependence of its rural labour force on agriculture is quite evident and it is unlikely to diminish drastically in the future (Sawant, *et al*, 1999). It can be noted that despite the high income and industrial dominance, magnitude of poverty in Maharashtra (30.7 per cent) is higher by 3.20 percent than the national level average (27.5 per cent) in 2004-05 and as regards the population below poverty line in absolute number, the State stands third amongst major states in the country after Uttar Pradesh and Bihar. (GOM, 2009). Most of the poor in the state live in rural areas and agriculture is the major source of income for them. Agricultural growth is the most important determinant of rural poverty and therefore agricultural productivity growth has a positive impact on reducing poverty (Bhattarai and Narayanamoorthy, 2003). During last four decades, the population growth (2.26 per cent per annum) is at higher rate than foodgrains output growth (0.67 per cent per annum). Growing population outstrips agricultural growth as more people divide incremental gain. The slow crop output growth is due to low productivity of different crops in the state as compared to the national average (except sugarcane). Apart from reducing farmers' income, low productivity of crops pulls down the overall growth rate of agriculture production in the state. Therefore, improvement in growth performance of the agriculture and allied sectors would be the most important factor for reducing rural poverty, increasing farmers' income in Maharashtra.

Inter-regional inequality within the Maharashtra has been a matter of concern for a long (Mishra and Panda, 2006). Among the four regions in the state, viz. Konkan, Western Maharashtra (with Khandesh), Vidarbha and Marathawada, Vidarbha has been the 3rd most developed region, while least developed region has been Marathawada. Thus, Marathawada and Vidarbha with weak industrial sectors has been most underdeveloped region in the state over the years (Shaban, 2006). In fact, this pattern of development ranking has been consistent over the years. As early as 1984, a fact finding committee under the chairmanship of Prof. V. M. Dandekar had attempted to analyze the regional imbalances in Maharashtra (GOM,

1984)¹. Though the process of removal of backlog was started from the year 1985-86 and establishment of separate development boards² for Vidarbha, Marathawada and the rest of Maharashtra in 1994, there are huge disparities between the districts and divisions of the state. As per Human Development Report Maharashtra 2002, except nine districts, viz. Mumbai, Thane, Raigad, Sindhudurg, Pune, Satara, Sangli, Kolhapur and Nagpur, all other districts have below state average Human Development Index, which shows backwardness of the districts and all districts are from Marathawada and Vidarbha region (GOM, 2002). The districts of Marathawada region are most backward among the all districts of Maharashtra and score low on the HDI. The low per capita income may be one the reasons of backwardness of these districts. All the districts from Vidarbha (except Nagpur) and Marathawada region had low per capita income as compared to state average during 2002. Infact it has been frequently been stated that if Grater Mumbai and Pune division are taken out, the rest of Maharashtra would not been better than the 'BIMARU'³ states (Shaban, 2006).

The development planning in Maharashtra began with the third five year plan in 1961⁴. The economy of the state has made commendable progress in various sectors during the plan periods. During the last forty years, the agricultural sector of Maharashtra has undergone a lot of changes. As mentioned earlier, though Maharashtra is one of the richest states in terms of per capita income, its agricultural performance is not very appreciable. Having accounted for about 12 percent of India's gross cropped area (in 2005-06), the contribution of state's agriculture in the agricultural GDP of the country is only about 10.48 percent in 2007-08, mainly due to predominant cultivation of crops under rainfed condition. Keeping in view the importance of agriculture, the Government of Maharashtra

¹ The Government of Maharashtra had appointed a fact-finding committee of experts under the Chairmanship of Dr. V.M. Dandekar on August 3, 1983. The Dandekar committee undertook a sectoral study of backlog in nine developmental sectors and submitted report in 1984. The sectoral backlog was calculated as on 30.06.1982 was Rs. 3186.77 crore. Vidarbha region was the worst sufferer with the sectoral backlog. The report of the Dandekar Committee was not formally accepted by the Government of Maharashtra (GOI, 2006).

² Under Article 371 (2) of the Constitution, separate development boards for Vidarbha, Marathawada and the rest of Maharashtra were constituted by the Hon. Governor on 1st May, 1994. According to Clause 7 of the Development boards for Vidarbha, Marathawada and the rest of Maharashtra Order 1994, the Governor has to ensure equitable allocation of funds for developmental expenditure over the areas of Developmental Boards, subject to the requirements of the state as a whole (GOM, 2008, Annual Plan).

³ BIMARU States includes Bihar, Madhya Pradesh, Rajasthan, Uttar Pradesh.

⁴ A separate development plan exclusively for Maharashtra state started in 1961 with the third five year plan, after the re-organization of Bombay state into two as Gujarat and Maharashtra in 1960-61.

introduced various programmes in different plan periods since third five year plan (for detail, see Annexure I) and the draft agricultural policy prepared by the state government has also highlighted the thrust areas to be focused in the future (see Box 2.1)⁵. The number of initiatives were taken to improve the performance of agriculture in the state. As a result of initiatives taken by the government, the agricultural sector of Maharashtra has undergone lot of changes. But, still it is lagging behind in many parameters as compared to the national average (see, Table 2.1). Therefore, in this chapter, an attempt is made to review the recent development of agriculture in the state. Specifically, we review the rainfall, pattern, irrigation development, changes in land use and cropping pattern in the state, input use, growth in production and productivity of different crops, changes on cost structure of principal crops, trends in agricultural prices and capital formation in agriculture. While reviewing the development of different areas in agriculture, we try to underline the important areas in which more attention needs to be given in the future.

Box 2.1: Highlights of Maharashtra's Agricultural Policy

The Agricultural Policy adopted by the State Government aims at the following:

- Development of the sector on a sustainable basis by using the available resources economically, efficiently and in an environmentally sound manner with a view to increase farmers' income and production.
- To envelop the needs of vulnerable sections, generate both skilled and unskilled employment and make a positive intervention towards poverty alleviation.
- To promote agriculture development on commercial and industrial lines.
- To prepare plan of action for full exploitation of the limited water resources.
- To improve the working of Agricultural Universities.
- To promote farm and infrastructural facilities for post harvest management, storage, transport, marketing and export to ensure that farmers will get due price for their produce.
- To improve the systems relating Agricultural Produce Market Committees.

Source: GOM (2003).

⁵ The State Government of Maharashtra has formulated a comprehensive draft of Agriculture Policy which was presented to the State Legislature by the Chief Minister of Maharashtra on December 18, 1996 and resolved that the policy would be finalized after the discussion in the Budget Session of the State Legislature and considering various recommendations received in this regard. The draft agriculture policy aims at development of the sector on a sustainable basis by using the available resources economically, efficiently, effectively and in an environmentally sound manner with a view to increasing farmers' income and production. Keeping the farmer at the focal point, the Agriculture Policy 1997-98 aims to promote agricultural development on commercial and industrial lines to achieve primacy in the agricultural sector. The policy also aims to strengthen the competitive resolve of the farmers in the light of emerging global scenario with a view to taking full advantage of the emerging opportunities (Economic Survey, 2000-01 (GOM, 2001)).

Table 2.1: Selected Indicators of Agricultural Development: Maharashtra and India

Particulars	Maharashtra	India
Population (2001)		
Total (crore)	9.68	102.53
Rural (crore)	5.57	74.03
Urban (crore)	4.10	28.49
Rural agricultural workers (percent is to total workers)	80.08	73.33
Share of agriculture and allied sector in GDP/SDP (in 2007-2008 current prices)	13.80	17.80
Rural Poverty (percent) 2004-05 <i>URP Consumption</i>	29.60	28.30
Rural Literacy rate (percent) 2001	70.84	58.74
Per capita income (Rs.) (NSDP at current prices, 2007-08)	47051	33283
Share of Agriculture and allied activities to Total Plan Expenditure (10 th Plan : 2002-2007)	3.47	3.90
Normal rainfall (in mm)	1254.1	852.0
Average size of holdings (2000-01)	1.66	1.33
Percentage of irrigated area to gross cropped area (in 2005-06)	18.9	42.9
Percent of groundwater irrigated area to NIA (2005-06)	69.33	58.76
Electricity use in Agriculture (% to total) 2006-07	15.66	21.73
Cropping intensity (%) 2005-06	129.1	135.9
Input use:		
Fertiliser (kg/ha) (2007-08)	103.1	117.1
HYVs coverage (2004-05) %	63.34	77.16
Diesel Engines & Electric Pumpsets for Irrig.(per 000 ha of NSA) 2003	66.8	118.2
Wheeled Tractors .(per 000 ha of NSA) 2003	6.0	17.8
Area under major crops (percent to GCA): 2005-06		
Jowar	21.01	4.49
Pulses	15.21	11.58
Foodgrains	56.46	63.31
Sugarcane	2.22	2.41
Cotton	12.75	4.47
Oilseed	16.22	16.04
Fruits and Vegetables	7.71	4.83
Productivity (kg/ha): 2006-07		
Foodgrains	940	1756
Pulses	602	612
Sugarcane	74898	69022
Cotton	253	421
Oilseed	963	916
Regulated Markets (31.03.2009)		
Total	880	7139
Principal	299	2393
Sub-yard	581	4746
Area covered by each market (in sq. km)	349.65	460.46
Population fed by each market (in lakh)	1.099	1.440

Notes: relates to the year 2001

Sources: GOI (2008), GOM (2009), CMIE (2009), GOI (2009), and FAI (2008).

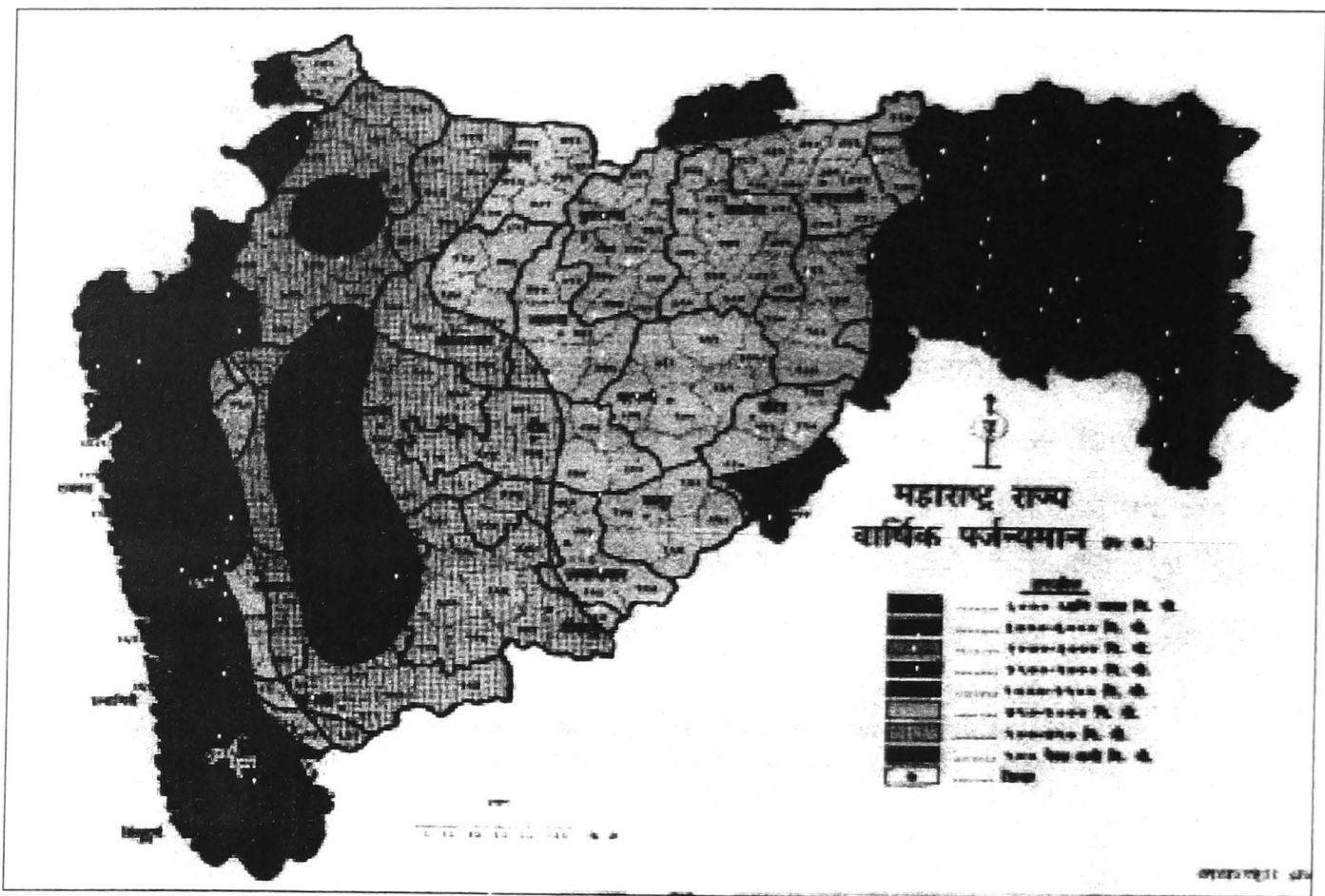
2.2 Rainfall:

Agriculture in the state though has been making progress however its performance did not remain much satisfactory as compared to non-agricultural sectors. It is due to the fact that agriculture in the state is mainly rainfed agriculture. A major part of its territory falls on the plateau where the rainfall is low and highly unstable. Therefore the growth prospect of agriculture in the state is largely associated with the level and distribution of rainfall. Failure of rainfall especially at critical stage of plant growth results drought condition and crop failure thereby creates severe problems, particularly food and economic problems for agricultural community and livestock. Though a beneficiary of the South West Monsoon, which lasts from July to September, the rainfall is varying; it is as high as 2000 mm in the Western Ghats and some 600 mm in the plains (HDRM, GOM, 2002).

Monsoon rain plays a critical role in the agricultural development of the state, as over 83 percent of cropped area is cultivated under rainfed condition as of today. Though the average rainfall of the state is relatively higher as compared to many states in India, its timeliness and spread across months as well as across different regions are not very much favourable (Narayanamoorthy and Kalamkar, 2004). While the normal rainfall of the Konkan division (about 2900 mm) is about 135 percent higher than the average normal rainfall of the state (1254 mm), the same is less by about 40 percent in Aurangabad division. Moreover, except 10 districts of the total 34 districts in the state, the normal rainfall of all other districts is less than the state's average normal rainfall (Narayanamoorthy and Kalamkar, 2004). Nearly one third of area of the state falls under rain-shadow region where the rains are scanty and erratic. In these areas, only dry land cultivation is undertaken (GOM, 2008, Economic Survey). Map 2.1 and Figure 2.1 clearly shows how widely rainfall varies across regions/across the year in the state. This wide variation in rainfall acts as one of the major constraints in state's agriculture. An analysis shows that the productivity of agricultural commodities goes down sharply whenever there is a reduction in rainfall (Narayanamoorthy and Kalamkar, 2004). This is because of the fact that foodgrains and other crops are cultivated predominantly in those districts which receive relatively less-normal rainfall. As providing assured irrigation facility for all those districts which have low rainfall is very difficult because of limited irrigation potential, proper rainwater harvesting programmes (watershed development programme, etc.) would help to improve the productivity of crops and

thereby the overall performance of agriculture. Apart from variation in the normal rainfall across districts, it also widely varies across *talukas* within a district/region. This not only discourages the farmers to adopt the required quantity of various yield increasing inputs but ultimately results in lower productivity most of the time. In view of the limited water potential as well as increasing demand for water from different sectors, the only option available before the policy makers is to implement sustainable rain water harvesting systems at a rapid pace through watershed development programme.

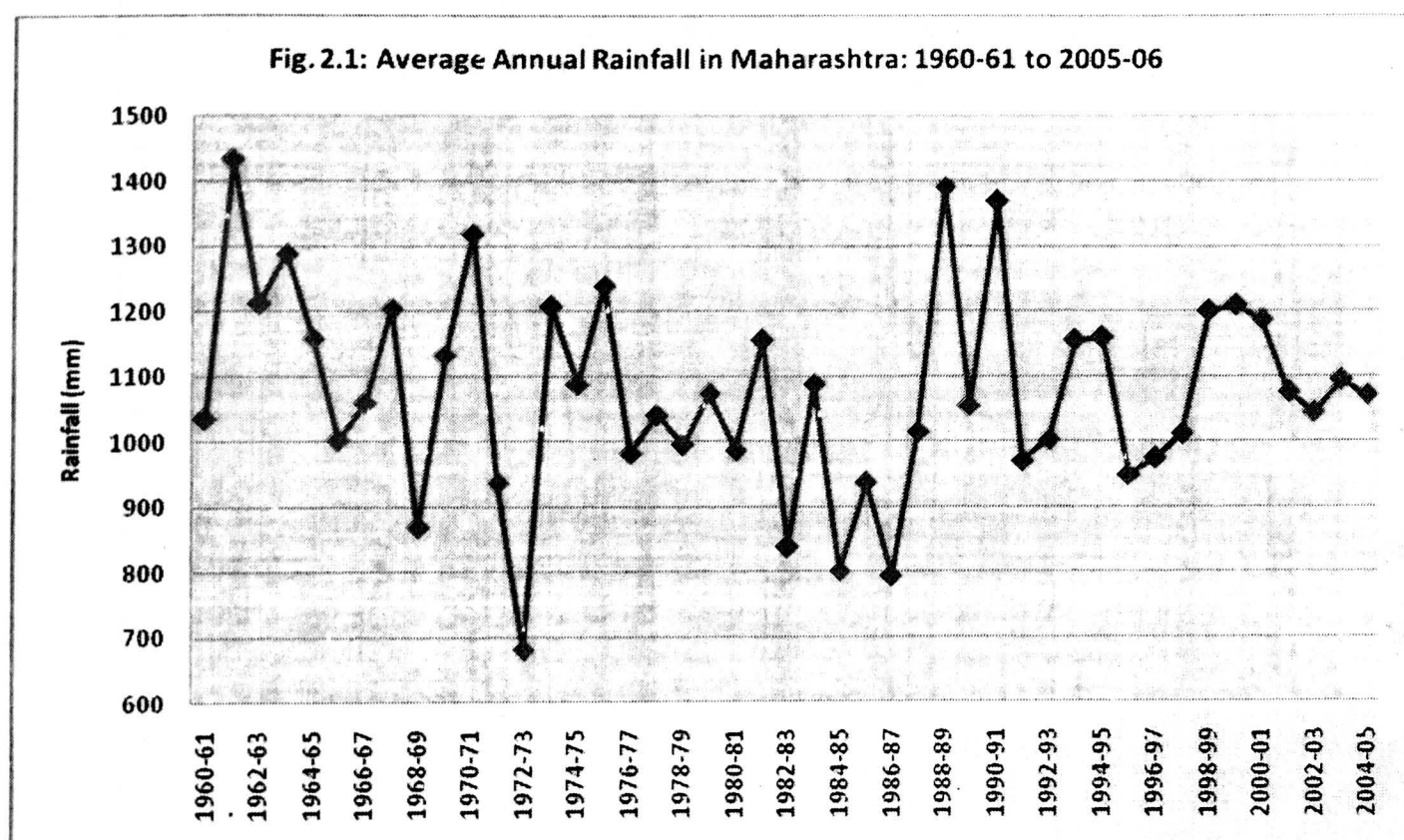
Map 2.1: Annual Rainfall in Maharashtra State



In order to get clear picture about fluctuation in rainfall, five years rainfall average is taken from 1960-61 to 2004-05 and districts are classified as high, medium and low rainfall districts at nine point periods⁶. The districtwise rainfall pattern in the state during 1960-61 to 2004-05 is presented in Table 2.2. It can be seen from the table that due to large year to year fluctuation in amount of rainfall,

⁶ The districts were divided into three groups as high, medium and low rainfall groups. The average rainfall values falling above mean plus 1 Standard Deviation (SD) of state average rainfall values regarded as high rainfall district and similarly mean minus 1SD as low rainfall district. The range between mean + and minus 1SD would be called as medium /normal rainfall.

districts are shifting from one group to another, i.e. high to medium and to low rainfall group and vice versa. Out of 26 districts, during the period 1960-61 to 1964-65, 4 districts were in high rainfall group, 10 districts fall in medium rainfall group and remaining 12 districts fall in low rainfall group. The corresponding numbers for the period during 2001-2005 were 6, 10 and 17 (out of 33 reported districts)⁷, respectively. The districtwise average rainfall during the period 1990-91 to 2004-05 is presented in Figure 2.2. It can be seen that most of the districts from Pune, Latur and Amravati divisions fall under low rainfall group.



⁷ The state of Maharashtra came into existence on the first day of May in the year Nineteen Hundred and Sixty, as a result of the bifurcation of the composite Bombay state into Maharashtra and Gujarat, with 26 districts and 229 tahsils. Nine new districts have been created since then and currently the number of districts in the state is 35. Four new districts were created after the 1981 census, namely, Sindhudurg (1981), Jalna (1st May, 1982), Latur (August 1982) and Gadchiroli (August 26, 1982). Thus the number of districts in Maharashtra has increased from 26 in 1984 to 30 in 1991. Five more districts were created during the year 1990-1999, namely Mumbai Suburban (1st October 1990), Washim (1st July 1998), Hingoli (1st May 1999), Gondiya (1st May 1999), and Nandurbar (1st July 1998). Maharashtra State is divided into six administrative divisions viz., Konkan, Nashik, Pune, Aurangabad, Amravati and Nagpur. These are further divided into 35 districts 353 tahsils for the purpose of administration.

However, agricultural statistics has been reported for 34 districts (excluding Mumbai City district), which are divided into eight agricultural divisions as Konkan Division (Mumbai Sub., Thane, Raigad, Ratnagiri and Sindhudurg), Nashik Division (Nashik, Dhule, Nandurbar and Jalgaon), Pune Division (Ahmednagar, Pune and Solapur), Kolhapur Division (Satara, Sangli and Kolhapur), Aurangabad Division (Aurangabad, Jalna and Beed), Latur Division (Latur, Osmanabad, Nanded, Parbhani and Hingoli), Amravati Division (Buldhana, Akola, Washim, Amravati and Yavatmal) and Nagpur Division (Wardha, Nagpur, Bhandara, Gondiya, Chandrapur and Gadchiroli).

Table 2.2: Districtwise Average Annual Rainfall in the State: 1960-61 to 2004-05

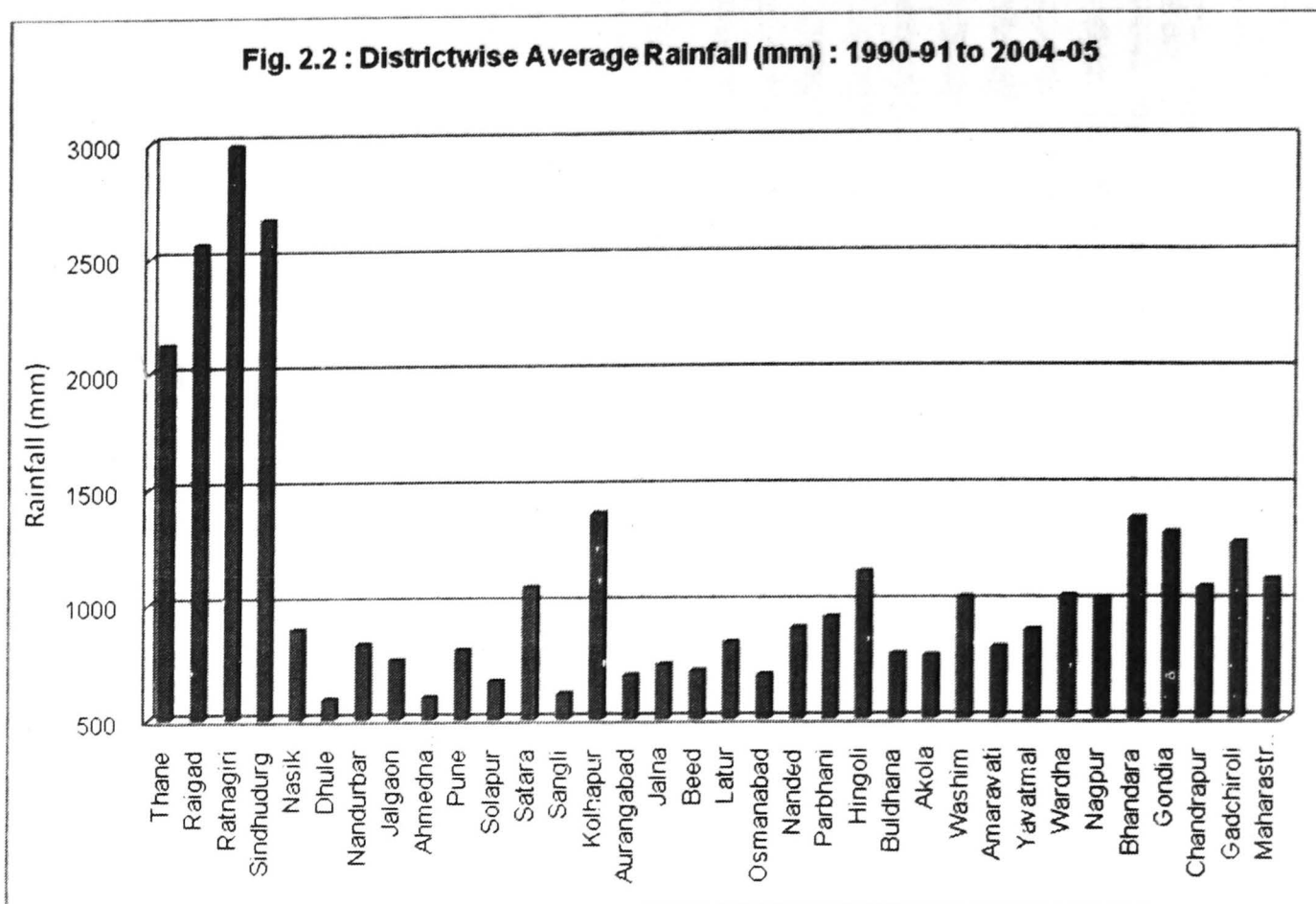
(Rainfall in mm)

<i>High rainfall district</i>																	
1960-61 to 1964-65		1965-66 to 1969-70		1970-71 to 1974-75		1975-76 to 1979-80		1980-81 to 1984-85		1985-86 to 1989-90		1990-91 to 1994-95		1995-96 to 2000-01		2001-02 to 2004-05	
Districts	Rainfall	Districts	Rainfall	Districts	Rainfall	Districts	Rainfall	Districts	Rainfall	Districts	Rainfall	Districts	Rainfall	Districts	Rainfall	Districts	Rainfall
Thane	2909.2	Thane	1821.5	Thane	1821.5	Thane	1829.5	Thane	2062.0	Thane	1481.4	Thane	1966.5	Thane	1866.6	Thane	2481.2
Raigad	2338.0	Raigad	2049.8	Raigad	2049.8	Raigad	2132.5	Raigad	2487.3	Raigad	2064.8	Raigad	2463.4	Raigad	2390.8	Raigad	2816.0
Ratnagiri	3158.4	Ratnagiri	2469.4	Ratnagiri	2469.4	Ratnagiri	2084.4	Ratnagiri	1954.8	Ratnagiri	2549.9	Ratnagiri	2855.2	Ratnagiri	2809.0	Ratnagiri	3209.1
Sindhudurg	2325.6	Sindhudurg	2594.4	Sindhudurg	2594.4	Sindhudurg	2621.0	Sindhudurg	2486.6	Sindhudurg	2522.6	Sindhudurg	2248.0	Sindhudurg	3017.4	Sindhudurg	2716.1
				Bhandara	1384.7	Bhandara	1398.2	Bhandara	1202.0	Gadchiroli	1418.1	Bhandara	1526.1	Kolhapur	1347.1	Kolhapur	1662.5
						Chandrapur	1328.4					Chandrapur	1441.7	Gondiya	1437.3	Bhandara	1418.9
												Gadchiroli	1360.0				
<i>Medium rainfall district</i>																	
1960-61 to 1964-65		1965-66 to 1969-70		1970-71 to 1974-75		1975-76 to 1979-80		1980-81 to 1984-85		1985-86 to 1989-90		1990-91 to 1994-95		1995-96 to 2000-01		2001-02 to 2004-05	
Districts	Rainfall	Districts	Rainfall	Districts	Rainfall	Districts	Rainfall	Districts	Rainfall	Districts	Rainfall	Districts	Rainfall	Districts	Rainfall	Districts	Rainfall
Satara	1285.8	Nasik	1145.0	Satara	1040.3	Satara	1220.5	Satara	942.0	Kolhapur	861.3	Satara	1005.8	Nasik	883.4	Nasik	1006.5
Kolhapur	1244.4	Satara	1187.4	Kolhapur	994.2	Kolhapur	1139.4	Kolhapur	1016.0	Beed	961.1	Kolhapur	1150.9	Satara	1154.2	Satara	1048.4
Osmanabad	1012.4	Kolhapur	1068.6	Yavatmal	1018.9	Nanded	890.4	Nanded	852.3	Nanded	948.2	Parbhani	1010.5	Latur	875.5	Parbhani	982.8
Nanded	1136.2	Nanded	934.5	Wardha	1138.4	Parbhani	954.5	Parbhani	837.7	Parbhani	1067.0	Yavatmal	962.0	Nanded	993.5	Hingoli	1148.3
Parbhani	1121.7	Yavatmal	964.2	Nagpur	1170.3	Akola	885.0	Amravati	795.6	Yavatmal	885.6	Wardha	1061.5	Hingoli	1052.4	Washim	1020.9
Yavatmal	1196.7	Wardha	864.1	Chandrapur	1167.6	Amravati	901.3	Yavatmal	880.0	Wardha	876.6	Nagpur	1180.2	Washim	1027.6	Wardha	1055.7
Wardha	1045.3	Nagpur	1101.6			Yavatmal	1111.9	Wardha	1054.6	Nagpur	939.3			Yavatmal	910.6	Nagpur	855.8
Nagpur	1249.1	Bhandara	1120.9			Wardha	1064.7	Nagpur	975.7	Bhandara	1209.9			Wardha	965.0	Gondiya	1269.1
Bhandara	1410.5	Chandrapur	1221.6			Nagpur	1133.1	Chandrapur	1039.0	Chandrapur	1209.2			Nagpur	1014.9	Chandrapur	880.2
Chandrapur	1375.0							Gadchiroli	892.3					Bhandara	1165.5	Gadchiroli	1210.7
														Chandrapur	1096.4		
														Gadchiroli	1199.7		

Table 2.2 continues.....

Low rainfall district																	
1960-61 to 1964-65		1965-66 to 1969-70		1970-71 to 1974-75		1975-76 to 1979-80		1980-81 to 1984-85		1985-86 to 1989-90		1990-91 to 1994-95		1995-96 to 2000-01		2001-02 to 2004-05	
Districts	Rainfall	Districts	Rainfall	Districts	Rainfall	Districts	Rainfall	Districts	Rainfall	Districts	Rainfall	Districts	Rainfall	Districts	Rainfall	Districts	Rainfall
Nasik	610.1	Dhule	833.9	Nasik	628.9	Nasik	804.2	Nasik	654.6	Nasik	633.7	Nasik	770.1	Dhule	635.1	Dhule	615.8
Dhule	582.0	Jalgaon	734.0	Dhule	569.4	Dhule	572.0	Dhule	580.6	Dhule	492.7	Dhule	515.8	Nandurbar	758.7	Nandurbar	849.7
Jalgaon	797.2	Ahmednagar	554.7	Jalgaon	742.6	Jalgaon	742.4	Jalgaon	699.7	Jalgaon	524.3	Jalgaon	845.1	Jalgaon	726.3	Jalgaon	694.6
Ahmednagar	578.8	Pune	612.5	Ahmednagar	527.2	Ahmednagar	526.5	Ahmednagar	635.9	Ahmednagar	414.9	Ahmednagar	759.5	Ahmednagar	532.1	Ahmednagar	498.9
Pune	773.2	Solapur	673.6	Pune	584.6	Pune	822.1	Pune	752.6	Pune	666.1	Pune	832.4	Pune	842.9	Pune	718.3
Solapur	810.6	Sangli	584.5	Solapur	697.9	Solapur	724.3	Solapur	733.3	Solapur	709.4	Solapur	748.8	Solapur	730.1	Solapur	515.2
Sangli	681.9	Aurangabad	731.9	Sangli	573.6	Sangli	713.1	Sangli	555.3	Satara	733.5	Sangli	807.9	Sangli	586.7	Sangli	480.1
Aurangabad	668.6	Beed	708.8	Aurangabad	620.3	Aurangabad	813.8	Aurangabad	640.5	Sangli	389.3	Aurangabad	822.8	Aurangabad	672.8	Aurangabad	593.0
Beed	770.0	Osmanabad	688.3	Beed	675.7	Beed	713.5	Jalna	549.9	Aurangabad	571.6	Jalna	772.3	Jalna	758.4	Jalna	680.5
Buldhana	878.7	Parbhani	818.6	Osmanabad	794.7	Osmanabad	830.6	Beed	542.2	Jalna	716.5	Beed	669.2	Beed	810.9	Beed	641.2
Akola	980.7	Buldhana	787.9	Nanded	769.2	Buldhana	859.2	Latur	571.0	Latur	719.7	Latur	819.7	Osmanabad	806.3	Latur	790.7
Amravati	865.9	Akola	653.5	Parbhani	800.0			Osmanabad	611.1	Osmanabad	814.3	Osmanabad	665.2	Parbhani	818.4	Osmanabad	621.3
		Amravati	721.6	Buldhana	761.4			Buldhana	665.0	Buldhana	745.3	Nanded	893.9	Buldhana	840.1	Nanded	787.3
				Akola	796.7			Akola	658.0	Akola	827.6	Buldhana	802.4	Akola	797.9	Buldhana	688.0
				Amravati	809.5					Amravati	714.6	Akola	854.4	Amravati	839.6	Akola	661.0
												Amravati	868.2			Amravati	724.6
																Yavatmal	768.7

Source: Season and Crop Reports (Various issues) and Agricultural Statistical Information of Maharashtra State, Government of Maharashtra, Pune



Drought Prone Districts of the State:

As we have seen earlier, though the state received rains from south-west monsoon lasting from June to September, its spread is uneven, ranging from as high as 2000 mm in the coastal areas to 600 mm in the interiors. In the large parts of the State, which experience low mean temperature and lie in the rain shadow of the Ghat, the average rainfall varies between 600 mm and 750 mm. Such areas accounts for about two-fifths of the total geographical area in the State, of which about 17 percent is vulnerable to chronic droughts (EPWRF, 2004). About a quarter of India's drought prone districts are in Maharashtra, with 73 per cent of its geographic area classified as semi-arid (World Bank, 2008)⁸.

The drought proneness of the state is a critical additional stress factor that adversely affects productivity, livelihood, and the rural economy and ironically the cultivated areas lie in drought affected districts. As per Central Water Commission study, out of 725 talukas of 99 districts in the country, 315 talukas (from 74 districts)

⁸ As per World Bank Report (2008), twelve district are categorized as drought affected districts, viz., Ahmednagar, Solapur, Nashik, Pune, Sangli, Satara, Aurangabad, Beed, Osmanabad, Dhule, Jalgaon and Buldhana, which accounts for 60 percent of net sown area.

are identified drought prone districts, with area about 0.511 lakh sq km which account for 47 percent of total area (Table 2.3). In Maharashtra, total 45 talukas from nine districts are identified as drought prone. More than one-third of the state's area is prone to frequent drought (Kulkarni, 2000). The five years average rainfall in drought prone district of Maharashtra state during 1960-61 to 2004-05 is presented in Table 2.4.

Table 2.3: List of Identified Drought Prone Districts in Maharashtra

Sr. No.	District	No. of Talukas	Area of the District (Sq Km)	As per CWC's Study-1982		
				No. of talukas affected by drought	Area affected by drought (sq. Km)	% area affected
1	Ahmednagar	13	16762.2	7	9491.8	57
2	Aurangabad	12	16385	2	3111.3	19
3	Bid	7	11169	3	4595	41
4	Nasik	13	15631.5	7	8098.9	52
5	Osmanabad	11	14027	7	9515	68
6	Pune	14	15688.2	4	4932.1	31
7	Sangli	8	8610.25	5	5939.66	69
8	Satara	11	10436.9	4	3878.5	37
9	Solapur	11	15057	6	8102.5	54
	Maharashtra	100 (13.8)	123767.05 (11.4)	45 (14.3)	57664.7 (11.3)	47
	India	725	1081131.38 (in 99 districts)	315	511288.64 (in 74 districts)	47

Note: Figures in parenthesis are percentage to all India total

Source: CWC (2004) (Central Water Commission, NWP Directorate, <http://mospi.gov.in>)

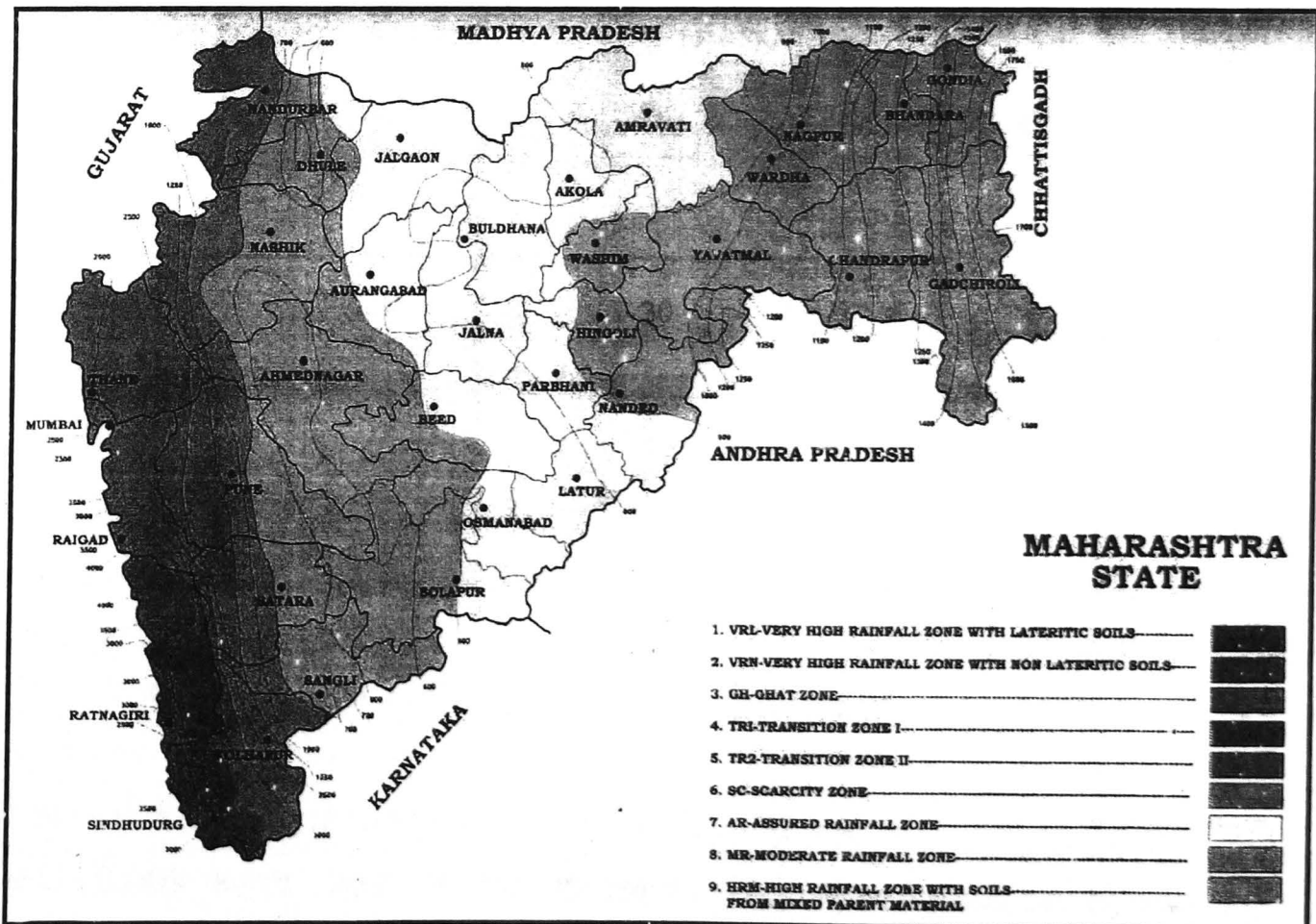
A large part of the State suffers from crop failures or periodical drought because of the failure or erratic nature of the monsoon. Variations in the dates of the onset and cessation of the rainy season, in the number of rainy days and in the frequency and duration of the dry spells govern the character of the rainy season. In these circumstances, therefore, farming practices and cropping patterns have necessarily to be adjusted to the variation in the rainy season and since this is not always possible. Undue variations in the pattern of rainfall bring hardship, the intensity of which depends on the degree of deviation of the rainfall from the normal pattern (GOM, 2003b). Maharashtra experienced severe and successive years of drought in 1970-71 to 1973-74 and 2000-01 to 2003-04. The large tract of rainfed agricultural land in the state has become un-remunerative (World Bank, 2008). The

agrarian crisis has become acute, with signs of a breakdown of coping mechanism among vulnerable groups whose exposure to drought appear to be increasing (World Bank, 2008). Therefore, the Drought Prone Area Programme is implemented in 148 identified drought blocks spread in 25 district of the state with major activities of minor irrigation, soil conservation and afforestation (GOM, 2003b).

Agro Climactic Zones:

Maharashtra has wide agro-climatic variations because of its size and topography. It's cultivated area is distributed in plains and plateaus. Vast area with varying soil, water, and other climatic features are bound to have different agro-climatic condition. Taking into consideration the rainfall pattern, topography, soil characteristics, climatic condition and cropping pattern, nine zones have been identified (see, Map 2.2), viz. Southern Konkan Coastal Zone, Northern Konkan Coastal Zone; Western Ghats Zone; Sub Montance Zone, Western Maharashtra Plain Zone, Western Maharashtra Dry Zone, North Maharashtra Plateaus, Western Vidarbha Zone, and Eastern Vidarbha Zone (for detail, see Annexure II).

Map 2.2: Agro-Climatic Zones of Maharashtra



2.3 Irrigation Status:

Irrigation is the most important element in the steady growth of the agricultural sector. It not only increases agricultural production but also minimizes the uncertainty due to unpredictable rainfall. Limited availability of irrigation is one of the main constraints that affect the growth of agriculture in Maharashtra. The irrigation sector of Maharashtra is one of the largest in the country, both in terms of the number of large dams and the live storage capacity. Nevertheless, the irrigation sector of Maharashtra has been facing multifarious problems. While the water availability for the future use of irrigation has been reducing at a fast rate, the demand for water for irrigation purposes has been alarmingly increasing due to agricultural expansion and intensification (Narayanamoorthy and Kalamkar, 2007).

Considering the predominant nature of rainfed cultivation and wide variation in the rate of rainfall across regions, a significant emphasis has been given for the development of irrigation in the state by the policy makers since independence. Despite huge spending on the irrigation projects, the proportion of gross area irrigated to gross cropped area in the state is around 18 percent as against about 43 percent at the national level during the year 2006-07. In fact, the percentage of irrigation was less than 15 percent in 18 out of 33 districts in 2002-03. This kind of situation is seldom seen in any of the states in India. The low level of irrigation as well as the erratic rainfall pattern often discourages the farmers to take up intensive cultivation in many regions in the state. The area under irrigation (GIA) increased from 1.24 mha in TE 1962-63 to to 3.96 mha in 2006-07 in Maharashtra, an increase of about 2.8 percent per annum (see, Table 2.5). However, the utilisation percentage of irrigation is very low in the state. As of June 2006, about 5.29 million hectares of irrigation potential has been created in the state. Of this, only about 38.05 percent (2.01 mha) has been utilized. This is very low as compared to the utilisation percentage of the national level, which was about 89.45 percent at the end of Eighth Plan. Inadequate availability of funds for developing hardware aspects of irrigation such as construction of main canals and distribution systems are often cited as the main reasons for low percentage of utilisation.

Table 2.4: Rainfall in Drought-prone Districts of Maharashtra State

(Rainfall in mm)

Drought Prone Districts	1960-61 to 1964-65		1965-66 to 1969-70		1970-71 to 1974-75		1975-76 to 1979-80		1980-81 to 1984-85		1985-86 to 1989-90		1990-91 to 1994-95		1995-96 to 2000-01		2001-02 to 2004-05	
	Rainfall	CV	Rainfall	CV	Rainfall	CV	Rainfall	CV	Rainfall	CV	Rainfall	CV	Rainfall	CV	Rainfall	CV	Rainfall	CV
Ahmednagar	578.8	22.2	554.7	20.8	527.2	41.6	526.5	39.6	635.9	28.4	414.9	14.5	759.5	31.4	532.1	32.6	498.9	24.4
Aurangabad	668.6	32.1	731.9	16.3	620.3	41.2	813.8	28.6	640.5	41.7	571.6	45.2	822.8	11.2	672.8	11.3	593.0	19.3
Beed	770.0	10.1	708.8	16.1	675.7	37.3	713.5	30.3	542.2	25.7	961.1	26.8	669.2	42.1	810.9	19.8	641.2	7.3
Nasik	610.1	15.0	1145.0	-	628.9	32.0	804.2	35.9	654.6	33.1	633.7	27.1	770.1	17.7	883.4	17.5	1006.5	22.9
Osmanabad	1012.4	25.0	688.3	20.5	794.7	34.2	830.6	24.9	611.1	25.4	814.3	43.5	665.2	31.7	806.3	18.6	621.3	18.1
Pune	773.2	15.9	612.5	27.4	584.6	31.2	822.1	16.7	752.6	15.1	666.1	27.2	832.4	17.2	842.9	17.1	718.3	23.1
Satara	1285.8	17.6	1187.4	28.1	1040.3	24.8	1220.5	16.0	942.0	21.9	733.5	17.7	1005.8	15.7	1154.2	11.4	1048.4	19.9
Sangli	681.9	17.1	584.5	35.7	573.6	22.5	713.1	33.2	555.3	25.5	389.3	30.8	807.9	27.1	586.7	12.3	480.1	27.9
Solapur	810.6	18.7	673.6	24.6	697.9	34.8	724.3	34.1	733.3	25.4	709.4	26.3	748.8	44.5	730.1	18.7	515.2	26.4
Maharashtra	1225.2	12.1	1053.3	12.2	1046.2	23.8	1066.2	9.6	973.9	15.8	1038.6	21.3	1131.5	14.0	1068.8	11.8	1094.3	5.0

Notes: The drought prone district identified by CWC (2004); C.V.-Coefficient of Variation.

Sources: Computed from EPWRF (2004), GOM (various years, Season and Crop Report) and GOM(various years, Districtwise Agricultural Statistical Information of Maharashtra State)

Table 2.5: Proportion of Gross Irrigated Area and Net Irrigated Area from Different Source of Irrigation: TE 1960- 63 to 2006-07

(Area in 00 ha)

Particulars	TE 1962-63	TE 1972-73	TE 1982-83	TE 1992-93	TE 2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07
Gross Irrigated Area (GIA)	12439	15531	24338	32773	36465	36672	36681	36360	36650	38100	39580
% GIA to Gross Cropped Area (GCA)	6.6	8.7	12.4	15.6	16.9	17.5	16.38	16.4	16.4	16.9	17.5
Sources of Irrigation:											
Surface Irrigation	4805	5795	7906	9744	10209	9901	10399	10300	10510	10700	11370
Well Irrigation	6126	7506	11243	17136	22519	21455	19312	19140	19420	20770	21090
Net Irrigated Area (NIA)	10931	13301	19148	26880	32727	31356	29711	29440	29930	31470	32460
% Net Area Irrigated (Net Irrigated Area to Net Cropped Area)	6.08	7.86	10.67	14.80	18.40	18.21	16.90	16.88	17.11	18.01	18.57

Note: TE-Triennium Endings.

Source: Season and Crop Report (various issues) and Economic Survey 2008-09, GOM.

Table 2.6: Division-wise Trends in Area under Irrigation in Maharashtra (Area in '00 ha)

Division	Surface Irrigation						Well Irrigation					
	TE 1962-63	TE 1972-73	TE 1982-83	TE 1992-93	TE 2000-01	TE 2001-02	TE 1962-63	TE 1972-73	TE 1982-83	TE 1992-93	TE 2000-01	TE 2001-02
Konkan	109.67 <i>2.28</i>	106.00 <i>1.83</i>	185.67 <i>2.35</i>	348.33 <i>3.57</i>	349.33 <i>3.42</i>	300.00 <i>3.01</i>	97.67 <i>1.59</i>	166.00 <i>2.21</i>	87.00 <i>0.77</i>	100.67 <i>0.59</i>	293.33 <i>1.30</i>	335.67 <i>1.50</i>
Nasik	293.00 <i>6.10</i>	513.33 <i>8.86</i>	561.00 <i>7.10</i>	376.33 <i>3.86</i>	505.00 <i>4.95</i>	616.00 <i>6.18</i>	843.33 <i>13.77</i>	1651.00 <i>21.99</i>	2162.33 <i>19.23</i>	3618.00 <i>21.11</i>	3911.33 <i>17.37</i>	3608.67 <i>16.18</i>
Pune	1214.67 <i>25.28</i>	1226.67 <i>21.17</i>	1917.67 <i>24.26</i>	2296.33 <i>23.57</i>	2640.67 <i>25.87</i>	2719.33 <i>27.29</i>	2333.00 <i>38.09</i>	2294.33 <i>30.57</i>	3293.33 <i>29.29</i>	4839.67 <i>28.24</i>	6031.00 <i>26.78</i>	5949.00 <i>26.67</i>
Kolhapur	758.00 <i>15.78</i>	968.00 <i>16.71</i>	1148.00 <i>14.52</i>	1503.67 <i>15.43</i>	1463.33 <i>14.33</i>	1510.00 <i>15.15</i>	871.67 <i>14.23</i>	879.00 <i>11.71</i>	1382.33 <i>12.30</i>	1955.33 <i>11.41</i>	2903.33 <i>12.89</i>	2964.67 <i>13.29</i>
Aurangabad	59.33 <i>1.23</i>	185.67 <i>3.20</i>	508.00 <i>6.43</i>	1027.67 <i>10.55</i>	950.67 <i>9.31</i>	924.33 <i>9.28</i>	856.67 <i>13.98</i>	875.33 <i>11.66</i>	1698.33 <i>15.11</i>	2685.67 <i>15.67</i>	3247.33 <i>14.42</i>	2976.33 <i>13.34</i>
Latur	125.33 <i>2.61</i>	194.33 <i>3.35</i>	706.67 <i>8.94</i>	876.00 <i>8.99</i>	800.00 <i>7.84</i>	798.33 <i>8.01</i>	631.33 <i>10.31</i>	859.33 <i>11.45</i>	1190.67 <i>10.59</i>	2057.67 <i>12.01</i>	2435.00 <i>10.81</i>	2571.33 <i>11.53</i>
Amravati	5.33 <i>0.11</i>	42.67 <i>0.74</i>	171.00 <i>2.16</i>	236.00 <i>2.42</i>	245.00 <i>2.40</i>	249.00 <i>2.50</i>	259.67 <i>4.24</i>	459.67 <i>6.12</i>	916.00 <i>8.15</i>	913.00 <i>5.33</i>	1841.00 <i>8.18</i>	1796.33 <i>8.05</i>
Nagpur	2318.67 <i>48.26</i>	2561.33 <i>44.20</i>	2707.67 <i>34.25</i>	3079.67 <i>31.61</i>	3254.67 <i>31.88</i>	2847.33 <i>28.58</i>	232.67 <i>3.80</i>	378.67 <i>5.04</i>	512.67 <i>4.56</i>	965.67 <i>5.64</i>	1856.33 <i>8.24</i>	2103.33 <i>9.43</i>
State	4805.00 <i>100.00</i>	5794.67 <i>100.00</i>	7905.67 <i>100.00</i>	9744.00 <i>100.00</i>	10208.67 <i>100.00</i>	9964.33 <i>100.00</i>	6125.67 <i>100.00</i>	7506.33 <i>100.00</i>	11242.67 <i>100.00</i>	17135.67 <i>100.00</i>	22518.67 <i>100.00</i>	22305.33 <i>100.00</i>
Division	Net Irrigation						Gross Irrigation					
Konkan	207.67 <i>1.90</i>	215.00 <i>1.62</i>	272.67 <i>1.42</i>	449.00 <i>1.67</i>	642.67 <i>1.96</i>	635.67 <i>1.97</i>	213.67 <i>1.72</i>	225.67 <i>1.45</i>	331.00 <i>1.36</i>	520.00 <i>1.59</i>	728.67 <i>1.89</i>	722.00 <i>1.89</i>
Nasik	1137.67 <i>10.41</i>	2164.33 <i>16.27</i>	2723.33 <i>14.22</i>	3994.33 <i>14.86</i>	4416.33 <i>13.49</i>	4224.67 <i>13.09</i>	1473.33 <i>11.84</i>	2863.33 <i>18.44</i>	3774.00 <i>15.51</i>	4868.33 <i>14.85</i>	5104.00 <i>13.22</i>	4908.67 <i>12.86</i>
Pune	3549.00 <i>32.47</i>	3520.33 <i>26.47</i>	5211.00 <i>27.21</i>	7136.00 <i>26.55</i>	8671.67 <i>26.50</i>	8668.33 <i>26.86</i>	4132.67 <i>33.22</i>	4272.33 <i>27.51</i>	6492.67 <i>26.68</i>	8465.00 <i>25.83</i>	9881.67 <i>25.59</i>	9875.00 <i>25.87</i>
Kolhapur	1629.67 <i>14.91</i>	1847.67 <i>13.89</i>	2530.33 <i>13.21</i>	3459.00 <i>12.87</i>	4366.67 <i>13.34</i>	4474.67 <i>13.87</i>	1943.67 <i>15.63</i>	2176.33 <i>14.01</i>	3080.00 <i>12.66</i>	4099.00 <i>12.51</i>	5111.33 <i>13.24</i>	5220.33 <i>13.68</i>
Aurangabad	916.33 <i>8.38</i>	1061.00 <i>7.98</i>	2206.33 <i>11.52</i>	3713.33 <i>13.81</i>	4198.00 <i>12.83</i>	3900.67 <i>12.09</i>	1074.67 <i>8.64</i>	1277.67 <i>8.23</i>	3023.33 <i>12.42</i>	4465.67 <i>13.63</i>	5169.67 <i>13.39</i>	4871.33 <i>12.76</i>
Latur	674.67 <i>6.17</i>	1053.67 <i>7.92</i>	1897.33 <i>9.91</i>	2933.67 <i>10.91</i>	3235.00 <i>9.88</i>	3369.67 <i>10.44</i>	755.67 <i>6.08</i>	1155.33 <i>7.44</i>	2401.33 <i>9.87</i>	3929.67 <i>11.99</i>	4198.67 <i>10.87</i>	4328.00 <i>11.34</i>
Amravati	265.67 <i>2.43</i>	502.33 <i>3.78</i>	1087.00 <i>5.68</i>	1149.00 <i>4.27</i>	2086.00 <i>6.37</i>	2045.33 <i>6.34</i>	266.33 <i>2.14</i>	559.67 <i>3.60</i>	1499.00 <i>6.16</i>	1704.67 <i>5.20</i>	2501.33 <i>6.48</i>	2454.33 <i>6.43</i>
Nagpur	2552.33 <i>23.35</i>	2936.67 <i>22.08</i>	3220.33 <i>16.82</i>	4045.33 <i>15.05</i>	5111.00 <i>15.62</i>	4950.67 <i>15.34</i>	2575.00 <i>20.70</i>	3001.00 <i>19.32</i>	3736.33 <i>15.35</i>	4720.67 <i>14.40</i>	5914.00 <i>15.32</i>	5793.33 <i>15.18</i>
State	10931.00 <i>100.00</i>	13301.00 <i>100.00</i>	19148.33 <i>100.00</i>	26879.67 <i>100.00</i>	32727.33 <i>100.00</i>	32269.67 <i>100.00</i>	12438.67 <i>100.00</i>	15531.33 <i>100.00</i>	24337.67 <i>100.00</i>	32773.00 <i>100.00</i>	38609.33 <i>100.00</i>	38173.00 <i>100.00</i>

Notes: Figures in *italic* are percentage to state total, TE-Triennium Endings.

Source: GOM (various issues of *Season and Crop Report of Maharashtra State and Districtwise Agricultural Statistical Information of Maharashtra State*).

Besides the problem of low development of irrigation, the created irrigation potential is also not equally distributed across regions in the state (see, Table 2.6). Data show that four divisions namely Pune, Kolhapur, Aurangabad and Nagpur together accounted for about 80.30 percent (0.8 mha) of total surface irrigated area of the state during TE 2001-02. However, the distribution of area under well irrigation across divisions is relatively better than surface source of irrigation. Except Konkan, Nagpur and Amravati divisions, the share of well irrigated area to total (net) well irrigated area is varied from about 11 percent to 26 percent in other divisions. Interestingly, the share of surface irrigated area is found to be higher in those areas where the share of well irrigated area is also higher, except Nashik and Nagpur divisions. As irrigation is one of the important factors which determine the income generating capacity of the rural population and also involves a large amount of public investment, the allocation of resources for irrigation development needs to be linked with the percentage of utilisation of irrigation potential across regions in the future.

Maharashtra state stands on the upper side of the ladder in terms of investment on irrigation. Up to Tenth Five Year Plan period, for which we have comparable data, altogether Rs. 387.53 billion (in current prices) has been spent only on irrigation development. As a result of large investment on irrigation, Maharashtra state accounts for about 37 percent (1651 dams) of the total number of large dams constructed in the country, as per the latest information available from CWC (2004). Another important issue pertaining to irrigation is the relationship between investment on irrigation and area created from each plan period. We could see hardly any relationship between investment and area created across plan periods. During the sixth plan period, the state has spent Rs. 11.87 billion on Major and Medium Irrigation (MMI) and created about 0.507 mha, by spending only about Rs. 23416/ha. But this has changed during seventh and eighth plan periods. With an investment of Rs. 23.92 billion during eighth plan period, the state could create only about 0.283 mha from MMI source. This means that the average investment required creating one hectare of irrigation increased to Rs. 84505 during eighth plan period. Incompletion of projects in time due to paucity of funds is identified as the main reason for poor cost efficiency (see, Gulati *et al.*, 1994; Abbie *et al.*, 1982; Deshpande and Narayanamoorthy, 2001). Despite having largest number of dams

and also storage (second highest in the country) capacity of 22.10 cubic km from the completed projects, in terms of achievements, the proportion of cultivated area under irrigation is only about 17 percent of gross cropped area (GCA) as of today, which is one of the lowest among the states in the country. One of the important reasons for the less proportion of irrigated area is that two-third of water available in the state is used only for sugarcane, which accounts for less than three percent of gross irrigated area in the state. Thus, it is clear that irrigation water is not used judiciously in the state.

In irrigated area, farming is generally carried out scientifically with commercial attitude based on the relative profitability of each crop. Farmers in such area prefer to allocate more land under such crops which fetch them higher income while in rainfed agriculture, which accounted for nearly 83 percent area, majority of the farmers allocate more land under drought resistance, low yielding and low value crops to guard against crop losses due to failure of rainfall. Thus, farmers in such area choose their crops in such a way that even under the adverse climatic conditions, they get something to subsist on. Their main concern is to minimize the losses rather than to maximize the economic gain. This is because in such agriculture return from investment is not certain. Therefore high variability in rainfall and low level of irrigation are the biggest challenges to agriculture in the state, which ultimately limit the growth prospects of agriculture through land use and cropping pattern.

One of the significant developments in Maharashtra's irrigation is the impressive growth in micro-irrigation (drip and sprinkler). Maharashtra is the leading state in adoption of micro irrigation, contributing almost half of the country's micro irrigated area. Keeping in view the water balance of the state, government of Maharashtra has been promoting drip method of irrigation since 1986 through subsidy programmes. The area under drip method of irrigation (DMI) has increased from a mere 236 ha in 1986-87 to about 217 thousand hectares in 2001-02, and 482.34 thousand hectares in 2007-08. As of 2007-08, Maharashtra State alone accounted for about 34 percent of India's total drip irrigated area. The main driving factors being, accelerated horticultural development, dwindling groundwater resources, full-fledged growth of indigenous micro irrigation industry, substantial financial support from the government, progressive farming community and

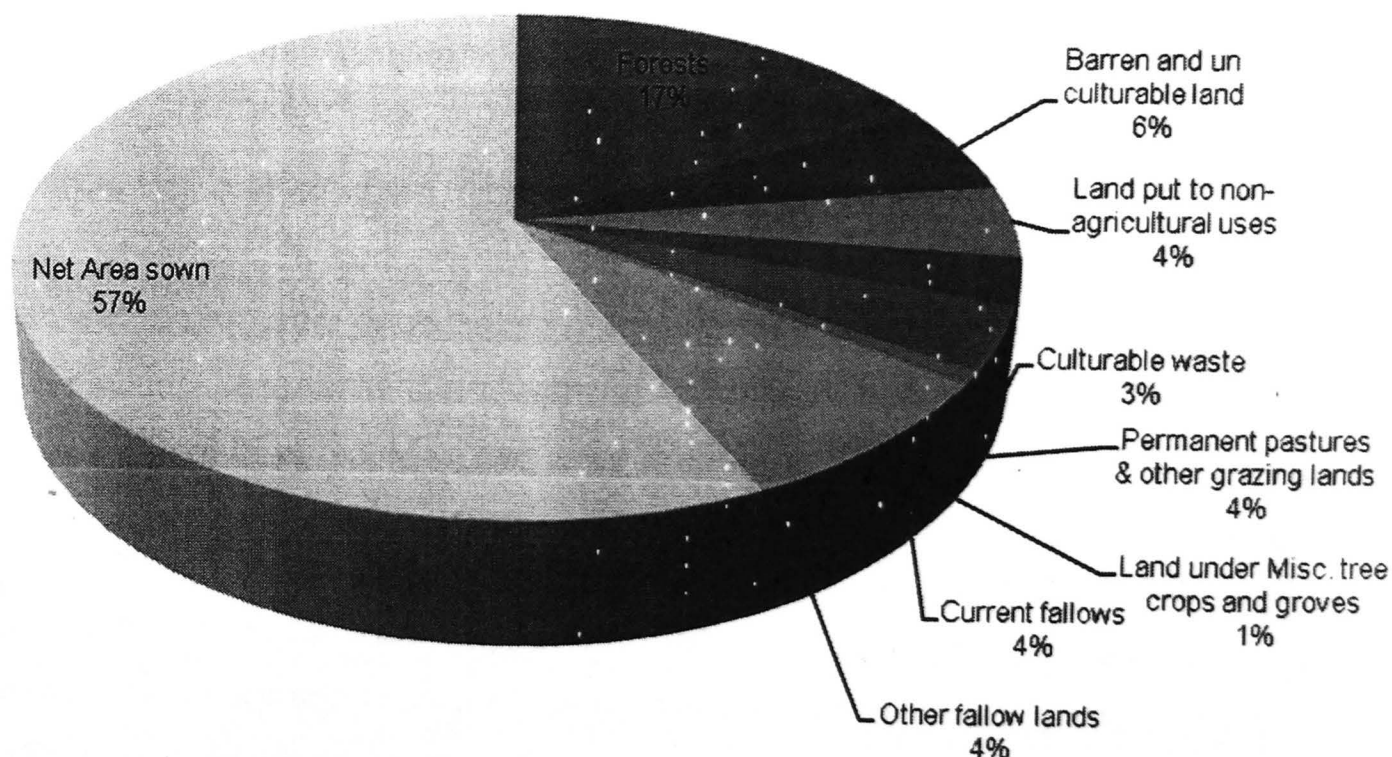
research support from various academic institutions (Kulkarni, 2000). Studies carried out in different crops using field survey data suggest that not only the investment on drip irrigation is economically viable but it also saves substantial amount of water and electricity (Narayanamoorthy, 2008). Since DMI is highly suitable for almost all horticultural crops and the state also has lot of potential for the same crops, area under DMI can be increased by many fold by extending the promotional schemes currently followed by the state for another one decade or so. Micro irrigation is adopted for thirty types of fruit trees, vegetables, flowers, and other crops like sugarcane, cotton, and agro-forestry. On the whole, despite having some positive development in DMI, the irrigation sector of the state has been facing serious problems which need to be addressed immediately to improve the performance of agriculture.

2.4 Land Use Pattern:

Land use pattern explains how effectively land resources are utilized for different purposes in a state. Development in irrigation and growth in population are the two important factors, which mostly decide the land use pattern of any state. Table 2.7 presents the detailed land use pattern of the state. Land use statistics shows that pattern of land use has been fairly stable since 1961, with marginal downward change in the share of forest area or simply upward movement in the proportion of area under no agricultural use (see, Kalamkar 2003). Since crops are cultivated predominantly under rainfed condition in Maharashtra, net sown area (NSA) has marginally declined between TE 1962-63 and TE 2004-05 (by 1.55 percent points), which is somewhat different from the trend emerging at the national level. Despite having limited availability of irrigation facility, area cultivated more than once increased from 3.18 percent of total geographical area in TE 1962-63 to 15.65 percent in TE 2004-05. In fact, area cultivated more than once increased nearly three times between TE 1982-83 and TE 2004-05. Intensive cultivation of annual crops such as sugarcane, horticulture crops, etc., could be the main reasons for this sharp increase. While there is no significant change in area under fallow, lands under cultivable waste as well as permanent pastures and grazing land, land used for non-agricultural purpose and barren and unculturable land, which has increased from about 72.77 lakh hectares in TE 1962-63 to 80.44 lakh

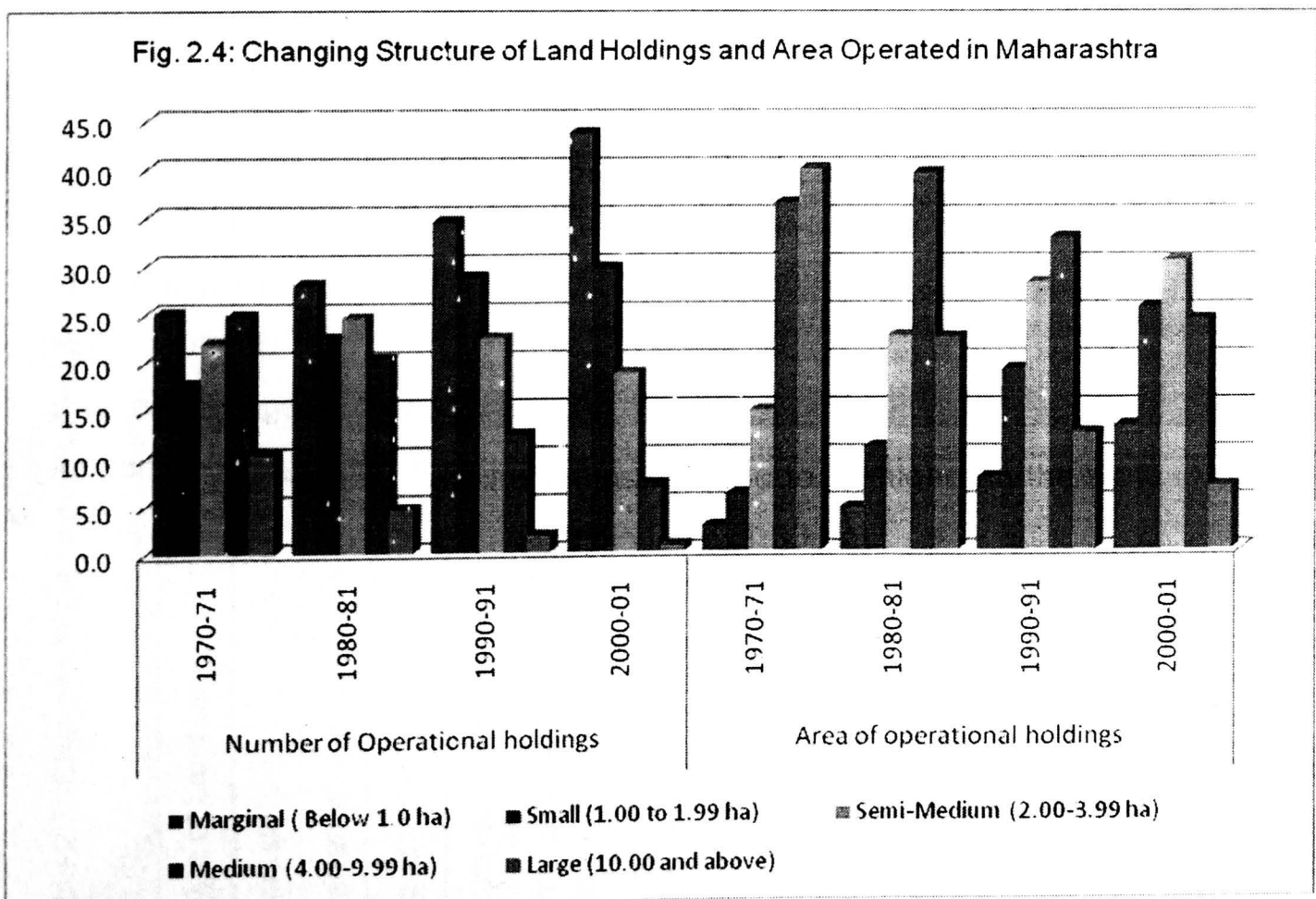
hectares in TE 2004-05, an increase of about 10.5 percent over base period. Urban agglomeration and continuous expansion of industrial sector could be the reasons for the substantial increase in land used for non-agricultural purpose. The increase in land put to non-agricultural uses is due to the fact that more and more land is brought under construction of buildings, roads, industries and other development purposes. The successive reduction in other uncultivated land may also be attributed to the same reason (Goswami, *et al.*, 2001). Out of the total arable land available in the state, 85 per cent land is already used for agricultural production. Thus on the extensive front, agriculture in the state has extremely limited scope to bring additional land under cultivation (Dandge and Pawar, 2004). Despite a severe scarcity for land resources, altogether about 49.33 lakh hectares of lands are available in the form of cultivable waste, permanent pastures, land under tree crops and grooves, current as well as other fallows. With a proper wasteland development programme, these lands can be brought under productive use, which may help to reduce the rural poverty in the state.

Fig. 2.3: Land Use Pattern in Maharashtra :TE 2004-05



2.5 Changing Structure of Landholdings:

Land holding pattern of Maharashtra state is somewhat different from the all-India level. Though the proportion of marginal and small holdings has been increasing both at the state and the national level, the share of these groups in the total number of holdings is relatively lower in Maharashtra as compared to all-India level. The changing structure of land holdings and area operated in Maharashtra is presented in Table 2.8 and Figure 2.4. As per Agriculture Census 2000-01, the total number of land holdings in the state were 1.21 crore with 2.01 lakh ha area of operational holdings. The marginal and small holdings accounted for about 73.4 percent of the total holdings in Maharashtra, whereas the same group accounted for only nearly 38.7 percent of total area. Whereas, total 7.8 percent of medium and large farmers had 31.0 percent of area of operational holdings. An interesting fact emerging from Table 2.5 is that there is a sharp reduction in the number of large holdings in Maharashtra (from 10.4 percent in 1970-71 to 0.7 percent in 2000-01). Because of relatively lower number of marginal and small holdings in Maharashtra, the average size of operational holdings is found to be higher in the state (1.66 ha) as compared to the same at the all-India level (1.33 ha).



The district-wise and division-wise number and area of operational holdings is presented in Table 2.9. It can be seen from the table that the average size of the operational holdings in Maharashtra has declined to 1.66 ha in the year 2001, from 2.21 ha in 1990-91. The same kind of trend has been recorded in all the districts of the state. Out of total number of operational holdings in 2001, the highest numbers of marginal land holdings were recorded in Kolhapur (67.7 percent) and Konkan division (60.9 per cent) and lowest in Amravati (23.3 percent) and Latur divisions (32.6 percent). Among the districts, the average size of operational holdings was lowest in Kolhapur district (0.79 ha) and the highest was in Yavatmal (2.70 ha). The corresponding average of size of holdings during 1990-91 was 1.11 ha for Kolhapur, 3.29 ha for Yavatmal district and state average was 2.21 ha. The remaining districts average size of holdings varies from 0.99 ha to 2.43 ha in 2000-01. As compared to 1990-91, the average size of holdings has decreased in all the districts in 2000-01. At the state level, the average holding size has decreased by more than 25 percent in 2000-01 over the base period 1990-91. About 92 percent of land holding in Kolhapur district was categorised as marginal and small, however they accounted for only 63.4 percent of total land area in 2000-01. The highest increase in number and area under operational holdings of small and marginal group of farmers during 1991 and 2001 was recorded in Nashik district, by 15.4 and 17.5 percent points respectively. It is clear from the table that the average size of land holding is higher in suicide prone districts of Vidarbha (Amravati, Yavatmal, Buldhana, Akola, Washim and Wardha districts) than state average. However, it is very low in Kolhapur division and at par in Pune division. Thus, despite having higher average land holding size in Vidarbha region, the crop cultivation has become uneconomical due to rainfed farming/ vagaries of monsoon.

Table 2.7: Changes in the Land Use Pattern in Maharashtra

(Percent to total geographical area)

Type of Land use	TE 1962-63	TE 1972-73	TE 1982-83	TE 1992-93	TE 2000-01	TE 2004-05
Forests	17.62	17.55	17.33	16.70	16.73	16.95
Barren and un culturable land	5.84	5.81	5.65	5.25	5.02	5.60
Land put to non-agricultural uses	2.29	2.86	3.41	3.73	4.42	4.51
Culturable waste	3.00	4.42	3.23	3.12	3.12	2.98
Permanent pastures & other grazing lands	4.62	5.38	5.06	3.73	3.80	4.06
Land under Misc. tree crops and groves	0.59	0.67	0.69	0.94	1.11	0.81
Current fallows	3.78	5.29	2.23	3.92	3.76	4.26
Other fallow lands	3.81	3.00	4.03	3.56	4.24	3.92
Net Area sown	58.45	55.01	58.36	59.04	57.81	56.90
Area sown more than once	3.18	3.32	5.44	9.43	12.18	15.65
Gross Cropped Area	61.63	58.34	63.80	68.47	70.00	73.63
Geographical Area (Lakh ha)	304.07	307.58	307.58	307.58	307.58	307.58

Note: TE indicates Triennium Ending Average

Source: Season and Crop Report, GOM (various issues) and EPWRF (2004).

Table 2.8: Changing Structure of Land Holdings and Area Operated in Maharashtra: 1970-71 to 2000-01

Size class (Hectare)	Number of Operational holdings (In hundred)				Area of operational holdings (In hundred hectares)				Average size of holdings (hectare)			
	1970-71	1980-81	1990-91	2000-01	1970-71	1980-81	1990-91	2000-01	1970-71	1980-81	1990-91	2000-01
Marginal (< 1.0 ha)	12419 (25.1)	19259 (28.1)	32747 (34.6)	52880 (43.7)	5776 (2.7)	9733 (4.6)	16176 (7.7)	26408 (13.2)	0.47	0.51	0.49	0.50
Small (1.00 to 1.99 ha)	8783 (17.7)	15409 (22.5)	27276 (28.8)	35974 (29.7)	12842 (6.1)	23337 (10.9)	39833 (19.0)	51153 (25.5)	1.46	1.51	1.46	1.42
Semi-Medium (2.00-3.99 ha)	10872 (22.0)	16858 (24.6)	21258 (22.4)	22669 (18.7)	31306 (14.8)	48178 (22.6)	58797 (8.1)	60901 (30.4)	2.88	2.86	2.77	2.69
Medium (4.00- 9.99 ha)	12291 (24.8)	13917 (20.3)	11710 (12.4)	8615 (7.1)	77174 (36.4)	84493 (39.6)	68564 (32.8)	48571 (24.2)	6.28	6.07	5.86	5.64
Large (10.00 and above)	5141 (10.4)	3182 (4.6)	1706 (1.8)	864 (0.7)	84696 (40.0)	47875 (22.4)	25878 (12.4)	13582 (6.8)	16.47	15.05	15.17	15.72
All	49506	68625	94697	121002	211794	213616	209248	200615	4.28	3.11	2.21	1.66

Note: Figures in parenthesis are percentage to total.

Sources: GOM (2001, 2009) and CMIE (2009).

Table 2.9: Districtwise and Regionwise Land Holdings and Area Operated in Maharashtra: 1990-91 and 2000-01

(in percentage to total)

District	1991											2001										
	Marginal (< 1.00 Ha.)		Small (1.00 - 1.99)		Semi Medium (2.0- 3.99 ha.)		Medium (4.0 - 9.99 ha)		Large (10.0 ha.& above)		Av. size of holdings	Marginal (< 1.00 Ha.)		Small (1.00 - 1.99)		Semi Medium (2.0- 3.99 ha.)		Medium (4.0 to 9.99 ha.)		Large (10.0 ha.& above)		Av. size of holdings
	No.	Area	No.	Area	No.	Area	No.	Area	No.	Area	(ha)	No.	Area	No.	Area	No.	Area	No.	Area	No.	Area	(ha)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Thane	53.3	12.1	21.6	17.4	14.3	22.2	8.9	29.7	2.0	18.5	1.8	58.7	16.0	20.3	19.3	13.0	23.9	6.7	26.5	1.2	14.3	1.5
Raigad	63.8	19.0	18.5	19.3	11.0	22.4	5.7	25.0	1.1	14.3	1.4	69.9	24.4	16.4	20.3	8.9	22.0	4.1	21.8	0.7	11.5	1.1
Ratnagiri	47.2	7.1	17.5	10.6	17.5	20.8	14.1	35.8	3.8	25.7	2.4	51.5	10.4	18.8	13.5	16.0	23.0	11.2	33.5	2.5	19.6	1.9
Sindhudurg	61.6	10.8	14.8	12.3	12.5	20.4	8.7	30.3	2.3	26.2	1.7	65.3	14.9	15.0	14.1	11.1	22.3	7.1	30.5	1.6	18.2	1.4
Konkan Div.	56.1	11.2	18.1	14.1	13.9	21.3	9.5	31.2	2.4	22.1	1.8	60.9	15.2	17.7	16.2	12.4	22.9	7.4	29.0	1.5	16.6	1.5
Nashik	28.9	6.1	29.1	17.1	25.2	27.8	14.4	34.0	2.4	15.1	2.5	41.7	13.2	31.7	27.4	19.3	30.9	6.6	22.4	0.7	6.0	1.7
Dhule	21.5	5.5	35.0	20.8	27.0	30.0	15.1	35.5	1.4	8.3	2.5	34.6	11.6	35.6	27.9	21.3	31.0	7.9	24.5	0.6	5.1	1.8
Nandurbar	-	-	-	-	-	-	-	-	-	-	-	23.6	8.0	39.7	26.6	26.7	35.4	9.5	26.2	0.5	3.8	2.0
Jalgaon	26.2	6.8	34.9	22.2	24.8	30.2	12.8	32.5	1.2	8.4	2.3	30.5	10.0	38.5	29.7	22.1	31.7	8.3	24.5	0.6	4.1	1.9
Nashik Div.	25.9	6.1	32.7	19.8	25.5	29.2	14.1	33.9	1.7	11.0	2.4	35.3	11.3	35.2	28.1	21.2	31.7	7.6	23.9	0.6	5.0	1.8
Ahmednagar	35.1	9.4	31.4	23.0	23.2	31.9	9.0	26.0	1.2	9.7	2.0	47.3	17.2	30.9	30.2	16.9	31.0	4.5	16.9	0.4	4.7	1.5
Pune	38.9	8.1	24.9	16.1	21.6	26.6	12.2	32.1	2.4	17.1	2.3	51.9	16.4	24.0	22.7	16.9	29.2	6.3	23.0	0.8	8.7	1.6
Solapur	21.1	3.9	27.1	12.9	28.3	25.5	19.3	37.4	4.2	20.4	3.1	32.1	8.8	31.1	22.0	25.7	33.3	9.9	27.2	1.1	8.7	2.1
Pune Div.	32.8	7.2	28.3	17.6	24.0	28.2	12.6	31.6	2.3	15.5	2.4	44.8	14.1	28.8	25.2	19.2	31.3	6.5	22.1	0.7	7.2	1.7
Satara	57.5	17.2	23.4	24.4	13.2	26.5	5.2	21.7	0.7	10.2	1.4	67.9	29.0	19.7	26.5	9.7	26.0	2.6	13.7	0.2	4.8	1.0
Sangli	48.6	12.1	23.5	19.0	17.6	27.4	8.7	28.8	1.5	12.7	1.8	58.5	19.9	22.6	24.4	13.7	29.0	4.6	20.7	0.5	6.0	1.3
Kolhapur	66.3	23.0	18.9	24.2	10.5	25.9	3.8	19.4	0.4	7.6	1.1	75.7	34.6	16.3	28.8	6.3	21.1	1.5	10.6	0.2	4.9	0.8
Kolhapur Div	57.7	16.8	22.0	22.4	13.6	26.7	5.7	23.6	0.8	10.4	1.4	67.7	27.1	19.4	26.3	9.8	25.8	2.8	15.4	0.3	5.3	1.0

Table 2.9 continues.....

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Aurangabad	24.4	6.3	34.7	22.3	27.2	32.6	12.4	31.2	1.2	7.7	2.3	37.6	12.9	34.6	30.0	21.2	33.3	6.2	20.2	0.4	3.6	1.7
Jalna	24.3	6.3	35.6	22.7	25.6	30.4	13.4	33.6	1.2	6.9	2.3	36.6	12.0	34.9	29.3	20.9	32.5	7.3	23.5	0.3	2.8	1.7
Beed	30.4	7.8	31.7	21.1	24.2	30.4	12.3	32.1	1.3	8.5	2.2	42.7	13.9	31.1	26.8	19.3	32.6	6.4	22.3	0.5	4.5	1.6
Aurangabad Div	26.8	6.9	33.8	22.0	25.6	31.2	12.6	32.2	1.3	7.8	2.3	39.4	13.0	33.3	28.5	20.4	32.8	6.6	22.0	0.4	3.7	1.6
Latur	17.2	4.2	32.6	17.0	29.4	29.4	18.6	39.0	2.2	10.4	2.8	27.3	8.3	36.4	25.1	24.6	32.3	10.9	29.5	0.8	4.8	2.1
Osmanabad	17.7	3.6	30.1	14.6	28.5	26.2	20.4	40.3	3.2	15.4	3.0	25.4	6.4	34.3	20.5	26.3	30.8	12.7	32.4	1.3	9.8	2.2
Nanded	26.5	7.6	35.0	24.3	26.7	34.4	11.1	29.4	0.7	4.3	2.1	38.9	14.7	35.3	31.7	20.5	34.4	5.1	17.3	0.2	1.9	1.6
Parbhani	23.0	5.7	32.3	19.5	28.0	32.2	15.6	36.3	1.1	6.4	2.4	34.2	11.6	34.3	27.8	23.8	36.0	7.4	22.5	0.3	2.1	1.8
Hingoli	-	-	-	-	-	-	-	-	-	-	-	33.2	10.7	35.2	27.4	23.2	34.5	7.9	24.0	0.5	3.4	1.8
Latur Div.	22.1	5.4	32.8	19.2	27.9	30.9	15.6	35.9	1.6	8.6	2.5	32.6	10.4	35.1	26.6	23.3	33.5	8.4	25.0	0.6	4.5	1.9
Buldhana	22.7	5.7	33.8	19.2	25.8	27.7	15.5	35.6	2.2	11.8	2.6	30.7	9.8	36.6	27.3	23.0	31.8	9.0	26.2	0.7	5.0	1.9
Akola	19.3	4.7	33.6	17.4	26.5	25.8	17.5	37.0	3.1	15.0	2.8	29.0	9.8	37.3	25.8	22.6	29.4	10.0	27.8	1.1	7.2	2.1
Washim	-	-	-	-	-	-	-	-	-	-	-	21.7	6.2	37.1	21.9	25.3	28.5	14.2	34.0	1.8	9.5	2.4
Amravati	22.8	6.4	36.5	21.1	24.0	26.3	14.5	34.0	2.2	12.2	2.5	28.2	9.6	39.4	27.9	21.6	28.2	9.8	27.4	1.0	6.9	2.1
Yavatmal	4.2	0.9	35.6	15.9	34.3	28.5	22.3	39.8	3.6	15.0	3.3	6.9	1.8	42.5	23.2	33.2	33.3	15.5	32.7	1.8	9.0	2.7
Amravati Div	17.4	4.3	34.9	18.2	27.5	27.1	17.4	36.8	2.8	13.6	2.8	23.3	7.1	38.8	25.4	25.2	30.6	11.4	29.5	1.2	7.4	2.2
Wardha	13.4	3.3	32.9	15.8	30.5	28.1	20.4	39.7	2.8	13.1	3.0	16.3	5.0	39.9	23.6	28.7	32.1	13.8	32.2	1.3	7.1	2.4
Nagpur	19.4	4.7	33.5	18.3	27.8	28.9	17.2	37.2	2.1	10.9	2.7	25.0	7.7	37.9	25.8	25.3	32.3	11.0	28.8	0.9	5.4	2.1
Bhandara	55.7	8.0	26.4	28.5	12.9	26.9	4.6	19.8	0.4	4.4	1.3	61.6	27.7	25.8	32.7	9.9	24.7	2.6	12.9	0.2	1.9	1.1
Gondiya	-	-	-	-	-	-	-	-	-	-	-	63.3	29.3	24.4	31.6	9.5	23.6	2.6	13.4	0.2	2.1	1.1
Chandrapur	28.7	6.2	27.0	17.1	25.8	27.6	16.2	36.9	2.2	12.3	2.6	31.9	8.6	30.3	20.8	25.5	32.7	11.2	30.6	1.0	7.2	2.1
Gadchiroli	33.5	8.7	30.4	21.1	23.8	30.7	10.8	29.8	1.4	9.7	2.1	37.8	11.7	31.5	24.9	21.9	32.1	8.1	25.1	0.8	6.2	1.8
Nagpur Div.	33.6	8.2	29.5	19.7	22.6	28.2	12.8	33.6	1.6	10.3	2.2	38.5	11.8	31.9	25.3	20.4	30.8	8.4	26.5	0.7	5.6	1.8
Maharashtra	34.6	7.7	28.8	19.0	22.4	28.1	12.4	32.8	1.8	12.4	2.2	43.7	13.2	29.7	25.5	18.7	30.4	7.1	24.3	0.7	6.7	1.7

Note: Figures are percentage to total

Source: GOM (2001), Report of Agricultural Census 2000-01 and www.indiaagrstat.com

2.6 Changes in Cropping Pattern:

One of the important factors, which determine the cropping pattern is availability of irrigation. Owing to limited availability of irrigation, which is only around 18 percent of GCA as of today, rainfed crops have been predominantly cultivated in Maharashtra, as reported in Table 2.10. However, the cropping pattern of the state has changed considerably over the last 40 years. Area under cereal crops declined by nearly 12 percent points between TE 1962-63 (55.60 percent) and TE 2004-05 (39.74 percent) mainly because of substantial reduction in area under Jowar, which is the important foodgrain crop of Maharashtra. Though the productivity of pulse crops has been lower in the state, the total area under pulse crops has increased from 12.60 percent in TE 1962-63 to 15.26 percent in TE 2004-05. As the alternative crops suitable to rainfed condition are not available, farmers continue to cultivate pulse crops predominantly in the state.

Oilseed crops such as soybean, sunflower, sesamum, groundnut, etc. have also been cultivated predominantly in the state. Despite a significant reduction in area under groundnut, area under total oilseed crops increased marginally (increased from 10.11 percent to 12.62 percent) between TE 1962-63 and TE 2004-05. This is mainly because of impressive increase in area under soybean crop since early 1990s. Since both pulses and oilseeds are mainly cultivated under rainfed condition and also the state has enormous potential for cultivating these crops, the policy makers should give top priority for promoting the cultivation of these crops. Cotton is another important crop predominantly cultivated under rainfed condition in the state. In spite of facing problems such as severe pest attack, increased cost of cultivation, low productivity and profitability, area under cotton has marginally increased between TE 1962-63 and TE 2000-01 (2.6 mha to 3.2 mha) and then marginally declined in TE 2004-05 (2.8 mha). One interesting observation is that despite significant increase in productivity of cotton in recent years (due to introduction of Bt cotton varieties in 2002), area under cotton is stable as compared to TE 2000-01. This only shows that there is a tremendous potential for expanding the cultivation of cotton in the state. Measures such as introduction of pest resistance varieties (Bt cotton, etc.), improved cultivation practices, quality extension network and proper marketing network may help to improve the cultivation of cotton crop in the state.

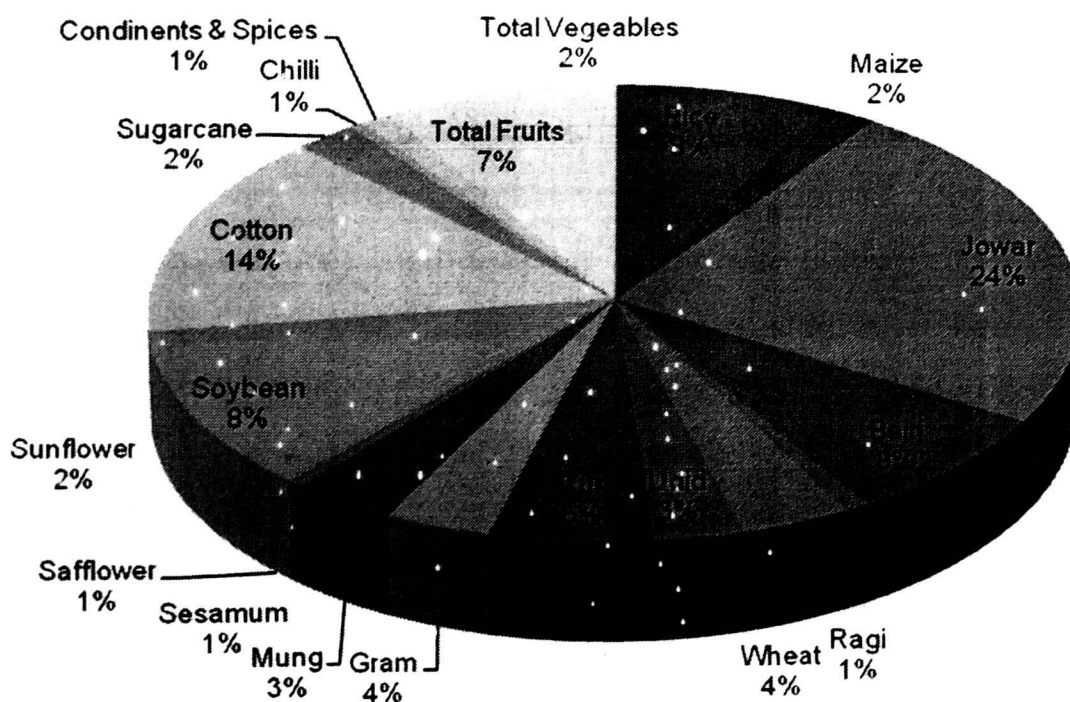
Table 2.10: Changes in Cropping Pattern in Maharashtra TE 1962-63 to TE 2004-05 (Area in '00 ha)

Crops	TE 1962-63		TE 1972-73		TE 1982-83		TE 1992-93		TE 2000-01		TE 2004-05	
	Area	% to GCA	Area	% to GCA	Area	% to GCA	Area	% to GCA	Area	% to GCA	Area	% to GCA
Rice	13204	6.96	13393	7.46	14700	7.49	15805	7.50	15159	6.97	15206	6.71
Maize	278	0.15	394	0.22	625	0.32	1297	0.62	2976	1.37	3908	1.73
Jowar	62048	32.71	57379	31.98	65071	33.16	58961	28.00	48620	22.36	46668	20.61
Bajra	16683	8.80	15935	8.88	15862	8.08	19234	9.13	17616	8.10	14672	6.48
Ragi	2240	1.18	1881	1.05	2105	1.07	1975	0.94	1565	0.72	1458	0.64
Wheat	8984	4.74	8334	4.64	10127	5.16	7319	3.48	9334	4.29	6950	3.07
Total Cereals	105465	55.60	99067	55.21	110152	56.14	105733	50.20	97139	44.68	90006	39.74
Udid (Black Gram)	4352	2.29	4579	2.55	4344	2.21	4381	2.08	5675	2.61	3771	2.50
Tur (Red Gram)	5455	2.88	5442	3.03	6461	3.29	10100	4.80	10581	4.87	10601	4.68
Gram (Bengal Gram)	3929	2.07	3343	1.86	4013	2.04	5647	2.68	8686	4.00	6821	3.01
Mung (Green Gram)	4077	2.15	4338	2.42	5351	2.73	7540	3.58	6912	3.18	4520	2.99
Total Pulses	23901	12.60	23242	12.95	26649	13.58	32414	15.39	35917	16.52	34563	15.26
Total Foodgrains	129229	68.13	122309	68.16	136801	69.72	138153	65.60	133055	61.20	124569	55.00
Groundnut	11155	5.88	8520	4.75	6610	3.37	7539	3.58	5244	2.41	4045	1.79
Sesamum	-	-	681	0.38	1343	0.68	2913	1.38	1422	0.65	1148	0.51
Safflower	3257	1.72	4346	2.42	4751	2.42	4980	2.36	3220	1.48	2532	1.12
Soybean	-	-	-	-	-	-	2729	1.30	5968	2.74	16489	7.28
Sunflower	-	-	-	-	502	0.26	4436	2.11	8739	4.02	2951	1.30
Total Oil seed	19168	10.11	17220	9.60	16685	8.50	25657	12.18	26571	12.22	28577	12.62
Cotton	26181	13.80	26075	14.53	25814	13.16	26849	12.75	31655	14.56	28006	12.37
Sugarcane	1484	0.78	2010	1.12	3591	1.83	5542	2.63	6512	3.00	4475	1.98
Chili	1583	0.83	1395	0.78	1394	0.71	1265	0.60	1054	0.48	1017	0.45
Continents & Spices	2026	1.07	1803	1.00	1787	0.91	1659	0.79	1416	0.65	2133	0.94
Total Fruits	708	0.37	936	0.52	1353	0.69	2562	1.22	4293	1.97	13150	5.81
Total Vegetables	802	0.42	1056	0.59	1455	0.741	2510	1.19	2994	1.38	3657	1.61
GCA	189683	100	179440	100	196224	100	210605	100	217421	100	226485	100

Sources: GOM (2009, various issues of *Season and Crop Report of Maharashtra State*); GOM (various issues of *Economic Survey of Maharashtra*), CMIE (various issues), GOI (various issues of *Agricultural Statistics at a Glance*).

Despite severe water scarcity in the state, area under sugarcane in the state has increased nearly four times between TE 1962-63 (1.48 lakh ha) and TE 2000-01 (6.52 lakh ha) and then recorded marginal decline in TE 2004-05 (4.48 lakh ha). The share of sugarcane area in GCA has also increased from just 0.78 percent in TE 1962-63 to 3.00 percent in TE 2000-01 and then declined to 1.98 percent in TE 2004-05. Though net returns per unit of water generated by sugarcane is very low when compared to most of the foodgrain crops (Rath and Mitra, 1989), estimates show that this crop alone consumes nearly two-third of irrigation water available in the state (World Bank, 2002). Continued support of the sugar industries (through state government) encourages the farmers to cultivate this water intensive crop. Keeping in view the water balance of the state, strict rules need to be enacted to discourage the cultivation of sugarcane under flood or conventional method of irrigation.

Fig. 2.5: Cropping pattern in Maharashtra: TE 2004-05



Emergence of Crop Constellations:

The importance of crops in the economy of the farmers has to be viewed from relative perspectives. Simple proportion of area under the crop may not suffice to indicate its importance in inter regional/district across crops (Deshpande, *et al.*,

2004). In order to over this analytical issue, a ratio indicating the relative share across crops in a district relative to the state importance of that crop, i.e. crop concentration ratio is calculated at two points period (TE 1992-93 and TE 2004-05) to see the change over base period and presented in Table 2.11.

Table 2.11: Crop Concentration Ratio- Maharashtra State

Crops	Crop Concentration Ratio	
	TE 1992-93	TE 2004-05
Paddy	0.33	0.30
Maize	0.19	0.45
Jowar	3.90	4.20
Bajra	1.62	1.33
Ragi	0.84	0.79
Wheat	0.27	0.22
Udid	1.10	1.82
Tur	2.46	2.54
Gram	0.76	1.02
Moog	1.91	2.13
Groundnut	0.79	0.54
Sesamum	1.05	0.58
Safflower	6.36	5.72
Sunflower	2.00	1.24
Soybean	0.75	2.03
Cotton	3.12	2.90
Sugarcane	1.31	0.92
Chillies	1.27	1.00
Condiments	0.69	0.21
Total Fruits	0.78	1.05
Total Vegetables	0.44	0.50

Table 2.12 and 2.13 provides districtwise relative importance of the crops at two period points (TE 1992-93 and TE 2004-05). We have retained the CCRs above 0.40 as the cut-off (for detail, please see Deshpande *et.al*, 2004). It can be seen from the table that crop concentration is more in Konkan and Nagpur division. The crop diversification prevails in Amravati, Latur and Nashik division. As we seen earlier, the land holding size in these areas are large and therefore farmers are diversifying towards soybean, and other commercial crops. However, the areas with crop specialization has low size of land holdings and probably the economic viability at the lower size of holding and assurance of income flow due to presence of commercial crops make it possible (Deshpande, et al., 2004). The districts growing important crops as per crop concentration ratio is presented in table 2.14.

Table 2.12: Districtwise Cropwise Crop Concentration Ratio -Maharashtra State: TE 1992-93

Districts/ Division	Paddy	Maize	Jowar	Bajra	Ragi	Wheat	Udid	Tur	Gram	Moog	Groundnut	Sesamum	Safflower	Sunflower	Soybean	Cotton	Sugarcane	Chillies	Con Spi	Fruits	Vegetables	Fruits and Vegetables
Thane	5.34	0.00	0.00	0.00	5.70	0.01	0.64	0.24	0.28	0.06	0.03	0.21	0.00	0.00	0.00	0.00	0.00	0.16	0.17	0.86	1.11	0.98
Raigad	8.96	0.00	0.00	0.00	10.58	0.00	0.18	0.16	0.37	0.12	0.03	0.52	0.00	0.00	0.00	0.00	0.00	0.20	0.48	1.32	0.61	0.97
Ratnagiri	4.77	0.00	0.00	0.00	14.69	0.00	0.12	0.05	0.01	0.02	0.07	0.95	0.00	0.00	0.00	0.00	0.00	0.10	0.51	6.98	0.15	3.60
Sindhudurg	7.44	0.08	0.00	0.00	6.43	0.00	0.16	0.00	0.00	0.00	0.85	0.09	0.00	0.00	0.00	0.00	0.05	0.64	0.76	17.29	0.34	8.90
Nashik	0.57	2.03	0.20	4.15	5.28	2.20	0.58	0.18	1.76	0.24	1.45	0.03	0.04	0.14	0.07	0.01	1.51	0.78	0.94	1.51	3.74	2.61
Dhule	0.48	3.52	0.66	2.26	1.19	0.95	1.99	0.57	1.13	1.69	3.39	1.09	0.05	0.15	0.05	0.67	0.85	1.90	1.50	0.49	0.64	0.57
Jaigaon	0.07	0.16	0.91	1.14	0.00	0.98	2.98	0.45	1.61	1.20	1.46	5.06	0.65	0.31	0.05	1.53	0.68	0.71	0.66	3.88	0.32	2.12
Ahmednagar	0.07	0.83	1.39	2.81	0.29	1.65	0.07	0.33	0.77	0.42	0.54	0.14	1.70	1.24	0.01	0.01	2.03	0.29	0.33	0.45	0.89	0.67
Pune	0.63	0.90	1.42	1.72	1.07	1.19	0.11	0.08	1.05	0.20	1.01	0.18	1.27	0.19	0.03	0.00	1.39	0.68	0.78	0.58	3.04	1.80
Solapur	0.05	2.71	2.13	0.35	0.00	0.99	0.12	0.80	0.91	0.09	0.76	0.08	1.71	3.07	0.01	0.02	1.53	0.52	0.56	0.70	0.60	0.65
Satara	0.76	0.57	1.21	1.68	1.93	1.05	0.37	0.27	0.71	0.29	2.89	0.02	0.24	0.17	0.33	0.01	2.57	0.29	0.77	0.28	2.41	1.34
Sangli	0.33	1.56	1.40	1.55	0.09	0.93	0.44	0.44	1.17	0.22	2.01	0.05	0.66	0.49	2.76	0.02	2.23	0.95	0.97	0.67	0.34	0.51
Kolhapur	2.80	0.80	0.34	0.01	6.44	0.56	0.27	0.20	0.86	0.20	3.86	0.09	0.00	0.01	3.22	0.00	5.36	2.07	1.61	0.46	0.72	0.59
Aurangabad	0.03	3.33	0.94	2.37	0.00	1.24	1.15	1.26	1.68	1.01	0.56	1.17	2.27	0.88	0.05	0.57	1.43	0.77	0.66	0.33	0.28	0.31
Jalna	0.04	2.98	0.97	1.24	0.00	1.23	1.13	1.23	0.58	2.36	0.40	0.56	2.79	0.94	0.00	1.33	0.85	0.56	0.49	0.26	0.35	0.30
Beed	0.11	0.78	1.21	1.96	0.00	0.65	0.22	1.17	0.72	0.84	0.86	0.77	1.34	2.78	0.15	0.35	0.88	1.15	1.90	0.39	2.43	1.40
Latur	0.47	0.79	1.26	0.18	0.00	0.75	3.07	2.07	1.17	0.99	1.33	1.93	0.86	4.59	0.09	0.30	0.79	0.74	0.97	0.07	0.33	0.20
Osmanabad	0.28	1.23	1.44	0.17	0.00	0.88	1.20	2.48	1.77	0.63	0.86	0.81	2.09	4.90	0.00	0.00	1.15	0.65	1.08	0.30	0.73	0.51
Nanded	0.54	0.10	1.21	0.02	0.00	0.77	1.06	1.16	0.66	1.05	0.58	1.16	0.47	1.52	0.02	2.42	0.73	2.14	1.85	0.93	0.15	0.54
Parbhani	0.28	0.23	1.16	0.09	0.00	1.06	0.88	1.26	1.09	2.28	0.73	0.64	2.40	1.37	0.05	1.85	0.52	0.33	0.54	0.84	0.24	0.54
Buldhana	0.06	1.00	0.88	0.20	0.00	0.76	3.31	1.36	0.82	2.20	0.46	1.98	2.58	0.73	0.02	2.38	0.14	0.99	0.80	0.20	0.54	0.37
Akola	0.09	0.10	1.01	0.06	0.00	0.52	2.64	1.60	0.81	3.08	0.23	1.11	1.10	0.45	0.26	2.70	0.11	0.26	0.24	0.22	0.24	0.23
Amravati	0.21	0.10	0.76	0.05	0.00	0.64	0.39	1.98	1.12	1.85	0.87	0.67	0.14	0.09	3.24	3.18	0.08	0.75	0.63	2.63	0.54	1.59
Yavatmal	0.12	0.03	0.87	0.15	0.00	0.47	0.98	2.11	0.43	1.69	0.41	1.03	0.11	0.25	0.39	3.54	0.46	0.51	0.42	0.24	0.32	0.28
Wardha	0.12	0.00	0.74	0.02	0.00	1.28	0.24	2.62	1.29	0.19	1.08	1.87	0.01	0.08	6.02	2.83	0.16	0.54	0.47	1.02	0.67	0.85
Nagpur	0.86	0.18	0.79	0.00	0.00	2.07	0.24	1.87	1.56	0.27	1.02	1.44	0.00	0.02	13.84	0.79	0.04	6.16	5.00	2.27	2.14	2.21
Bhandara	9.37	0.00	0.07	0.00	0.00	1.24	0.90	0.39	0.87	0.37	0.04	0.38	0.01	0.00	1.69	0.00	0.16	1.23	1.33	0.13	1.18	0.65
Chandrapur	3.70	0.12	0.87	0.00	0.00	1.13	0.66	0.84	0.60	0.56	0.02	3.30	0.01	0.03	3.19	0.91	0.01	3.53	3.01	0.05	0.69	0.37
Gadchiroli	8.79	1.71	0.35	0.00	0.00	0.25	0.73	0.15	0.63	0.57	0.04	2.03	0.01	0.00	0.04	0.01	0.00	1.65	1.32	0.16	0.25	0.20

Table 2.13: Districtwise Cropwise Crop Concentration Ratio -Maharashtra State: TE 2004-05

Districts/ Division	Paddy	Maize	Jowar	Bajra	Ragi	Wheat	Udid	Tur	Gram	Moog	Groundnut	Sesamum	Safflower	Sunflower	Soybean	Cotton	Sugarcane	Chillies	Con Spi	Fruits	Veg	FV
Thane	8.26	0.02	0.00	0.00	9.70	0.01	0.74	0.23	0.41	0.11	0.09	0.69	0.00	0.00	0.00	0.00	0.00	0.24	0.25	1.69	0.95	1.38
Raigad	9.20	0.00	0.00	0.00	7.89	0.00	0.12	0.10	0.17	0.02	0.08	0.23	0.00	0.00	0.00	0.00	0.00	0.41	0.76	4.07	0.53	2.62
Ratnagiri	4.62	0.02	0.00	0.00	10.83	0.00	0.06	0.05	0.00	0.02	0.10	0.08	0.00	0.00	0.00	0.00	0.00	0.09	0.52	5.89	0.31	3.60
Sindhudurg	7.39	0.04	0.00	0.00	2.70	0.00	0.10	0.00	0.00	0.02	1.70	0.25	0.00	0.00	0.00	0.00	0.00	0.47	1.06	13.07	0.12	7.74
Nashik	0.78	2.28	0.09	5.11	6.77	1.43	0.49	0.20	0.98	0.32	2.17	0.14	0.02	0.07	0.18	0.08	0.98	0.72	0.93	1.69	4.27	2.75
Dhule	0.15	1.10	0.39	4.49	1.87	1.26	0.81	0.40	0.79	1.53	4.37	4.35	0.00	0.04	0.05	1.13	0.46	1.81	1.40	0.16	0.77	0.41
Nandurbar	0.95	3.35	0.83	0.82	0.15	0.97	2.30	1.49	1.06	1.64	2.72	0.37	0.04	0.19	0.10	0.89	0.73	2.95	2.21	1.76	0.29	1.16
Jalgaon	0.01	0.66	0.59	0.63	0.00	0.75	1.62	0.36	0.82	0.88	0.31	3.60	0.00	0.05	0.05	2.09	0.45	0.89	0.75	2.03	0.44	1.37
Ahmednagar	0.08	0.85	1.74	2.40	0.44	1.28	0.12	0.18	1.17	0.28	0.42	0.13	1.38	0.65	0.22	0.07	1.16	0.35	0.43	0.43	1.41	0.83
Pune	0.81	0.66	1.64	1.52	1.76	1.24	0.08	0.07	1.03	0.15	2.37	0.50	0.71	0.21	0.01	0.00	1.79	0.75	0.93	0.59	3.67	1.86
Solapur	0.00	1.08	2.85	0.28	0.00	1.08	0.11	0.23	0.82	0.06	0.30	0.04	1.17	1.99	0.01	0.02	2.13	0.62	0.70	0.74	0.92	0.81
Satara	1.00	1.22	1.31	1.60	2.23	1.39	0.28	0.18	0.83	0.22	5.21	0.13	0.37	0.32	0.39	0.02	2.35	0.30	0.77	0.64	1.71	1.08
Sangli	0.37	1.48	1.63	1.27	0.11	0.86	0.28	0.31	1.02	0.22	2.35	0.05	0.27	0.85	1.23	0.02	2.78	0.65	0.71	0.54	0.58	0.56
Kolhapur	2.02	0.60	0.12	0.00	4.54	0.36	0.13	0.08	0.40	0.12	4.77	0.00	0.00	0.06	1.17	0.00	5.54	1.97	1.61	0.97	0.46	0.76
Aurangabad	0.01	5.13	0.84	2.02	0.00	1.04	0.22	0.80	1.05	0.40	0.47	1.11	1.41	0.92	0.06	1.34	0.43	0.89	0.80	0.59	0.33	0.48
Jalna	0.01	4.59	1.12	1.62	0.00	0.82	0.93	1.37	0.54	2.29	0.13	0.94	2.48	0.96	0.21	1.73	0.64	0.64	0.61	0.30	0.29	0.29
Beed	0.04	0.32	1.69	3.08	0.00	1.01	0.35	1.08	0.76	0.36	0.62	1.32	2.47	2.53	0.35	0.82	1.28	0.86	1.19	0.21	1.59	0.77
Latur	0.42	0.44	1.22	0.18	0.00	1.20	4.40	2.09	1.57	1.17	1.02	2.27	2.57	6.96	1.82	0.08	1.55	0.70	0.91	0.15	0.50	0.29
Osmanabad	0.36	0.93	2.24	0.41	0.00	1.02	2.72	2.30	2.13	0.98	0.65	1.60	4.24	6.69	0.34	0.03	0.94	0.70	1.02	0.15	0.59	0.33
Nanded	0.38	0.11	1.17	0.01	0.01	1.12	2.89	1.42	1.27	1.43	0.44	1.76	0.95	1.74	1.22	2.17	0.79	1.79	1.58	0.49	0.11	0.33
Parbhani	0.17	0.15	1.59	0.18	0.00	1.45	0.78	1.52	1.43	3.01	0.29	1.24	4.17	1.32	0.64	1.86	0.77	0.37	0.50	0.41	0.26	0.34
Hingoli	0.32	0.09	0.86	0.02	0.00	2.22	1.32	1.05	1.48	1.29	0.33	1.10	4.70	1.82	2.45	1.17	1.20	0.28	0.56	0.66	0.31	0.51
Buldhana	0.00	2.01	0.74	0.09	0.00	1.12	3.65	1.50	1.02	3.53	0.08	1.37	0.20	0.18	1.67	1.75	0.06	1.30	1.05	0.34	0.29	0.32
Akola	0.00	0.08	0.75	0.05	0.00	0.42	1.25	1.99	1.30	3.85	0.08	1.01	0.34	0.41	0.93	3.26	0.05	0.36	0.33	0.40	0.32	0.37
Washim	0.02	0.01	0.50	0.05	0.00	0.51	3.67	1.65	1.41	2.73	0.02	0.57	0.41	0.20	3.11	1.08	0.11	0.18	0.17	0.63	0.17	0.44
Amravati	0.14	0.07	0.45	0.01	0.00	0.34	0.32	1.90	0.98	2.01	0.11	0.29	0.21	0.12	2.07	2.07	0.10	1.05	0.83	2.92	0.40	1.88
Yavatmal	0.05	0.01	0.63	0.07	0.00	0.45	0.90	2.80	0.49	1.33	0.27	1.08	0.01	0.04	1.66	3.07	0.27	0.58	0.50	0.67	0.21	0.48
Wardha	0.01	0.00	0.38	0.00	0.00	1.61	0.07	2.95	1.88	0.09	0.33	0.30	0.00	0.02	6.29	2.43	0.37	0.50	0.48	1.10	0.53	0.87
Nagpur	1.10	0.04	0.41	0.00	0.00	1.86	0.15	1.84	1.73	0.15	0.69	0.08	0.00	0.10	5.08	1.01	0.07	4.74	4.03	2.46	1.65	2.13
Bhandara	5.88	0.01	0.01	0.00	0.00	0.65	0.11	0.36	0.22	0.07	0.03	0.44	0.00	0.00	0.29	0.00	0.15	1.65	1.81	0.13	1.69	0.77
Gondiya	11.49	0.05	0.00	0.00	0.00	0.48	0.08	0.42	0.32	0.07	0.00	0.97	0.00	0.00	0.01	0.00	0.11	0.49	0.71	0.09	1.09	0.50
Chandrapur	3.97	0.00	0.36	0.00	0.00	1.71	0.08	1.04	0.91	0.10	0.01	0.46	0.00	0.02	3.62	0.79	0.00	3.27	2.91	0.03	0.88	0.38
Gadchiroli	11.98	0.83	0.18	0.00	0.00	0.14	0.11	0.24	0.34	0.11	0.01	2.79	0.00	0.01	0.22	0.01	0.00	2.12	1.76	0.08	0.30	0.17

Note: Figures for Chili, Condiments and Spices, Fruits and Vegetables refers to TE 2000-01, for Gondiya- figures relates to TE 2000-01.

Table 2.14: Districtwise Major Crops Grown in Maharashtra

Crop	Districts growing major crops as per Crop Concentration Ratio	
	TE 1992-93	TE 2004-05
Rice	Thane, Raigad, Ratnagiri, Sindhudurg, Nashik, Dhule, Pune, Satara, Kolhapur, Latur, Nanded, Nagpur, Bhandara, Chandrapur, Gadchiroli	Thane, Raigad, Ratnagiri, Sindhudurg, Nashik, Nandurbar, Pune, Satara, Kolhapur, Latur, Nagpur, Bhandara, Gondiya, Chandrapur, Gadchiroli
Maize	Nashik, Dhule, Ahmednagar, Pune, Solapur, Satara, Sangli, Kolhapur, Aurangabad, Jalna, Beed, Latur, Osmanabad, Buldhana, Gadchiroli	Nashik, Dhule, Nandurbar, Jalgaon, Ahmednagar, Pune, Solapur, Satara, Sangli, Kolhapur, Aurangabad, Jalna, Latur, Osmanabad, Buldhana, Gadchiroli
Jowar	Dhule, Jalgaon, Ahmednagar, Pune, Solapur, Satara, Sangli, Aurangabad, Jalna, Beed, Latur, Osmanabad, Nanded, Parbhani, Buldhana, Akola, Amravati, Yavatmal, Wardha, Nagpur, Chandrapur	Nandurbar, Jalgaon, Ahmednagar, Pune, Solapur, Satara, Sangli, Aurangabad, Jalna, Beed, Latur, Osmanabad, Nanded, Parbhani, Hingoli, Buldhana, Akola, Washim, Amravati, Yavatmal, Nagpur
Bajra	Nashik, Dhule, Jalgaon, Ahmednagar, Pune, Satara, Sangli, Aurangabad, Jalna, Beed	Nashik, Dhule, Nandurbar, Jalgaon, Ahmednagar, Pune, Satara, Sangli, Aurangabad, Jalna, Beed, Osmanabad
Ragi	Thane, Raigad, Ratnagiri, Sindhudurg, Nashik, Dhule, Pune, Satara, Kolhapur	Thane, Raigad, Ratnagiri, Sindhudurg, Nashik, Dhule, Ahmednagar, Pune, Satara, Kolhapur
Wheat	Nashik, Dhule, Jalgaon, Ahmednagar, Pune, Solapur, Satara, Sangli, Kolhapur, Aurangabad, Jalna, Beed, Latur, Osmanabad, Nanded, Parbhani, Buldhana, Akola, Amravati, Yavatmal, Wardha, Nagpur, Bhandara, Chandrapur	Nashik, Dhule, Nandurbar, Jalgaon, Ahmednagar, Pune, Solapur, Satara, Sangli, Aurangabad, Jalna, Beed, Latur, Osmanabad, Nanded, Parbhani, Hingoli, Buldhana, Akola, Washim, Yavatmal, Wardha, Nagpur, Bhandara, Gondiya, Chandrapur
Udid	Thane, Nashik, Dhule, Jalgaon, Sangli, Aurangabad, Jalna, Latur, Osmanabad, Nanded, Parbhani, Buldhana, Akola, Yavatmal, Bhandara, Chandrapur, Gadchiroli	Thane, Nashik, Dhule, Nandurbar, Jalgaon, Jalna, Latur, Osmanabad, Nanded, Parbhani, Hingoli, Buldhana, Akola, Washim, Yavatmal
Tur	Dhule, Jalgaon, Solapur, Sangli, Aurangabad, Jalna, Beed, Latur, Osmanabad, Nanded, Parbhani, Buldhana, Akola, Amravati, Yavatmal, Wardha, Nagpur, Chandrapur	Dhule, Nandurbar, Aurangabad, Jalna, Beed, Latur, Osmanabad, Nanded, Parbhani, Hingoli, Buldhana, Akola, Washim, Amravati, Yavatmal, Wardha, Nagpur, Gondiya, Chandrapur
Gram	Nashik, Dhule, Jalgaon, Ahmednagar, Pune, Solapur, Satara, Sangli, Kolhapur, Aurangabad, Jalna, Beed, Latur, Osmanabad, Nanded, Parbhani, Buldhana, Akola, Amravati, Yavatmal, Wardha, Nagpur, Bhandara, Chandrapur, Gadchiroli	Thane, Nashik, Dhule, Nandurbar, Jalgaon, Ahmednagar, Pune, Solapur, Satara, Sangli, Kolhapur, Aurangabad, Jalna, Beed, Latur, Osmanabad, Nanded, Parbhani, Hingoli, Buldhana, Akola, Washim, Amravati, Yavatmal, Wardha, Nagpur, Chandrapur
Mung	Dhule, Jalgaon, Ahmednagar, Aurangabad, Jalna, Beed, Latur, Osmanabad, Nanded, Parbhani, Buldhana, Akola, Amravati, Yavatmal, Chandrapur	Dhule, Nandurbar, Jalgaon, Jalna, Latur, Osmanabad, Nanded, Parbhani, Hingoli, Buldhana, Akola, Washim, Amravati, Yavatmal
Groundnut	Sindhudurg, Nashik, Dhule, Jalgaon, Ahmednagar, Pune, Solapur, Satara, Sangli, Kolhapur, Aurangabad, Beed, Latur, Osmanabad, Nanded, Parbhani, Buldhana, Amravati, Yavatmal, Wardha, Nagpur	Sindhudurg, Nashik, Dhule, Nandurbar, Ahmednagar, Pune, Satara, Sangli, Kolhapur, Aurangabad, Beed, Latur, Osmanabad, Nanded, Nagpur

Sesamum	Raigad, Ratnagiri, Dhule, Jalgaon, Aurangabad, Jalna, Beed, Latur, Osmanabad, Nanded, Parbhani, Buldhana, Akola, Amravati, Yavatmal, Wardha, Nagpur, Chandrapur, Gadchiroli	Thane, Dhule, Jalgaon, Pune, Aurangabad, Jalna, Beed, Latur, Osmanabad, Nanded, Parbhani, Hingoli, Buldhana, Akola, Washim, Yavatmal, Bhandara, Gondiya, Chandrapur, Gadchiroli
Safflower	Jalgaon, Ahmednagar, Pune, Solapur, Sangli, Aurangabad, Jalna, Beed, Latur, Osmanabad, Nanded, Parbhani, Buldhana, Akola	Ahmednagar, Pune, Solapur, Aurangabad, Jalna, Beed, Latur, Osmanabad, Nanded, Parbhani, Hingoli, Washim
Sunflower	Ahmednagar, Solapur, Sangli, Aurangabad, Jalna, Beed, Latur, Osmanabad, Nanded, Parbhani, Buldhana, Akola	Ahmednagar, Solapur, Sangli, Aurangabad, Jalna, Beed, Latur, Osmanabad, Nanded, Parbhani, Hingoli, Akola
Soybean	Sangli, Kolhapur, Amravati, Wardha, Nagpur, Bhandara, Chandrapur	Sangli, Kolhapur, Latur, Nanded, Parbhani, Hingoli, Buldhana, Akola, Washim, Amravati, Yavatmal, Wardha, Nagpur, Chandrapur
Cotton	Dhule, Jalgaon, Aurangabad, Jalna, Nanded, Parbhani, Buldhana, Akola, Amravati, Yavatmal, Wardha, Nagpur, Chandrapur	Dhule, Nandurbar, Jalgaon, Aurangabad, Jalna, Beed, Nanded, Parbhani, Hingoli, Buldhana, Akola, Washim, Amravati, Yavatmal, Wardha, Nagpur, Chandrapur
Sugarcane	Nashik, Dhule, Jalgaon, Ahmednagar, Pune, Solapur, Satara, Sangli, Kolhapur, Aurangabad, Jalna, Beed, Latur, Osmanabad, Nanded, Parbhani, Yavatmal	Nashik, Dhule, Nandurbar, Jalgaon, Ahmednagar, Pune, Solapur, Satara, Sangli, Kolhapur, Aurangabad, Jalna, Beed, Latur, Osmanabad, Nanded, Parbhani, Hingoli
Chillies	Sindhudurg, Nashik, Dhule, Jalgaon, Pune, Solapur, Sangli, Kolhapur, Aurangabad, Jalna, Beed, Latur, Osmanabad, Nanded, Buldhana, Amravati, Yavatmal, Wardha, Nagpur, Bhandara, Chandrapur, Gadchiroli	Raigad, Sindhudurg, Nashik, Dhule, Nandurbar, Jalgaon, Pune, Solapur, Sangli, Kolhapur, Aurangabad, Jalna, Beed, Latur, Osmanabad, Nanded, Buldhana, Amravati, Yavatmal, Wardha, Nagpur, Bhandara, Gondiya, Chandrapur, Gadchiroli
Condiments and Spices	Raigad, Ratnagiri, Sindhudurg, Nashik, Dhule, Jalgaon, Pune, Solapur, Satara, Sangli, Kolhapur, Aurangabad, Jalna, Beed, Latur, Osmanabad, Nanded, Parbhani, Buldhana, Amravati, Yavatmal, Wardha, Nagpur, Bhandara, Chandrapur, Gadchiroli	Raigad, Ratnagiri, Sindhudurg, Nashik, Dhule, Nandurbar, Jalgaon, Ahmednagar, Pune, Solapur, Satara, Sangli, Kolhapur, Aurangabad, Jalna, Beed, Latur, Osmanabad, Nanded, Parbhani, Hingoli, Buldhana, Amravati, Yavatmal, Wardha, Nagpur, Bhandara, Gondiya, Chandrapur, Gadchiroli
Fruits	Thane, Raigad, Ratnagiri, Sindhudurg, Nashik, Dhule, Jalgaon, Ahmednagar, Pune, Solapur, Sangli, Kolhapur, Nanded, Parbhani, Amravati, Wardha, Nagpur	Thane, Raigad, Ratnagiri, Sindhudurg, Nashik, Nandurbar, Jalgaon, Ahmednagar, Pune, Solapur, Satara, Sangli, Kolhapur, Aurangabad, Nanded, Parbhani, Hingoli, Washim, Amravati, Yavatmal, Wardha, Nagpur
Vegetables	Thane, Raigad, Nashik, Dhule, Ahmednagar, Pune, Solapur, Satara, Kolhapur, Beed, Osmanabad, Buldhana, Amravati, Wardha, Nagpur, Bhandara, Chandrapur	Thane, Raigad, Nashik, Dhule, Jalgaon, Ahmednagar, Pune, Solapur, Satara, Sangli, Kolhapur, Beed, Latur, Osmanabad, Wardha, Nagpur, Bhandara, Gondiya, Chandrapur
Fruits and Vegetables	Thane, Raigad, Ratnagiri, Sindhudurg, Nashik, Dhule, Jalgaon, Ahmednagar, Pune, Solapur, Satara, Sangli, Kolhapur, Beed, Osmanabad, Nanded, Parbhani, Amravati, Wardha, Nagpur, Bhandara	Thane, Raigad, Ratnagiri, Sindhudurg, Nashik, Dhule, Nandurbar, Jalgaon, Ahmednagar, Pune, Solapur, Satara, Sangli, Kolhapur, Aurangabad, Beed, Hingoli, Washim, Amravati, Yavatmal, Wardha, Nagpur, Bhandara, Gondiya

Source: Table 2.14 and Table 2.15.

2.7 Area, Production and Productivity:

Growth in total agricultural production over the period of times gives an idea of the pace of agricultural development in the state. As the new technology adopted during mid sixties had its impact on per hectare yield of crop also. It can be seen from the Table 2.15 that production of various crops has increased many folds in the state over the last forty years. But the productivity of different crops is relatively lower in the state as compared to the all-India average, which is the major problem of Maharashtra's agriculture (see, Table 2.16 and Figure 2.6). As can be seen from Table 2.16, barring a few crops, productivity of all other crops is significantly lower in Maharashtra as compared to the all-India average. As mentioned earlier, cultivation of crops predominantly under rainfed condition is observed as the main reason by various studies (Sawant, *et al.*, 1999; Dev, 1987; Mitra, 1990). Data presented in Table 2.16 also clearly indicate the low coverage of irrigation in different crops in the state as compared to the national level average. Crops such as Jowar, groundnut and sugarcane have higher coverage of irrigation in Maharashtra and therefore, the productivity of these crops is relatively higher/at par with the state. Productivity of important crops such as gram, cotton, etc., is very low in the state as compared to national average and other states as well mainly due to poor irrigation availability (GOI, 2002).

Unless the productivity of crops is increased significantly, farmers' income cannot be increased. While it may not be possible to provide irrigation for the whole cropped area because of limited availability of irrigation potential in the state, moisture availability can be improved in the rainfed areas through rain water harvesting system and watershed development programmes. Needless to mention that watershed development programme under operation in different parts of the state has already made significant impact on productivity of crops by increasing the water availability. By expanding the watershed development programme in all potential areas in the state, not only the productivity of crops can be increased but the rural poverty can also be reduced in a sustained manner through agricultural growth.

Table 2.15: Production of Important Crops in Maharashtra (Production '00' tonnes)

Crops	TE 1962-93	TE 1972-73	TE 1982-83	TE 1992-93	TE 2000-01	TE 2004-05
Rice	13601	12711	22309	22840	23520	22785
Wheat	4186	3955	8369	7789	12141	9261
Jowar	34570	15842	46686	53453	43224	34647
Bajra	4837	4377	6459	12682	12379	10562
Maize	189	216	601	1685	3898	7265
Total Cereals	59817	38946	87158	101444	97753	86659
Tur	3674	2263	3645	4565	7912	7094
Mung	1056	626	1301	3142	3175	3207
Udid	1188	846	1163	2077	2751	2955
Gram	1360	891	1411	2875	5207	4453
Total Pulses	8764	5635	9354	14113	20611	18902
Foodgrains	68579	44581	96512	115557	118364	105562
Groundnuts	7838	4328	5267	8333	5658	4492
Safflower	-	-	1998	2107	1616	1079
Sesamum	263	200	271	796	397	327
Sunflower	-	-	264	2282	1968	1367
Soybean	-	-	-	2419	14424	18959
Total Oilseeds	-	-	9165	15779	23827	26577
Sugarcane	109170	150617	292520	352411	524948	307330
Cotton	12813	9135	14149	16407	24704	28716

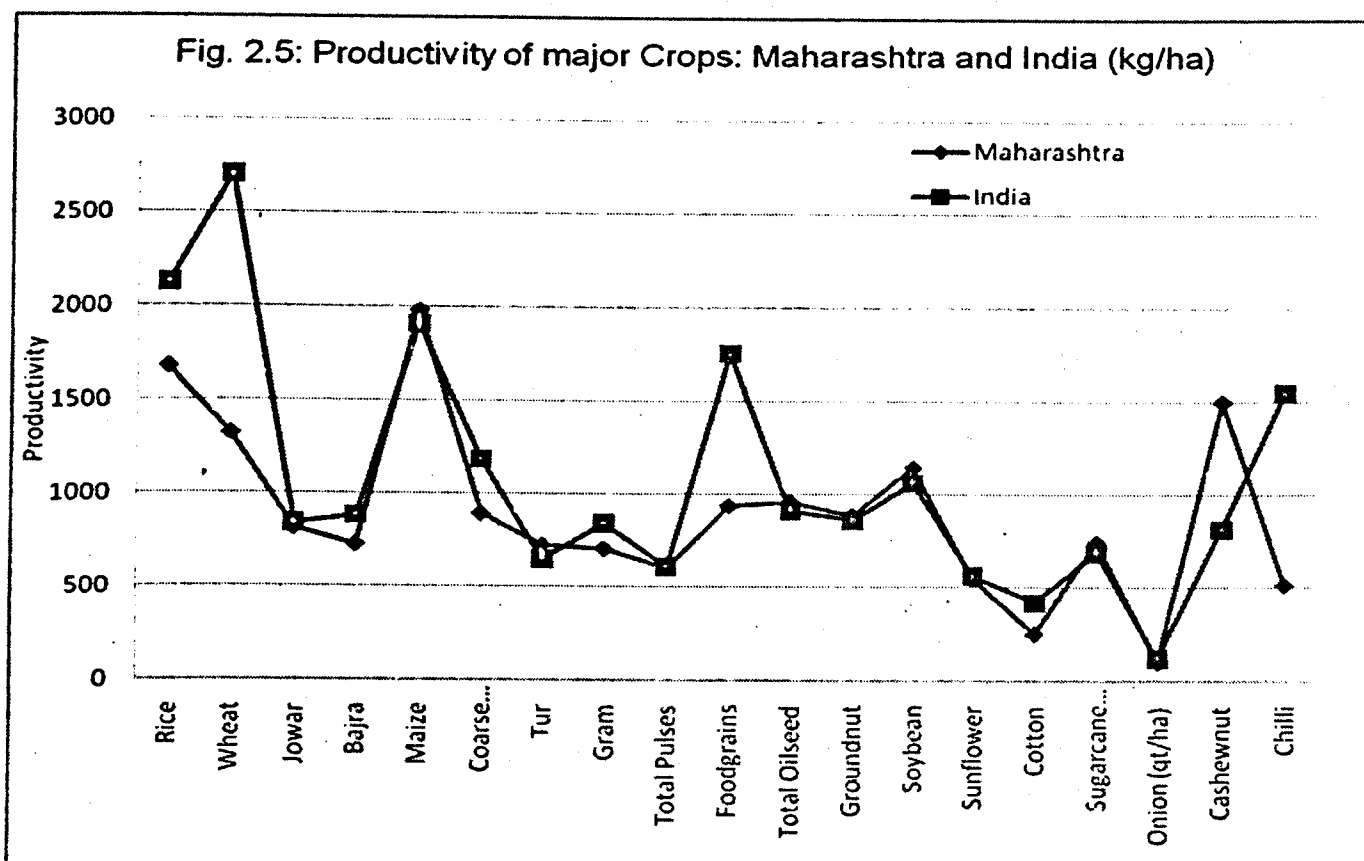
Sources: GOM (various issues of *Season and Crop Report of Maharashtra*), GOM (2009) and EPWRF (2004).

Table 2.16: Crop Productivity and Coverage of Irrigation in Maharashtra and India

Crops	Productivity (kg/ha) 2006-07		Coverage of Irrigation (%) 2005-06	
	Maharashtra	India	Maharashtra	India
Rice	1680	2131	28.7	56.0
Wheat	1325	2708	66.5	89.6
Jowar	817	844	10.5	9.0
Bajra	729	886	6.3	8.9
Maize	1983	1912	9.7	21.1
Coarse Cereals	895	1185	9.2	13.1
Tur	726	650	1.7	4.4
Gram	706	845	26.8	31.1
Total Pulses	602	612	23.4	15.1
Foodgrains	940	1756	16.7	45.5
Total Oilseed	963	916	7.7	28.2
Groundnut	889	866	70.6	19.6
Soybean	1147	1063	0.5	1.7
Sunflower	548	567	28.8	24.9
Cotton	253	421	4.8	36.1
Sugarcane	74898	69022	100.0	91.2
Onion	10202	12357	n.a.	n.a.
Cashewnut	1500	820	n.a.	n.a.
Chillies	516	1551	n.a.	n.a.

Note: n.a.- Not Available

Sources: GOI (2008), CMIE (2009).



The growth in area, production and productivity of major crops in Maharashtra during the period 1960-61 to 2004-05 is presented in Table 2.17. It can be seen from the table that during the pre green revolution period, i.e. period I 1960-61 to 1966-67, as expected, the production of almost all the crops in the state decreased significantly due to decrease in productivity. Though there was growth in area under cereals and pulses (except Jowar, Wheat and Gram crop), but it cannot substitute/overlapped the decrease in productivity of these crop, resulted in declined in production. One reason behind decrease in production and productivity of crops was severe drought experienced by the nation during 1965-66 and 1966-67. As expected and mentioned earlier, the adoption of green revolution was adopted in the country during mid 1960s, but it came in full swing in Maharashtra after 1971, and there was significant growth in production and productivity of all the major crops in the state. The foodgrains production in the state increased at the rate of 4.97 per cent per annum, despite low growth in area (0.88 percent per annum) during 1967-68 to 1979-80. Thus, productivity growth was instrumental in increase in foodgrains and oilseeds production. However, production of groundnut declined at the rate of 0.43 per cent per annum, which was due to drastic decline in area under this crop. The increase in productivity of groundnut could not substitute the negative growth in area under this crop.

Table 2.17: Growth Rates of Area (A), Production (P) and Yield (Y) of Major Crops in Maharashtra: 1960-61 to 2004-05 (% per annum)

Year	1960-61 to 1966-67 (P-I)			1967-68 to 1979-80 (P-II)			1980-81 to 1989-90 (P-III)			1990-91 to 2004-05 (P-IV)			1960-61 to 2004-05 (All)		
	A	P	Y	A	P	Y	A	P	Y	A	P	Y	A	P	Y
Rice	0.53	-5.96	-6.46 ^c	1.14 ^a	4.84 ^b	3.65 ^c	0.37	-0.42	-0.79	-0.36 ^a	-0.23	0.13	0.41 ^a	1.8 ^a	1.38 ^a
Maize	8.77 ^a	5.87 ^b	-2.67 ^a	4.12 ^a	15.4 ^a	10.83 ^a	6.74 ^a	9.29 ^b	2.39	9.44 ^a	12.09 ^a	2.42 ^c	6.21 ^a	8.78 ^a	2.43 ^a
Jowar	-0.49 ^a	-5.24	-4.77	1.09 ^a	7.29 ^b	6.13 ^b	-0.32	1.42	1.75	-2.02 ^a	-3.49 ^a	-1.51	-0.45 ^a	1.26 ^a	1.72 ^a
Bajra	2.99 ^a	-2.12	-4.97 ^c	-1.99 ^c	0.69	2.73	2.49 ^a	4.5	1.96	-2.12 ^a	-1.29	0.84	-0.17	2.63 ^a	2.81 ^a
Ragi	0.02	-3.74	-3.76	0.35	2.08	1.72	-0.09	0.06	0.16	-2.09 ^a	-2.08 ^a	0.01	-0.94 ^a	0.18	1.13 ^a
Wheat	-1.4	-4.27	-2.91	3.65 ^a	11.05 ^a	7.15 ^a	-2.95 ^a	-0.48	2.55	0.21	1.23	1.01	-0.41 ^b	2.67 ^a	3.09 ^a
Total Cereals	0.15	-5.04^c	-5.18^c	0.77^b	6.13^b	5.32^b	0.04	1.25	1.21	-1.32^a	-1.32	0	-0.22^a	1.77^a	1.99^a
Gram	-3.77 ^a	-6.87 ^b	-3.22	2.53 ^b	4.97 ^b	2.39	6.28 ^a	10.87 ^a	4.32	2.91 ^a	3.03 ^b	0.12	2.31 ^a	4.25 ^a	1.90 ^a
Mung	1.89 ^b	-0.01	-1.86	1.10	5.11	3.96	3.26 ^b	10.85 ^a	7.36 ^a	-0.78 ^b	-0.81	-0.03	1.44 ^a	3.48 ^a	2.01 ^a
Tur	1.66 ^b	-6.17 ^c	-7.71 ^b	1.10	3.23 ^c	2.11 ^c	4.91 ^a	7.18 ^a	2.17	0.37 ^a	3.75 ^b	3.37 ^b	1.87 ^a	2.33 ^a	0.46 ^c
Udid	1.43 ^c	-2.14	-3.52 ^c	-0.49	3.39	3.90 ^b	1.3 ^c	8.52 ^a	7.13 ^a	2.23 ^a	2.44	0.21	0.46 ^a	2.47 ^a	2.01 ^a
Total Pulses	0.07	-4.38^b	-4.44^b	1.19^c	4.05^c	2.83^c	2.76^a	7.48^a	4.59^a	0.51^b	2.21	1.68	1.05^a	2.58^a	1.51^a
Total Foodgrain	0.17	-4.92^c	-5.09^c	0.88^b	5.89^b	4.97^b	0.61^b	1.95	1.33	-0.81^a	-0.8	0.01	0.06	1.89^a	1.82^a
Groundnut	-1.18	-9.0 ^b	-8.01 ^b	-1.19 ^b	-0.43	0.77	3.15 ^b	3.46	0.30	-4.89 ^a	-5.03 ^a	-0.14	-1.96 ^a	-0.18	1.82 ^a
Sesamum	1.59	1.18	-0.4	0.66	3.22	2.55 ^c	12.63 ^a	13.82 ^a	1.06	-7.82 ^a	-7.25 ^a	0.61	0.65 ^c	1.60 ^a	0.95 ^a
Safflower *	-0.95	-	-	2.65 ^a	-	-	3.83 ^a	8.84 ^b	4.83	-6.02 ^a	-6.65 ^b	-0.67	0.09	-2.99 ^d	-0.04
Sunflower*	-	-	-	-	-	-	37.08 ^a	33.48 ^a	-2.62	-4.23 ^b	-5.38 ^b	-1.20	6.48 ^a	6.62 ^a	0.13
Soybean*	-	-	-	-	-	-	-	-	-	15.52 ^a	18.16 ^a	2.28 ^c	15.52 ^a	18.16 ^a	2.48 ^c
Total Oilseed	-1.35 ^b	0.85	2.23 ^c	0.94 ^b	2.90	1.94	6.77 ^a	6.20 ^b	-0.53	0.4	2.89 ^c	2.48 ^c	1.28 ^a	4.36 ^a	3.06 ^a
Cotton	0.76	-3.78	-4.51	-1.43^a	1.36	2.83	0.23	3.39	3.16	0.73	3.55^b	2.80^c	0.32^a	2.35^a	2.02^a
Sugarcane	1.35	-0.32	-1.65	5.28^a	6.60^a	1.25^c	1.7^b	-0.48	-2.14^d	-1.06	-0.31	0.76	3.63^a	3.40^a	-0.22^c
Con -Spi	0.21	-	-	-0.70	-	-	-0.29	-	-	0.86	-	-	-0.58 ^a	-	-
Vegetables	3.93 ^a	-	-	2.44 ^a	-	-	7.31 ^a	-	-	3.30 ^a	-	-	3.66 ^a	-	-
Fruits	3.81 ^a	-	-	3.47 ^a	-	-	5.54 ^a	-	-	12.72 ^a	-	-	5.84 ^a	-	-
Chillies	0.69	-	-	-1.03 ^b	-	-	-1.05 ^b	-	-	-1.76 ^a	-	-	-1.06 ^a	-	-
GCA	0.21	-	-	0.50	-	-	1.20 ^a	-	-	0.45 ^b	-	-	0.42 ^a	-	-

Notes: * Overall Period - Safflower P and Y, APY of Sunflower, growth rates refers to the period 1980-81 to 2004-05, for Soybean APY refers to 1990-91 to 2004-05; a, b, c are significant at 1, 5 and 10 percent significance level; P- Period.

Source: Computed from Season and Crop Report of Maharashtra (various issues) and GOM (2009).

During post green revolution period, i.e. period III 1980-81 to 1989-90, except rice, wheat and sugarcane, all other crops recorded increase in production. The decrease in production of wheat and sugarcane was due to decline in area and however, in case of rice crop, it was due to productivity decline. During this period, the production of oilseed and pulses crops increased significantly, which may be due to implementation of Technology Mission in the country during 1986-87. As discussed earlier, during post reform period, i.e. 1990-91 to 2004-05, production of most of the crops has declined due to decline in area and productivity. The decrease in production was due to either declined or stagnant productivity of these crops. For example, all the major cereals crops of the state recorded decrease in production due to stagnant productivity and reduction in area. Except soybean, all other oilseed crop production has also decelerated due to negative productivity growth. The increase in production of soybean was heavily contributed by increase in area followed by productivity growth. As soybean is coming up an alternative crop in rainfed areas and therefore area under cereals and cotton is switching over to soybean crop in recent years.

2.8 Changes in Input use:

Improvement in yield which is a key to long term growth depends on a host of factors that includes technology, use of quality seeds, fertilizers and pesticides and micronutrients, not the least irrigation. Each of these plays an important role in determining the yield level and in then the augmentation in the level of production (GOI, 2009 Economic Survey 2008-09). The changes in input use in Maharashtra during last four decades at five point periods is presented in Table 2.18. One of the indicators of level of adoption of technology in agriculture is the use of High Yielding Variety seeds (HYVs) in different crops. Seed is the most cost efficient means of increasing agricultural production and productivity. Though the use of HYVs is positively correlated with the availability of irrigation, farmers have been using the same even under rainfed condition because of the government's subsidy programmes. While HYVs have been used for different crops including non-foodgrain crops, data on the coverage of HYVs for non-foodgrains are seldom available even at the micro level. This does not allow us to find out the extent of adoption of HYVs in various crops, especially in non-foodgrain crops. It is evident

from the Table 2.18 that despite having low irrigation facility and wide variation in rainfall across different regions in Maharashtra, coverage of HYVs is significantly increased from 1.08 lakh hectares in 1966-67 to 82.32 lakh hectares in 2003. This shows that farmers belonging to Maharashtra are fully aware of the importance of HYVs in crop cultivation. However, relatively higher coverage of HYVs in cereal crops does not reflect in the productivity of the crops, which is a major concern of the agricultural sector of Maharashtra (productivity of different crops is discussed earlier in the same chapter). This is mainly because of predominant cultivation of HYVs under rainfed condition, where moisture stress often affects the yield of crops substantially. By introducing drought resistant cum high yielding varieties in different crops, productivity of crops can be increased to a larger extent.

Credit availability is of crucial importance for agriculture development of any region. Some of the studies concluded that farmer indebtedness has been singled out as the foremost cause for farmer suicides in Vidarbha region of Maharashtra (Planning Commission, GOI, 2006) and a few states (Deshpande and Nagesh, 2005), however other (GOI, 2007a) argues that root cause of the current agrarian crisis is not indebtedness alone - indebtedness is just a symptom. The underlying causes are stagnation in agriculture, increasing production and marketing risks, institutional vacuum and lack of alternative livelihood opportunities. In view of this, it is important to have a look of ground level flow of credit to agriculture and allied sector in the state⁹. Financial assistance is provided to farmers by way of short-term loans, credits etc. by various Government and co-operative agencies. The National Bank for Agriculture and Rural Development (NABARD), the apex bank in the country helps in promoting agricultural and rural development and performs pivotal role in development of agriculture. As per Economic Survey of Maharashtra (various issues), it is observed that the ground level credit flow to agriculture sector increased significantly from Rs. 859 crore in 1980-81 to Rs. 1283 crore in 1990-91, Rs. 4576 crore in 2000-01 and Rs. 12113 crore in 2007-08. However, as per

⁹ Due to non availability of data on credit flow to agriculture sector from Lead Bank, we collected the districtwise data from District Socio-Economic Review of each district. There are huge variations in the data at the district level and in some case, it is not available for all the year. Also variations are observed in case of state level data reported by Fertilizer Association in India in *Fertilizer Statistics* (source- NABARD), Economic Survey (Government of Maharashtra).

NABARD publication on *State Focus Paper - Maharashtra State - 2008-09*, the reported corresponding figure was Rs. 12084 crore¹⁰.

The financial institutions directly associated with agricultural finance at grassroot level in the State are Primary Agricultural Credit Co-operative Societies (PACS) extending short-term crop loans to their cultivator members. During 2007-08, the amount of loans advanced to the cultivators by the PACS was Rs. 5,828 crore (against Rs. 5,788 crore in 2006-07) of which Rs. 2,496 crore i.e. 43 per cent were given to small and marginal farmers (GOM, 2009). During last three years, favorable monsoon conditions enabled robust growth in the demand for credit. Announcement of various schemes under the programme of doubling of agriculture credit by the Government of India, provision of crop loans at rates of interest not exceeding 7 percent (6 percent in the state of Maharashtra) and buoyancy in the economy in general, appear to have facilitated the growth in credit flow (NABARD, 2008). The "Farm Credit Package" announced in June 2004 was aimed at doubling the flow of institutional credit for agriculture in the ensuing three years. The credit flow to the farm sector got doubled two years against the stipulated period of three years (GOI, 2009).

After having the credit flow information, it is important to see the prices received by the farmers immediately after harvest of the crops, i.e., Farm Harvest Price (FHP), because due to urgency of credit need most of the farmers sell their produce directly from farm or from home. The farm harvest prices are the average prices prevailed during the peak marketing period immediately after harvest of the respective crops. It can be seen from the table that the farm harvest price index has increased significantly during last four decades.

¹⁰ Flow of Institutional Credit to Agriculture in Maharashtra (Rs. in lakh)

Purpose	Agency	2004-05	Growth per cent over 2003-04	2005-06	Growth per cent over 2004-05	2006-07	Growth per cent over 2005-
Crop Loan	CBs	234537	122	193508	(18)	230608	19
	Co-op.	279829	18	341408	22	535973	57
	RRBs	14872	48	17651	19	30489	73
Sub-Total		529238	50	552567	4	797070	44
Term Loan	CBs	113294	67	188806	67	283439	50
	Co-op.	39036	54	62750	61	115241	84
	RRBs	4266	86	3442	(19)	12654	268
Sub-Total		156596	64	254998	63	411334	61
Total Agriculture		685834	46	807565	18	1208404	50

Source: NABARD (2008) (State Focus Paper 2008-09, NABARD).

The increased use of purchased inputs in agriculture necessitated to raise their use efficiencies through mechanizations. Farm mechanization has been helpful to bring about a significant improvement in agricultural productivity. Thus, there is strong need for mechanization of agricultural operations. The number of plant protection equipments such as sprayer and dusters has increased from 0.46 lakh in 1972 to 7.59 lakh in 2003, almost 17 times in thirty years. This increase may be due to high incidence of pest and disease attack on major crops, such as cotton, sugarcane, grape during 1990s. The use of four wheel tractors in state agriculture has increased, number of tractors increased to 1.05 lakh in 2003 from just 0.01 lakh in 1961. As per the Livestock Census reports, the number of electric pumpsets have increased at very high rate as compared to the use of diesel oil pumps. During 1961, only 7100 electric pumpsets and 63747 diesel oil pumpsets were in the state, which increased to 1005437 and 168228 in 2003, respectively. The electric pumpsets have increased by more than 143 times however oil pumpsets by hardly 3 times over last four decades. Despite having an acute power shortage of electricity in the state during last some years, the number of electric pumpsets increased by 153613 in the year 2003 over base period 1997. Despite low level of irrigation and interrupted and less power supply, the number of electric pump in the state has increased at higher rate. The government should provide adequate and continues electric supply to the agriculture sector. Though there is significant increase in number of pumpsets in the state, there is wide variation among the regions. Vidarbha and Marathawada regions are having backlog of 55.33 per cent and 28.06 per cent of total backlog in the state of pumpsets in 2005¹¹. The Western Maharashtra accounts for more than 54 percent of total pumpsets in the state and consumed 66 percent of total electricity used for pump in the state. Also the same pattern is observed in case of four wheeled tractors. Thus, there is a huge disparity among the regions in case of level of agriculture mechanization as well.

¹¹ Report of Fact Finding Team on Vidarbha (Planning Commission, GOI, 2006) has estimated the region-wise physical backlog of agricultural pumpsets as follows:

Region	No of Pumpsets(01.04.82) State Av. 38.80 pumps	No of Pumpsets (01.01.96) State Av. 38.80 pumps	Balance Backlog of 1996 on 01.04. 2005	No of Pumpsets on 01.04.2005
Vidarbha	57981 (40.58)	171472 (57.50)	107744 (63.66)	215099 (55.33)
Marathawada	52502 (36.74)	72113 (24.18)	23611 (13.95)	109073 (28.06)
Konkan	15545 (10.88)	54640 (18.32)	37903 (22.39)	64569 (16.61)
Western Maharashtra	16857 (11.80)	Backlog Nil (Excess 81579 pumpsets)	Nil	Backlog Nil (Excess 57320)
Total Backlog	142885 (100.0)	298225 (100.0)	169258 (100.0)	388741 (100.0)

Note: Figures in parenthesis are percentage to total.

The consumption of fertiliser of any state is mainly determined by factors such as availability of irrigation as well as area under paddy and wheat (NCAER, 1991; Vaidyanathan, 1994). While irrigation availability encourages the farmers to use higher amount of fertilisers for any given crop, paddy and wheat generally consume relatively higher amount of fertilisers. Despite having poor irrigation facility and less area under paddy and wheat, the consumption of fertilisers in the state is not very low as compared to the national level average. While the consumption of fertilizers in the state increased from 1.62 kg/ha in 1960-61 to 103.1kg/ha in 2007-08, the same has increased from 1.93 kg/ha to 117.1kg/ha at all India level during the same period. The consumption of fertilizers in the state is not very low as compared to the national average because of two reasons, i) sugarcane is intensively cultivated in the state, which consumes higher amount of fertilisers than many other crops; ii) high value horticultural crops such as grapes, banana, vegetables, etc, are also cultivated intensively in the state, which also require higher amount of fertilizers. Due to less awareness as well as resource constraints, farmers are not able to apply fertilizers in time with proper mix (of NPK). Uncertainties associated with rainfall and the limited access to irrigation were likely influencing fertilizer use in the state, as water is critical to efficient utilisation by plants of supplementary nutrient applications (World Bank, 2003). With the proper institutional credit support along with quality extension network, these constraints can be removed (Narayanamoorthy and Kalamkar, 2004).

In spite of limited availability of irrigation, the available irrigation water is not distributed properly across different crops, which is another important issue of Maharashtra's irrigation sector. Out of the total irrigated area of 3.86 million hectares available during TE 2000-01, foodgrain crops such as paddy, wheat, Jowar and bajra together accounted for only 38.05 percent, while sugarcane alone accounted for 16.87 percent. Pulses and oilseeds are the important crops in Maharashtra accounting about 28.74 percent of GCA in TE 2000-01, but these two crops together accounted for only about 14.0 percent of irrigated area during the same period (see, Table 2.21). Though the net returns per unit water generated by sugarcane is very low when compared to most of the foodgrain crops (Rath and Mitra, 1989), some estimates show that nearly two-third of irrigation water available in the state is used only by sugarcane, which accounts for only around 2.60 percent of gross cropped area (World Bank, 2002). Irrigated sugarcane area accounted for

over 16 percent of GIA in the state, which is very high when compared to the national average of about 5 percent during 2001-02. Despite severe water scarcity in the state, area under sugarcane has increased nearly four times between TE 1962-63 (1.46 lakh ha) and TE 2000-01 (6.51 lakh ha) in the state. The share of sugarcane area in GCA has also increased from just 0.78 percent to 3.00 percent during this period. The area under sugarcane in the state has increased at the rate of 2.1 percent per annum between 1990-91 to 2000-01. Recent data also indicate that the major share of additional irrigated area created in the state is still used for cultivating sugarcane crop. The predominant use of water for cultivating sugarcane crop limits the intensive cultivation of foodgrain and other crops in the state. Also, due to excessive application of water by traditional surface irrigation methods, land gets waterlogged and the yields decline (Kulkarni, 2000). Continued support of the sugar industries (through state government) encourages the farmers to cultivate this water intensive crop. Keeping in view the water balance of the state, strict rules need to be enacted to discourage the cultivation of sugarcane under flood or conventional method of irrigation.

Cotton is important cash crop, which has been traditionally cultivated in Maharashtra. Cotton is predominantly cultivated under rainfed condition in the state. In spite of facing problems such as severe pest attack, increased cost of cultivation, low productivity and profitability, area under cotton has marginally increased between TE 1962-63 and TE 2000-01. This only shows that there is a tremendous potential for expanding the cultivation of cotton in the state. Measures such as introduction of pest resistance varieties (Bt cotton, etc.), improved cultivation practices, quality extension network and proper marketing network may help to improve the cultivation of cotton crop in the state.

Table 2.18: Changes in Input use in Maharashtra: 1961-2003

Year	Gross Area under HVYs ^a (lakh ha)	Farm Harvest Price Index [#]	Agri Credit (Rs. in Crore)	No. of Plant Protection Equipments	No. of four wheeled tractors	No. of Pump sets		Fertilizer Consumption (NPK)	
						Electrical	Diesel (Oil Engines)	Per ha (Kg)	Total (mt)
1961	-	96.9	n.a.	-	1427	7100	63747	-	-
1966	1.08*	184.2	n.a.	-	3274	37979	146786	-	-
1972	9.70	206.8	n.a.	45847	5607	169778	173678	13.33	241441
1978	39.41	336.5	n.a.	117086	12348	378009	167802	18.15	359847
1982	45.37	430.5	746	245447	20704	448632	139196	26.45	529131
1987	65.50	507.2	817	398816	32464	599649	143007	32.31	656644
1992	70.86	991.7	1409	591195	46631	754636	104722	62.78	1263953
1997	89.58	1209.5	2656	756797	81353	851824	112259	60.84	1328526
2003	82.32	1432.0	5596	758731	105611	1005437	168228	88.40	1649477

Note: ^a total area under Paddy, Jowar, Bajra, Maize and Wheat crops; * relates to 1966-67; Plant Protection equipments includes Sprayers and dusters; # Farm Harvest Price Index calculated at the base TE 1962-63 by simple average of prices of all crops reported.

Sources: Season and Crop Report, GOM; FAI (various Issues).

Table 2.19: Area under Principal Hybrid/HYV Crops of the Maharashtra State: 1966-67 to 2004-05

Crop	Percentage to total area under crop					
	TE 1968-69	TE 1972-73	TE 1982-83	TE 1992-93	TE 2000-01	TE 2004-05
Paddy	6.49	17.02	64.01	78.81	92.79	86.19
Jowar	4.33	6.80	31.43	66.72	93.55	93.28
Bajra	6.35	20.40	42.49	82.37	93.25	88.99
Maize	22.30	11.00	90.09	99.18	73.82	76.84
Wheat	4.63	29.04	81.76	78.52	90.81	98.56
Total (PJBW)	5.12	12.47	42.72	72.77	92.47	91.02
Total Cereals	4.92	12.01	41.25	70.62	89.38	88.32
Total Foodgrains	3.98	9.73	33.22	54.05	65.25	63.81
Cotton	n.a.	n.a.	18.19	n.a.	89.51	99.00

Notes: PJBW-Paddy+Jowar+Bajra+Maize+Wheat; n.a.- Not Available

Source: GOM (various issues), Epitome of Maharashtra, Part II, Office of Commissioner of Agriculture, Pune.

Table 2.20: Gross Area under Irrigation of Principal Crops of the State: 1960-61 to 2004-05

(Area in '00 ha)

Crops	TE 1962-63		TE 1972-73		TE 1982-83		TE 1992-93		TE 2000-01		TE 2004-05	
	Irri Area	%	Irri Area	%	Irri Area	%	Irri Area	%	Irri Area	%	Irri Area	%
Rice	2732	20.69	3261	24.35	3980	27.07	4096	25.91	4314	28.46	3686	24.24
Maize	104	37.54	168	42.55	252	40.25	379	29.24	482	16.21	289	7.39
Jowar	2812	4.53	2564	4.47	4481	6.89	4709	7.99	5115	10.52	3318	7.11
Bajra	330	1.98	447	2.80	520	3.28	720	3.74	918	5.21	732	4.99
Wheat	1405	15.64	2741	32.89	5172	51.07	5231	71.47	6183	66.24	6177	88.87
Total Cereals	7324	6.94	9205	9.29	14437	13.11	15155	14.33	17014	17.51	14009	15.56
Udid (Black Gram)	4	0.09	3	0.07	10	0.23	11	0.25	4	0.08	n.a.	-
Tur (Red Gram)	24	0.44	11	0.20	27	0.41	52	0.52	186	1.76	187	1.76
Gram (Bengal Gram)	352	8.96	481	14.38	857	21.35	1888	33.43	2440	28.09	2525	37.01
Mung (Green Gram)	37	0.91	9	0.21	76	1.43	220	2.91	27	0.39	n.a.	-
Total Pulses	421	1.76	530	2.28	1019	3.82	2277	7.03	2752	7.66	2523	7.30
Total Foodgrains	7745	5.99	9735	7.96	15456	11.30	17432	12.62	19766	14.86	16532	13.27
Groundnut	130	1.17	220	2.59	680	10.29	1932	25.62	1480	28.22	728	17.99
Sesamum	-	-	2	0.34	35	2.58	23	0.80	1	0.07	n.a.	-
Safflower	-	-	20	0.47	36	0.76	46	0.92	3	0.08	n.a.	-
Soybean	-	-	-	-	-	-	77	2.83	85	1.43	149	0.90
Sunflower	-	-	-	-	1	0.20	915	20.62	930	10.64	729	24.71
Total Oil seed	198	1.03	306	1.78	886	5.31	3137	12.23	2655	9.99	2115	7.40
Cotton	469	1.79	692	2.66	1059	4.10	910	3.39	1230	3.89	774	2.76
Sugarcane	1464	98.67	2010	100.00	3591	100.00	5542	100.00	6512	100.00	5060	100.00
Chillies	650	41.06	577	41.38	627	44.94	907	71.65	1054	100.00	n.a.	-
Condiments & Spices	731	36.06	708	39.28	804	45.00	1256	75.71	1394	98.45	n.a.	-
Total Fruits			724	77.29	1020	75.39	2010	78.47	3305	77.00	n.a.	-
Total Vegetables	99	12.40	933	88.32	1144	78.64	1955	77.89	2784	92.96	n.a.	-
GCA	12439	6.56	15531	8.66	24338	12.40	32773	15.56	38609	17.76	36564	16.14

Notes: n.a.- Not available, figures are percentage to total area under crop.

Source: Season and Crop reports of Maharashtra State (various issues).

Table 2.21: Cropwise share in GCA and GIA in Maharashtra (Triennium ending averages)

Crops	TE 1962-63		TE 1972-73		TE 1982-83		TE 1992-93		TE 2000-01		TE 2004-05	
	% GCA	% GIA	% GCA	% GIA	% GCA	% GIA	% GCA	% GIA	% GCA	% GIA	% GCA	% GIA
Rice	6.96	21.96	7.46	21.00	7.49	16.35	7.50	12.50	6.97	11.17	6.71	10.08
Maize	0.15	0.84	0.22	1.08	0.32	1.03	0.62	1.16	1.37	1.25	1.73	0.79
Jowar	32.71	22.61	31.98	16.51	33.16	18.41	28.00	14.37	22.35	13.25	20.61	9.08
Bajra	8.80	2.65	8.88	2.88	8.08	2.14	9.13	2.20	8.10	2.38	6.48	2.00
Ragi	1.18	0.00	1.05	0.00	1.07	0.00	0.94	0.00	0.72	0.00	0.64	n.a.
Wheat	4.74	11.29	4.64	17.65	5.16	21.25	3.48	15.96	4.29	16.01	3.07	16.89
Total Cereals	55.60	58.88	55.21	59.27	56.14	59.32	50.20	46.24	44.68	44.07	39.74	38.31
Udid (Black Gram)	2.29	0.03	2.55	0.02	2.21	0.04	2.08	0.03	2.61	0.01	2.50	n.a.
Tur (Red Gram)	2.88	0.19	3.03	0.07	3.29	0.11	4.80	0.16	4.87	0.48	4.68	0.51
Gram (Bengal Gram)	2.07	2.83	1.86	3.09	2.04	3.52	2.68	5.76	4.00	6.32	3.01	6.90
Mung (Green Gram)	2.15	0.30	2.42	0.06	2.73	0.31	3.58	0.67	3.18	0.07	2.99	n.a.
Total Pulses	12.60	3.39	12.95	3.41	13.58	4.19	15.39	6.95	16.52	7.13	15.26	6.90
Total Foodgrains	68.13	62.27	68.16	62.68	69.72	63.51	65.60	53.19	61.20	51.19	55.00	45.21
Groundnut	5.88	1.05	4.75	1.42	3.37	2.80	3.58	5.89	2.41	3.83	1.79	1.99
Sesamum	0.00	0.06	0.38	0.02	0.68	0.14	1.38	0.07	0.65	0.00	0.51	n.a.
Safflower	1.72	0.00	2.42	0.13	2.42	0.15	2.36	0.14	1.48	0.01	1.12	n.a.
Soybean	0.00	0.00	0.00	0.00	0.00	0.00	1.30	0.24	2.74	0.22	7.28	0.41
Sunflower	0.00	0.00	0.00	0.00	0.26	0.00	2.11	2.79	4.02	2.41	1.30	1.99
Total Oil seed	10.11	1.59	9.60	1.97	8.50	3.64	12.18	9.57	12.22	6.88	12.62	5.78
Cotton	13.80	3.77	14.53	4.46	13.16	4.35	12.75	2.78	14.56	3.19	12.37	2.12
Sugarcane	0.78	11.77	1.12	12.94	1.83	14.76	2.63	16.91	3.00	16.87	1.98	13.84
Chillies	0.83	5.23	0.78	3.72	0.71	2.57	0.60	2.77	0.48	2.73	0.45	n.a.
Condiments & Spices	1.07	5.87	1.00	4.56	0.91	3.30	0.79	3.83	0.65	3.61	0.94	n.a.
Total Fruits	0.37	0.00	0.52	4.65	0.69	4.19	1.22	6.13	1.97	8.56	5.81	n.a.
Total Vegetables	0.42	0.80	0.59	6.01	0.74	4.70	1.19	5.96	1.38	7.21	1.61	n.a.

Note: n.a. - Not available.

Source: Season and Crop reports of Maharashtra State (various issues), Office of the Commissionerate of Agriculture, Govt. of Maharashtra, Pune and <http://agricoop.nic.in>.

2.9 Changing Cost Structure of Principle Crops in Maharashtra

We have seen deceleration in agricultural output in the state, which may be due to stagnating or declining profitability per hectare of some important crops in Maharashtra. This may be due to an increase in fixed costs, over capitalization of farm operations, an increase in the rent per acre and decrease in subsidies (Kalamkar, 2003). The recently announced National Agricultural Policy (2002) and State Agricultural Policy (1996) has indicated that the subsidies on inputs may be rationalized, as a result of which farming operations are becoming more expensive and accentuate the trends in declining profitability. Cost of cultivation is one of the important factors which are taken into account by CACP in formulating the Minimum Support Price (MSP) Policy.

The annual growth rates of cost, price and profit margin per quintal of cotton, sugarcane and jowar crops in Maharashtra is presented in Table 2.22. It could be seen from the table that the annual growth rate of cost of cotton, sugarcane and Jowar is 8.45, 7.09 and 9.57 per cent respectively, whereas the growth rate of price of these crops was 7.83, 9.28 and 7.38 per cent respectively during 1995-98 over 1981-84. The growth rate of cost and price was very low during 1980's. There has, however, been a significant increase in the growth rate of both the cost and the price in the 1990's. But the growth rate of cost is higher than price, which made the farming non-economical/non-profitable. In case of Cotton and Jowar, there was huge loss to the farmers (Kalamkar, 2003). This may be one of the probable reasons for suicidal death of the cotton growers in Maharashtra.

Table 2.22: Growth Rates of Cost, Price and Profit Margin per quintal of Cotton, Sugarcane and Jowar Crops in Maharashtra (per cent per annum)

Period	Cotton			Sugarcane			Jowar		
	Cost	Price	Profit	Cost	Price	Profit	Cost	Price	Profit
1988-91 over 1981-84	1.79	4.66	2.87	3.35	6.65	3.30	0.77	4.59	3.82
1995-98 over 1988-91	15.55	11.09	-4.45	10.97	11.97	1.00	19.13	10.25	-8.88
1995-98 over 1981-84	8.45	7.83	-0.62	7.09	9.28	2.19	9.57	7.38	-2.19

Source: Kalamkar (2003c).

Because of high instability in income, increased input costs and less profit margin, the debt burden on the farmers of the state has been increasing. This is because most of the marginal and small farmers try to experiment and take risks, but they are not able to visualize that a bad monsoon leading to a crop failure or a

glut in the market, which pushes them into indebtedness. The recent farmer suicides in Vidarbha and Marathawada have once again highlighted the disturbing reality of widening regional disparity in Maharashtra. As per the results of the 59th Round of NSS under '*Situation Assessment Survey of Farmers*', the annual income (includes wages, cultivation, farming of animals and non-farm business income) of the farmers household of Maharashtra state was Rs. 29556, which was higher than all India average (Rs. 25380/-). The income from the cultivation accounts for 51.28 percent in the state income, while corresponding figure was 45.82 at all India level. Though the annual net cultivation income was higher than cultivation expenditure at state as well as national level, but the consumption expenditure was higher than total income, indicates that income from all sources are not adequate to meet the expenses of the households. Then question arises that how do farmers manage other expenditure when the income is not enough to meet their consumption need? That means farmers must be possibly taking loan from various sources so as to meet the consumption as well as productive expenditure of the households (Narayanamoorthy, 2006). Therefore, it is important to see the trends in cost of cultivation of major crops during last three decades.

Jowar is the main coarse cereal crops grown in the state and accounts more than 20 percent share in gross cropped area. Though it is low value crops, it is grown extensively in almost all the divisions of the state, except Konkan division. Table 2.23 presents per hectare cost structure of Jowar crop in Maharashtra. It can be seen from the table that per hectare cost structure of Jowar has been changing and Cost C3 increased by 14 times during last three and half decades. The per hectare cost of cultivation of Jowar has increased from Rs. 716 in 1970s to Rs. 11722 in 2001-05. The cost on manure and insecticides has increased hardly between 1 to 3 times over 1970s, however machine labour cost has increased significantly (by 95 times) followed by irrigation, fertiliser and human labour cost.

Bajra crop is grown extensively in four division, viz. Kolhapur, Pune, Nashik and Aurangabad divisions of the state, which accounts for about 6 percent area in gross cropped area of the state. Trend in cost structure of bajra crop in Maharashtra is presented in Table 2.24. As seen in Jowar crop, since 1980s machine labour cost has increased significantly in case of bajra also. Seed cost has also increased almost seven times during two and half decades.

Table 2.23: Trends in Per Hectare Cost Structure of Jewar Crop in the Maharashtra State: 1970-71 to 2004-05 (Rs. /ha)

Crop	1970-71 to 1979-80	1980-81 to 1989-90	1990-91 to 1999-00	2000-2001 to 2004-05	1990-91 to 2004-05
Traditional Inputs					
Land	143.50	389.02	1503.42	1862.89	1703.13
Seed	24.66	51.49	251.40	315.23	286.86
Manure	45.99	66.54	112.32	166.64	142.50
Human Labour	199.27	521.20	2683.48	3316.16	3034.97
Bullock Labour	155.93	339.81	1139.20	2625.09	1964.69
Modern Inputs					
Insecticides	1.46	2.78	1.50	2.57	2.10
Irrigation Charges	8.99	34.74	129.40	327.60	239.51
Fertilisers	32.30	114.04	558.08	725.94	651.34
Machine labour	5.74	42.31	418.12	645.20	544.28
Others*	22.45	39.20	150.68	235.58	197.85
Dep. and FC Interest	76.03	272.13	988.48	1499.32	1272.28
Paid out cost A1	329.28	1052.96	4536.18	7260.62	6049.76
Total Cost C3	716.32	1873.35	7936.23	11722.23	10039.56

Notes: * includes interest on working Capital, Land revenue, cesses and taxes and miscellaneous charges; Depreciation on implements & Farm buildings and Interest on fixed capital; Cost C1= All actual expenses in cash and kind incurred in production by owner; Cost C1= Cost B1+imputed value of Family Labour; Cost C2= Cost B2+imputed value of Family Labour; Cost C2* = Cost C2 estimated by taking into account statutory minimum or actual wage whichever is higher: Cost C3=Cost C2* +10% of Cost C2* on account of managerial functions performed by farmer.

Source: CACP (various years).

Table 2.24: Trends in Per Hectare Cost Structure of Bajra Crop in the Maharashtra State: 1970-71 to 2004-05 (Rs./ha)

Crop	1980-81 to 1989-90	1990-91 to 1999-00	2000-2001 to 2004-05	1990-91 to 2004-05
Traditional Inputs				
Land	353.99	950.79	1560.66	1255.72
Seed	36.40	156.71	324.06	240.38
Manure	92.58	145.83	443.48	294.65
Human Labour	555.40	1915.57	3167.40	2541.49
Bullock Labour	420.52	1039.14	3241.29	2140.22
Modern Inputs				
Insecticides	0.00	0.07	0.05	0.06
Irrigation Charges	24.41	48.46	150.94	99.70
Fertilisers	99.14	418.70	564.05	491.38
Machine labour	52.87	347.20	929.82	638.51
Others*	37.64	115.84	246.16	181.00
Dep. and FC Interest	422.48	705.09	1004.00	854.54
Paid out cost A1	1170.11	3639.19	8046.06	5842.63
Total Cost C3	2095.43	5863.37	11631.89	8747.63

Notes and Source: Same as in Table 2.23.

The other two major cereal crops are Maize and Ragi. Maize is mostly grown in Western Maharashtra; however Ragi crop grown in Konkan region, occupies about 1.73 and 0.64 percent share in gross cropped area of the state respectively,

during the period in triennium endings 2004-05. The cost structure for both the crops is not reported by the CACP for the Maharashtra state in their report.

After analyzing the cost structure for coarse cereal crops, let us see the changes in same for pulse crops. Maharashtra state accounts for 16.20 percent of total pulses production of the country and rank second after Madhya Pradesh during the year 2006-07. However, productivity of total pulses in the state is very low (602 kg/ha) as compared to other states as well as national average (612 kg/ha). The major pulse crops grown in the state are Tur, Udid, Mung and Gram. The cost structure for Tur crop is presented in Table 2.25. It can be seen from the table that irrigation charges followed by machine charges and bullock charges increased at higher rate. Tur crop is grown generally mixed crop with cotton, soybean. After harvesting of main crop, farmers generally give one or two protective irrigation, because of which irrigation charges may have increased. Land cost is relatively high for this crop as compared to coarse cereals.

Table 2.25: Trends in Per Hectare Cost Structure of Tur Crop in the Maharashtra State: 1970-71 to 2004-05 (Rs./ha)

Crop	1990-91 to 1999-00	2000-2001 to 2004-05	1990-91 to 2004-05
Traditional Inputs			
Land	2032.87	2612.88	2355.10
Seed	356.94	467.79	418.52
Manure	59.38	98.35	81.03
Human Labour	2197.49	3233.70	2773.16
Bullock Labour	615.14	2553.79	1692.17
Modern Inputs			
Insecticides	65.65	70.61	68.41
Irrigation Charges	11.23	82.63	50.90
Fertilisers	210.12	460.39	349.16
Machine labour	124.65	420.13	288.81
Others*	119.29	243.11	188.08
Dep. and FC Interest	1449.24	2059.16	1788.09
Paid out cost A1	3216.36	6855.26	5237.97
Total Cost C3	7242.00	12322.54	10064.52

Notes and Source: Same as in Table 2.23.

The change in cost structure of Moong crop is presented in Table 2.26. It can be seen from the table that there was not much change in case cost of human labour, manure, land, insecticides, irrigation charges, fertilisers. The bullock labour and seed cost has increased marginally during the period 1991 to 2005. As this crops is low duration crop and generally grown as inter crop with Cotton mostly in Amravati division and no special attention is paid for cultivation of same. That is

why the cost structure is almost stable during last one and half decade. Trends in per hectare cost structure of Udid crop in the Maharashtra state is presented in Table 2.27. It can be seen from the table that cost on machine labour, fertislers, human and bullock labour, seed and insecticide has increased. The cost of cultivation of Udid crop in the state is around Rs. 6500 per hectare.

Table 2.26: Trends in Per Hectare Cost Structure of **Moong** Crop in the Maharashtra State: 1970-71 to 2004-05 (Rs./ha)

Crop	1990-91 to 1999-00	2000-2001 to 2004-05	1990-91 to 2004-05
Traditional Inputs			
Land	1024.54	1190.55	1100.00
Seed	345.62	516.71	423.39
Manure	67.92	69.11	68.46
Human Labcur	1723.96	2245.82	1961.17
Bullock Labour	914.72	2424.76	1601.10
Modern Inputs			
Insecticides	15.29	14.27	14.78
Irrigation Charges	4.69	6.27	5.48
Fertilisers	383.89	564.28	465.89
Machine labour	135.91	369.65	242.16
Others*	106.67	188.12	143.69
Dep. and FC Interest	440.39	904.80	651.48
Paid out cost A1	3263.84	5882.26	4454.03
Total Cost C3	5160.27	8494.33	6675.75

Notes and Source: Same as in Table 2.23.

Table 2.27: Trends in Per Hectare Cost Structure of **Udid** Crop in the Maharashtra State: 1970-71 to 2004-05 (Rs./ha)

Crop	1980-81 to 1989-90	1990-91 to 1999-00	2000-2001 to 2004-05	1990-91 to 2004-05
Traditional Inputs				
Land	212.27	870.34	1213.29	1013.24
Seed	111.32	322.32	567.83	424.61
Manure	18.08	68.19	130.51	94.16
Human Labour	364.07	1576.54	2351.04	1899.25
Bullock Labour	298.63	846.98	2385.06	1487.85
Modern Inputs				
Insecticides	0.96	34.32	33.41	33.91
Irrigation Charges	0.00	1.07	0.36	0.68
Fertilisers	98.45	416.22	724.80	544.80
Machine labour	3.31	96.75	335.47	196.22
Others*	30.81	104.10	197.60	146.60
Dep. and FC Interest	166.00	425.43	942.27	640.78
Paid out cost A1	826.76	3023.50	6097.26	4304.23
Total Cost C3	1303.90	4752.18	8881.64	6472.79

Notes and Source: Same as in Table 2.23.

As the data on cost structure for gram crop is available from the year 2002-03, the average of three years is presented in Table 2.28. Per hectare cost of cultivation of gram crop was about Rs. 11700/-, which is much higher as compared to other pulse crops. Gram crop is grown in rabi season and its seed cost and irrigation cost is higher than other pulse crops.

Table 2.28: Trends in Per Hectare Cost Structure of **Gram** Crop in the Maharashtra State: 1970-71 to 2004-05 (Rs./ha)

Crop	2000-2001 to 2004-05	1990-91 to 2004-05
Traditional Inputs		
Land	2121.07	2121.07
Seed	1435.95	1435.95
Manure	0.89	0.89
Human Labour	2758.85	2758.85
Bullock Labour	1070.04	1070.04
Modern Inputs		
Insecticides	71.94	71.94
Irrigation Charges	790.60	790.60
Fertilisers	485.75	485.75
Machine labour	892.86	892.86
Others*	211.85	211.85
Dep. and FC Interest	1857.78	1857.78
Paid out cost A1	6648.67	6648.67
Total Cost C3	11697.27	11697.27

Notes and Source: Same as in Table 2.23.

Though oilseed crops accounts for about more than 12 percent gross cropped area of the state in 2004-05, its contribution in total national oilseed production has decreased during last some years. Among the oilseed crops, Soybean, Sunflower, Safflower and Groundnut are the major oilseed crops grown in different regions of the state. The trend in per hectare cost structure of groundnut is presented in Table 2.29. The cost of cultivation of groundnut crop has increased from Rs.4422 per hectare in 1980s to Rs. 21926 per hectare in 2001-05. As the productivity of groundnut is almost stagnant between 10 to 12 quintal per hectare since 1990-91, the area under groundnut crop has come down drastically in all the division of the state and presentably it is grown in Pune division. In case of sunflower crop, human and bullock labour cost account significantly followed by cost of land and seed (Table 2.30). The manure cost has increased marginally as we have noticed in other crops.

Table 2.29: Trends in Per Hectare Cost Structure of **Groundnut** Crop in the Maharashtra State: 1970-71 to 2004-05 (Rs./ha)

Crop	1980-81 to 1989-90	1990-91 to 1999-00	2000-2001 to 2005-06	1990-91 to 2005-06
Traditional Inputs				
Land	847.07	2304.16	3093.88	2586.20
Seed	1090.54	2300.34	3077.23	2577.80
Manure	273.43	596.19	1193.50	809.52
Human Labour	922.21	3685.13	7023.81	4877.52
Bullock Labour	492.01	1330.79	2794.61	1853.58
Modern Inputs				
Insecticides	2.84	21.26	0.45	13.83
Irrigation Charges	89.83	209.80	592.29	346.41
Fertilisers	165.59	456.04	799.68	578.77
Machine labour	34.86	230.64	1177.46	568.79
Others*	104.16	243.58	442.99	314.80
Dep. and FC Interest	400.56	910.14	1789.58	1224.22
Paid out cost A1	2902.72	7619.36	14034.94	9910.64
Total Cost C3	4422.43	12288.37	21925.48	15730.19

Notes and Source: Same as in Table 2.23.

Table 2.30: Trends in Per Hectare Cost Structure of **Sunflower** Crop in the Maharashtra State: 1970-71 to 2004-05 (Rs./ha)

Crop	1980-81 to 1989-90	1990-91 to 1999-00	2000-2001 to 2005-06	1990-91 to 2005-06
Traditional Inputs				
Land	529.61	1031.92	1563.58	1209.14
Seed	101.83	597.88	1126.74	774.17
Manure	23.03	123.69	76.89	108.09
Human Labour	427.57	1437.18	2452.42	1775.60
Bullock Labour	299.93	927.85	2872.52	1576.07
Modern Inputs				
Insecticides	0.18	8.49	8.43	8.47
Irrigation Charges	99.56	174.46	477.73	275.55
Fertilisers	59.22	520.09	802.52	614.23
Machine labour	14.62	167.49	482.15	272.38
Others*	34.95	127.98	242.52	166.16
Dep. and FC Interest	179.62	597.40	669.92	621.58
Paid out cost A1	887.98	3725.21	7591.89	5014.10
Total Cost C3	1635.88	5709.90	10775.43	7398.41

Notes and Source: Same as in Table 2.23.

Safflower is another important oilseed crop grown during kharif season. Surprisingly, there was almost no change in the seed cost which is an important input in crop production. Also the cost of manure has become nil and irrigation cost has declined drastically. Therefore, the cost of cultivation of safflower crop has increased marginally from Rs.3535 per hectare in 1980s to Rs. 5620 per hectare in 2001-05.

Table 2.31: Trends in Per Hectare Cost Structure of Safflower Crop in the Maharashtra State: 1970-71 to 2004-5 (Rs./ha)

Crop	1980-81 to 1989-90	1990-91 to 1999-00	2000-2001 to 2004-05	1990-91 to 2004-05
Traditional Inputs				
Land	824.00	703.61	906.44	795.81
Seed	214.01	215.33	225.25	219.84
Manure	103.45	0.00	0.00	0.00
Human Labour	929.62	1193.30	1984.04	1552.73
Bullock Labour	354.47	524.96	1266.50	862.02
Modern Inputs				
Insecticides	5.44	54.60	11.72	35.11
Irrigation Charges	314.24	10.95	1.58	6.26
Fertilisers	425.68	128.30	186.15	154.59
Machine labour	35.70	89.52	97.36	93.09
Others*	154.25	71.73	124.43	95.69
Dep. and FC Interest	226.70	601.97	816.45	699.46
Paid out cost A1	2296.46	2030.55	3396.24	2651.32
Total Cost C3	3535.03	3592.42	5619.91	4514.01

Notes and Source: Same as in Table 2.23.

Soybean is the most important oilseed crop grown in the state. Since 1984-85, soybean crop has introduced and grown in the state and area under this crop is increasing every year. Mostly area under Jowar and cotton crop has been replaced by soybean in Vidarbha and Marathawada region. Therefore, it is important to see the cost structure of soybean crop. It can be seen from the Table 2.32 that seed cost of soybean crop is almost stagnant during last two and half decades, which is lower than groundnut. The human and bullock labour cost followed by land cost accounts heavily in traditional input groups, however, fertiliser and machine labour cost in modern input groups. The average cost of cultivation of soybean crop in the state was Rs.14238 per hectare in 2001-05, which was 50 percent higher than the average cost of cultivation in 1990s, which may be due to increase in paid out cost.

Table 2.32: Trends in Per Hectare Cost Structure of Soybean Crop in the Maharashtra State: 1970-71 to 2004-05 (Rs./ha)

Crop	1990-91 to 1999-00	2000-2001 to 2004-05	1990-91 to 2004-05
Traditional Inputs			
Land	1828.94	2533.81	2220.53
Seed	1339.28	1498.35	1427.65
Manure	132.44	230.23	186.77
Human Labour	2547.53	2979.19	2787.34
Bullock Labour	1236.88	2790.80	2100.17
Modern Inputs			
Insecticides	38.36	94.11	69.33
Irrigation Charges	19.09	79.60	52.71
Fertilisers	753.56	1076.17	932.79
Machine labour	515.86	1315.68	960.20
Others*	197.93	310.57	260.50
Dep. and FC Interest	794.75	1328.95	1091.53
Paid out cost A1	6266.35	9852.60	8258.71
Total Cost C3	9404.62	14237.85	12089.75

Notes and Source: Same as in Table 2.23.

Cotton is one of the important crops, which has been traditionally cultivated in Maharashtra. The area under cotton crop has increased from 2.62 million hectares (mha) in TE 1962-63 to 3.15 mha in TE 2001-02 in Maharashtra. During TE 2001-02, Maharashtra State alone accounted for about 36 percent of India's cotton area, which was about 8.78 million hectares (mha.). Favourable rain and climate condition that exists in certain parts of the State helps the farmers to cultivate the crop extensively. Though cotton crop has been cultivated predominantly in the State, the crop has been facing many constraints, one of which is predominant cultivation under rainfed condition. The coverage of irrigation under cotton crop was only about 2.76 percent in TE 2004-05. Surprisingly, there was no substantial increase in the coverage of irrigation under cotton crop during the last 30 years in the State. It has reported that the cultivation of cotton crop has become uneconomical, which may be one of the reasons for farmers suicides in Vidarbha region of the state. The trend in cost structure of cotton crop is presented in Table 2.33. It can be seen from the table that average cost of cultivation of cotton crop has increased from Rs. 2814/ha in 1980s to 18900/ha in 2001-05, increased by almost seven times over base period. The machine charges and irrigation cost has increased by almost 20 and 15 times

during corresponding years, respectively. Due to uncertain rains and increased gap in tow successive rainfalls, the farmers generally give one or two protective irrigations to the cotton crop due to which irrigation cost may have increased. The cost on insecticide and seed has also shown an increase because of introduction new seed by private companies and increase use of insecticide and pesticide for the control of bollworm and sucking pest attack.

Table 2.33: Trends in Per Hectare Cost Structure of Cotton Crop in the Maharashtra State: 1970-71 to 2004-05 (Rs./ha)

Crop	1980-81 to 1989-90	1990-91 to 1999-00	2000-2001 to 2004-05	1990-91 to 2004-05
Traditional Inputs				
Land	496.48	2677.91	2915.14	2796.52
Seed	164.72	753.04	1231.07	992.06
Manure	186.98	276.31	509.84	393.08
Human Labour	668.28	3625.53	4465.23	4045.38
Bullock Labour	426.00	1341.03	4079.39	2710.21
Modern Inputs				
Insecticides	131.96	803.44	655.94	729.69
Irrigation Charges	30.25	147.14	454.45	300.80
Fertilisers	268.86	1002.14	1345.24	1173.69
Machine labour	34.96	233.62	680.63	481.96
Others*	69.37	230.48	441.84	336.16
Dep. and FC Interest	335.72	1071.48	2120.70	1596.09
Paid out cost A1	1855.80	7377.53	12740.98	10357.23
Total Cost C3	2813.56	12179.89	18899.48	15539.68

Notes and Source: Same as in Table 2.23.

Sugarcane is another important cash crop grown mostly Western Maharashtra region. As we have seen earlier, though sugarcane crop account for around 3 percent gross cropped area, about one fifth of total irrigation water consumed by this crops. The breakup of cost of cultivation of sugarcane crops is presented in Table 2.34. It can be seen from the table that the average cost of cultivation of sugarcane crop has increased substantially by 748 percent in 2001-05 over the base period 1971-80, from Rs. 7158/- per hectare to 60717/- per hectare during the period of three and half decades. As seen in other crops, the machine labour cost has increased by 140 times (or 13926 percent) during period mentioned above, which shows the increase use of tractors and machineries in cultivation and thus mechanization of agriculture in Western Maharashtra region.

Table 2.34: Trends in Per Hectare Cost Structure of Sugarcane Crop in the Maharashtra State: 1970-71 to 2004-05 (Rs./ha)

Crop	1970-71 to 1979-80	1980-81 to 1989-90	1990-91 to 1999-00	2000-2001 to 2004-05	1990-91 to 2004-05
Traditional Inputs					
Land	1811.12	3061.48	6718.13	10808.49	8422.45
Seed	475.43	905.64	1885.75	3273.40	2463.94
Manure	1029.60	362.20	385.18	995.47	639.47
Human Labour	358.30	3927.80	8783.20	16219.32	11881.58
Bullock Labour	202.41	517.18	1198.31	2182.10	1608.22
Modern Inputs					
Insecticides	2.87	12.27	0.35	71.30	39.77
Irrigation Charges	1081.58	1871.42	3410.66	6362.10	4640.43
Fertilisers	1223.37	2140.90	3792.70	6622.34	4971.72
Machine labour	44.24	169.02	1856.48	6205.39	3668.53
Others*	456.39	728.45	1338.30	2537.38	1837.91
Dep. and FC Interest	269.99	638.24	2230.53	5439.75	3567.71
Paid out cost A1	4757.76	9995.65	20440.25	39932.05	28561.83
Total Cost C3	7157.73	14324.09	31599.44	60716.99	43731.75

Notes and Source: Same as in Table 2.23.

Overall, it is observed that the cost of cultivation of all the important crops has increased substantially during last three and half decades. The increase in machine labour was major input cost followed by human and bullock labour, seed and land cost in total cost of cultivation of crops. The manure cost share in total cost of cultivation per hectare has declined and in some cases it has become nil, which may be due to increased use of fertilizers in state agriculture.

2.9 Trend in Agricultural Prices in Maharashtra

In developing countries like India, where agriculture is very dominant, the agricultural prices occupy a key position in the price structure. It plays a dominant role in shaping the pace and pattern of agricultural growth (Thippaiah and Deshpande, 1998). A disquieting feature of the Indian agricultural economy is the uncertain trend in movement of the prices of agricultural commodities and agricultural program always hindered by fluctuations in prices. Thus the agricultural price policy is supposed to play a vital role in augmenting economic development of the state like Maharashtra whose agriculture sector continues to share part of the state's income. It is well known that agricultural prices have a tendency to display wider inter and intra-year fluctuations. Given the functions of agricultural prices, the implication of wider fluctuations remains that the income of producers would

fluctuate more than the fluctuation in output. As a result, not only the producer's price will be depressed in the short run but also the producers' enthusiasm to invest in agriculture to enhance the future production will be dampened. On the other hand, the unrestrained rise in agricultural price would affect the levels of living of the population in the country. It is for these reasons those governments' intervention for price stabilization become necessary. The main objective of the agricultural price policy since 1965 to mid seventies has been to ensure an incentive price to farmers for maximizing their production (Patel and Shiyani, 1997) and to encourage higher investment and production. Towards this ends, minimum support prices for the major agricultural products are announced each year which are fixed after taking into account the recommendation of the Commission for Agricultural Prices (CACP). It is therefore become important to analyze the trend in Minimum Support price, Farm Harvest Price and Wholesale Prices of major commodities in Maharashtra state.

The average annual growth rates of Wholesale Prices Index (WPI), Farm Harvest Prices (FHP) and Minimum Support Prices (MSP) of Major Crops of Maharashtra in different periods is presented in Table 2.35. It can be seen from the Table that during the period 1980-81 to 1989-90, the growth rate of MSP of all the crops was higher than the FHP (in case of rice, growth was almost at same rate). However, growth rate of WPI of the crops was higher than MSP and FHP, except in case of bajra, maize, wheat, groundnut and cotton. During 1990-91 to 2004-05, except wheat (WPI) and cotton (WPI and FHP), all other crops have recorded higher growth in MSP as compared to WPI and FHP. Thus, during 1990-91 to 2004-05, there was significant increase in Minimum Support Prices of agricultural commodities as compared to earlier period (s). Most of the increase in MSP was noticed during last five years. Because of which, the farm harvest prices and wholesale prices of agricultural commodities has increased. However, in addition to Farm Harvest Prices, productivity of the crops have grater bearing on the income of the farmers (Kalamkar, 2004).

Table 2.35: Growth Rates of Wholesale Price Index (WPI), Farm Harvest Prices (FHP) and Minimum Support Prices (MSP) of Major Crops in Different periods

Crops	Period I: 1960-61 to 1966-67			Period II: 1967-68 to 1979-80			Period III: 1980-81 to 1989-90			Period IV: 1990-91 to 2004-05			Overall Period: 1960-61 to 2006-07		
	WPI	FHP	MSP	WPI	FHP	MSP	WPI	FHP	MSP	WPI	FHP	MSP	WPI	FHP	MSP
Rice	2.7**	14.8*	-	6.7*	4.2*	7.5*	6.4*	5.4*	5.3*	2.6**	4.3**	7.1*	7.1*	6.0*	7.6*
Jowar	8.8**	9.5*	-	8.7*	6.5*	5.4*	4.7*	2.0*	3.9*	5.4*	5.8*	7.5*	7.3*	6.2*	6.8*
Bajra	14.1**	14.4*	-	3.8**	3.4*	4.8*	3.0*	3.7*	3.9*	4.4*	5.9*	7.6*	5.9*	5.5*	6.7*
Ragi	7.3	15.4*	-	9.6*	5.8*	5.4*	3.3*	3.4*	3.9*	5.0*	5.2*	7.5*	7.2*	5.8*	6.9*
Maize	-	14.9*	-		4.0**	5.1*	-	3.6*	3.9*	4.7*	5.3*	7.4*	-	5.7*	6.9*
Wheat	13.0*	16.4*	-	4.9*	3.4**	6.1*	3.2*	3.7*	4.4*	7.6*	5.5*	7.3*	6.2*	5.6*	7.0*
Tur	18.2*	15.8*	-	9.9*	10.2*	-	8.8*	4.9*	8.6*	3.1*	5.1*	7.6*	8.5*	8.5*	9.1*
Gram	26.3*	23.7*	-	8.8*	6.0*	-	9.9*	5.7*	7.1*	8.1*	6.6*	8.1*	8.5*	7.6*	9.4*
Mung	18.5*		-	10.7*	-	-	8.6*	-	7.6*	6.1*	-	7.7*	8.6*	-	8.9*
Udid	15.4*		-	8.4*	-	-	11.4*	-	7.9*	5.1*	-	7.7*	8.5*	-	8.9*
Groundnut	13.6*	14.8**	-	9.0*	7.2*	-	7.5*	4.8*	8.0*	4.9*	2.8*	6.5*	8.5*	7.4*	8.6*
Sesamum	-	11.9	-	-	7.5*	-	-	5.6*	-	4.6*	3.9*	-	4.6*	7.5*	-
Safflower	-		-	-		-	-	-	-	4.4*	-	7.0*	4.4*	-	7.5*
Sunflower	-		-	-		-	-	-	10.1*	3.1*	-	5.0*	3.1*	-	8.5*
Soybean	-		-	-		-	-	-	5.0*	4.3*	-	6.1*	4.3*	-	7.1*
Cotton	8.7*	5.2***	-	7.5*	10.6*	-	2.4**	1.3**	4.1*	8.7*	8.7*	6.9*	8.7*	7.3*	7.1*
Sugar raw	12.1**	14.2*	-	5.5**	3.6	3.7*	7.6*	3.1	6.2*	3.8*	4.1*	8.1*	7.5*	6.6*	7.1*
Chillies	11.8*	7.1	-	8.5*	8.9*	-	7.5*	5.6*		1.5*	3.3*		7.6*	6.2*	-

Notes: *, ** and *** are significant at 1, 5 and 10 per cent level, respectively; WPI- As per the availability of data, growth rates are calculated for the period 1961-67, 1968-80, 1981-90, 1991-2001 and 1961-2004 (2004-05): Overall Period – Figures in Italic (for Sesamum, Safflower, Sunflower and Soybean) are for 1990-91 to 2004-05.

MSP-Overall Period- Paddy, Wheat, Jowar, bajra and Maize- 1964-65 to 2004-05; Ragi- 1968-69 to 2004-05; Moog and Tur 1978-79 to 2004-05; Gram 1975-76 to 2004-05; Udid 1979-80 to 2004-05; Groundnut and Sunflower: 1976-77 to 2004-05; Soybean and Cotton 1977-78 to 2004-05; Safflower 1986-87 to 2004-05 and Sugarcane 1967-68 to 2004-05; Cotton 1974- Cotton average Monopoly Procurement price.

Sources: GOI (various issues of *Agricultural Prices in India*), GOI (various issues of *Agricultural Statistics at a Glance*), <http://agricoop.nic.in>

2.11 Capital Formation in Agriculture:

Investment in agriculture is essential for increasing as well as sustaining the overall growth of agriculture. Public sector investment in agriculture is essential because it stimulates private sector investment, as has been proved by various studies in India (see, Rath 1989; Mishra and Chand 1995; Dhawan 1998). Development planning in Maharashtra began with the third five year plan in 1961. The objectives of the various plans followed by the state since then has aimed at employment generation, containment of population, development of infrastructure, agriculture, industry, poverty alleviation and reducing disparities. The economy of the state has made commendable progress in various sectors during the plan periods. The sectoral distribution of plan expenditure in the state is given in the Table 2.36. Plan expenditures from three heads namely (i) agriculture and allied activities, (ii) rural development, (iii) irrigation and flood control, altogether from third plan to tenth plan period, about Rs. 65575 crore (in current prices) have been spent on the above mentioned three heads. Though these three heads altogether accounted for about 44 percent in the total plan expenditure from third plan to tenth plan period, the share of agriculture and allied services has sharply declined from 30.87 percent in third plan to 3.47 percent in tenth plan in Maharashtra. Unlike the agriculture and allied services, the plan expenditure in irrigation and flood control has sharply increased from 14.87 percent in third plan to nearly 37 percent in ninth plan and then decreased to about 28 percent in tenth plan in Maharashtra. This is in contrast to the national level picture, where the same share has declined from 7.8 percent to around 6.5 percent during this period. Considering the vast rainfed cultivated areas and also the importance of irrigation in agricultural growth, the state government has been giving top priority to exploit the available irrigation potential. This naturally requires more investment and therefore, investment in irrigation and flood control has increased substantially over the plan periods in Maharashtra. One needs to study how far this investment in irrigation has translated into irrigated area in the state.

The nexus between capital formation and agricultural growth, and agricultural growth and poverty alleviation are very well articulated in literature. Given the positive impact of agricultural growth on poverty alleviation, the role of capital formation as one of the major engines of agricultural growth has been well

Table 2.36: Sectoral distribution of Plan Expenditure in the Maharashtra State

(Rs. in Crore)

Sr. No	Five Year Plan Schemes	Agriculture and Allied Services	Rural Development	Irrigation and Flood Control	Power Development	Industry and Minerals	Transport and Communication	Others	Total (3 to 9)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	3 rd Plan (1961-66)	134.20 (30.87)	@	64.64 (14.87)	94.71 (21.79)	14.82 (3.41)	37.45 (8.61)	88.91 (20.68)	434.73 (100.00)
2	Three Annual Plans (1966-69)	111.20 (28.77)	@	57.69 (14.92)	115.46 (29.87)	10.64 (2.75)	35.19 (9.10)	56.40 (14.59)	386.58 (100.00)
3	4 th Plan (1969-74)	221.71 (22.07)	@	165.96 (16.52)	283.64 (28.24)	39.62 (3.94)	81.08 (8.07)	212.50 (21.15)	1004.51 (100.00)
4	5 th Plan (1974-79)	343.32 (12.91)	190.70 (7.17)	491.74 (18.49)	910.47 (34.22)	158.69 (3.97)	220.08 (8.27)	345.13 (12.97)	2660.13 (100.00)
5	Annual Plan (1979-80)	64.38 (7.93)	89.45 (11.01)	150.00 (18.47)	299.90 (36.92)	30.03 (3.70)	64.04 (7.88)	114.43 (14.09)	812.23 (100.0)
6	6 th Plan (1980-85)	393.38 (6.01)	894.94 (13.66)	1437.44 (21.95)	1734.76 (26.49)	225.31 (3.44)	422.81 (6.46)	1440.75 (21.99)	6549.39 (100.00)
7	7 th Plan (1985-90)	614.39 (5.56)	1575.86 (14.27)	2239.53 (20.28)	2835.39 (25.67)	420.25 (3.81)	585.77 (5.30)	2773.02 (25.11)	11044.21 (100.00)
8	8 th Plan (1992-97)	1470.60 (5.71)	2836.44 (11.01)	5668.34 (22.01)	5864.09 (22.77)	941.89 (3.66)	2015.36 (7.83)	6954.94 (27.01)	25751.66 (100.00)
9	9 th Plan (1997-2002)	1486.38 (3.33)	4190.88 (9.38)	16383.32 (36.69)	6977.79 (15.63)	474.63 (1.06)	4331.74 (9.70)	10811.43 (24.21)	44656.17 (100.0)
10	10 th Plan (2002-2007)	1918.86 (3.47)	7148.09 (12.92)	15238.14 (27.54)	5300.58 (9.58)	886.24 (1.60)	6442.63 (11.65)	18389.19 (33.24)	55323.72 (100.0)
	Total (3 rd to 10 th Plan)	6758.42 (4.55)	16926.36 (11.39)	41896.8 (28.19)	24416.79 (16.43)	3202.12 (2.15)	14236.15 (9.58)	41186.7 (27.71)	148623.33 (1000.0)

Note: @ included under agriculture and allied services, figures in parenthesis percentage to total.

Source: GOM (2009, Annual Plan 2008-09, Planning Department, Government of Maharashtra).

placed in the development policy perspective (Bisaliah, 2005). The decline in the share of agricultural sector's capital formation in GDP from 2.2 percent in the late 1990s to 1.7 percent in 2004-05 at national level is a matter of concern. This declining share was mainly due to stagnation or fall in public investments in irrigation, particularly since the mid-1990s. The improved availability of credit for agriculture and liberalized trade for agricultural products should enhance private investment in agriculture (indiabudget.nic.in).

Capital formation is one of the basic factors for increasing production. This is all the more important in agriculture where we are faced with the task of increasing production to keep pace with the increase in population against the odds of the vagaries of monsoon. The estimates of gross fixed capital formation at current prices in Maharashtra agriculture is presented in Table 2.37. It can be seen from the table that the Gross Fixed Capital Formation as a percent of agriculture gross state domestic product has declined from 7.4 percent in 1980-81 to 4.3 percent in 2006-07. At national level, the gross capital formation in agriculture as a proportion to the total GDP has shown a decline from 2.9 percent in 2001-02 to 2.5 percent in 2007-08. However, despite increase in the share of public sector, the share of agriculture and allied sector in total Gross Capital formation has declined to 7.0 percent in 2006-07 from 11.7 percent in 2001-02 at national level (GOI, 2009).

Table 2.37: Estimates of Gross Fixed Capital Formation (GFCF) at Current Prices in Agriculture of Maharashtra State (1980-81 to 2006-07) (Rupees in lakh)-1993-94 series

Year	Private Sector	Public Sector	Total Agriculture	GSDP at Current Prices	GFCF as Per cent of Agriculture GSDP
1980-81	105432	17495	122927	1663127	7.4
1985-86	210345	34364	244709	2961625	8.3
1990-91	394415	57135	451550	6443326	7.0
1995-96	885288	161793	1047081	15781814	6.6
2000-01	1279100	227622	1506722	25064189	6.0
2005-06	1631548	250981	1882529	43241313	4.4
2006-07	1840687	336348	2177035	50883600	4.3
GR (1980-81 to 2005-06)	11.4*	9.5*	11.2*	13.7*	-2.5*

Notes: Agriculture (Private sector) revised as per AIDIS report 1991-92 & 2002-03; Private sector live stock from 1980-81 is A. H. Live stock Gross Value of Output (At Current price); Data are provisional from the year 1999-2000 to 2006-07; GR-Exponential Growth rate - per cent per annum; * significant at 1 per cent level.

Source: EPWRF (2009) and Economic Survey of Maharashtra 2008-09 (Directorate of Economics and Statistics, Government of Maharashtra).

Public investments in the agricultural sector in India declined steadily in absolute terms and as a share of total investments since mid 1980s. This decline has serious implications for the sector's longer term growth prospects¹². The growing subsidy requirement of the sector accounts largely for declined public investment in this sector. In 1999-2000, public investments amounted to only about 14 percent of agricultural subsidies (including foodgrains, fertiliser, canal irrigation and power subsidies). This decline will have a negative impact on private investments over the longer term also, due to the inducement effect of public investments on private investments (World Bank, 2004).

Table 2.38: Capital Expenditure on Agriculture and Allied heads, 1974-75 to 1996-97: Maharashtra and India

Particulars	1974-75 to 1978-79	1980-81 to 1984-85	1985-86 to 1989-90	1990-91 to 1991-92	1992-93 to 1996- 97
	5 th Plan	6 th Plan	7 th Plan	Annual Plans	8 th Plan
At current prices (Rs Crore/year)					
Maharashtra	423	785	1241	1559	2206
India	2588	4797	6141	7892	11694
at 1980-81 prices, (Rs Crore/year)					
Maharashtra	727	599	549	527	489
India	4383	3637	2758	2653	2666
Per hectare of net sown area at constant prices (Rupees per year)					
Maharashtra	399	328	304	295	275
India	311	258	197	187	188
As percent of NSDP Agriculture at current prices					
Maharashtra	16.84	18.12	16.66	13.33	9.69
India	9.22	9.55	7.40	5.82	5.40
as percent of NSDP total at current prices					
Maharashtra	4.82	4.16	3.46	2.52	1.88
India	4.06	3.56	2.48	1.92	1.44
Percent Share in All India Capital Expenditure on agriculture					
Maharashtra	16.32	16.38	20.19	19.76	18.44

Source: NCAP (2000), New Delhi

Public investment in agriculture in India is funded by state governments and the union government. The evidence of the behaviour of public investment for Indian agriculture during 1974-75 to 1996-97 is estimated in Policy Paper No. 11 of National Centre for Agricultural Economics and Policy Research (NCAP), New Delhi (NCAP, 2002), which are presented in Table 2.38. It can be seen from the table that the total public investment at state level and country level at current prices steadily increased from Rs.423 and Rs. 2588 crore during 5th Five Year Plan

¹² One estimate shows that a 10 percent decrease in public investments (including irrigation and power) leads to a 2.4 percent reduction in agricultural GDP growth (World Bank, 2004).

period to Rs. 2206 and Rs.964 crore during 8th Five year plan period, respectively. However, capital expenditure on agriculture at 1980-81 prices for the state and country as a whole showed decline throughout after 1974-75 to 1978-79. The decline was very sharp during sixth and seventh five year plans. In case of capital expenditure per hectare of net sown area, it decline over the period of time at state as well as national level. Though capital expenditure as percent share of NSDP agriculture and NSDP total at current prices decline at state level, its percent share in all India capital expenditure on agriculture has increased from 16.32 percent during fifth five year plan to 18.44 percent in eighth plan.

The Public expenditure in Maharashtra is classified into revenue expenditure and capital expenditure¹³. The Capital expenditure on Agriculture and allied heads in presented in Table 2.39. It can be seen from the table that capital expenditure on agriculture and allied heads has increased in absolute terms over the period of time. The capital expenditure on agriculture and allied heads per net sown area has increased at current prices from Rs. 37.59 in 1980-81 to Rs. 44.22 in 1990-91, Rs. 235.35 in 2000-01 and Rs. 466.82 in 2007-08. However, the share of budget expenditure on agriculture has declined from 14.22 percent to 11.97 percent, 5.45 percent and 4.22 in corresponding years. The increase in capital expenditure per hectare of net sown area may be due to stagnant/decline net sown during last two decades. The net sown area in the state has declined marginally by 2.92 percent in 2006-07 over the base year 1980-81, from 18 million ha in 1980-81 to 17.48 million hectares in 2006-07. In order to achieve positive agricultural growth, capital formation in agriculture should be enhanced through strengthening market infrastructure, more focus on micro irrigation, micro finance, micro insurance and rural credit. Also there is a need to introduce national scheme for the repair, renovation and restoration of water bodies and set up knowledge centre in every village to reduce gap between technology transfers from lab to field.

¹³ Revenue expenditure is an amount that is expensed immediately and refers to items that are consumer and only last a limited period of time. In case of agriculture, revenue expenditure would include wages and salaries of government officials involved in the agricultural sector, operational expenses of the government related to agriculture and also government subsidies to agriculture. In contrast, capital expenditure is an amount spent to acquire or improve long terms assets. It is purchase of items which will last and be used time and again. Examples in agriculture are public irrigation works such as canals, electric pumps, etc. Thus distinction between revenue and capital expenditure is important. Capital expenditure has a lasting impact on the economy and helps to create a more productive and efficient economy (Shroff and Kajale, 2009).

Table 2.39: Public Investments in Agriculture in Maharashtra

Year	Capital Expenditure on Agriculture and Allied heads (Rs. Crore/year)		Capital Expenditure on Agriculture and Allied heads per hectare of Net Sown Area heads (Rs. /year)		Share of Budget Expenditure on agriculture
	at current prices	at 1980-81 prices	at current prices	at 1980-81 prices	
1980-81	68.79	68.79	37.59	20.87	14.22
1985-86	102.15	151.69	56.64	31.08	14.58
1990-91	82.09	97.96	44.22	23.82	11.97
1995-96	337.85	1659.29	187.90	104.51	7.34
2000-01	415.06	2504.36	235.35	131.89	5.45
2005-06	325.87	1543.70	186.50	106.73	3.78
2007-08	815.66	9671.48	466.82	267.17	4.22
GR (1980-81 to 2007-08)	10.7*	21.3*	10.9*	11.0*	-5.6*

Notes: GR-Exponential Growth rate - per cent per annum; * significant at 1 per cent level.

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

Terms of Trade in Agriculture:

The reform strategy for agriculture relied on making terms of trade (TOT) favorable to the sector by reducing protection to industry and trade liberalization. These favorable relative prices are expected to attract investible resources into agriculture and lead to higher growth of agricultural production. The index of TOT (with base TE 1990-91) deteriorated at national level from 106.6 in 1994-95 to 100.3 in 2004-05 (CACP, 2008). As per World Bank (2003) report, Terms of Trade in recent years have moved slightly against agriculture in Maharashtra. The index of output prices have risen by 50 percent during 1993-94 to 1999-2000 (as indicated by the state agricultural income implicit deflator), while the index of prices of all inputs taken together have risen by 56 percent during the same period (Table 2.40)

Table 2.40: Terms of Trade for Agriculture in Maharashtra

Year	Output price Index in Agriculture	Input Price Index in agriculture	Terms of Trade (output price/input price)
1993-94	100.0	100.0	100.0
1994-95	113.1	110.6	102.3
1995-96	121.9	117.6	103.7
1996-97	130.2	131.6	99.0
1997-98	141.3	142.4	99.3
1998-99	148.4	150.9	98.4
1999-00	150.1	156.1	96.2

Source: Derived from value of output and inputs as reported by the Maharashtra Directorate of Economics and Statistics (as mentioned in World Bank, 2003).

Measurement of Growth and Stagnation in Crop Productivity

3.1: Introduction

Economic development of India largely depends on the performance of its agriculture. Study of agricultural development assumes importance in this context. Adoption of green revolution technology, which is considered a watershed event in the post-independence agriculture era in India, has attracted special interest of researchers in terms of its impact on growth and instability of farm output. It is widely acknowledged that the new and improved technology helped India in achieving substantial increase in food production in a short period and brought the country close to attaining food self sufficiency by the early 1980s (Chand and Raju, 2009). However, the slow growth of agriculture recorded in the recent years has been a matter of concern among the policy makers, as agricultural growth plays a crucial role in improving rural employment and reducing rural poverty. The National Agriculture Policy approved by the Government of India during 2000, aimed to achieve annual growth of more than 4 per cent in the agriculture sector on a sustainable basis, through the efficient use of natural resources and combination of other measures. However, the annual growth rate achieved during the Tenth Five Year Plan averaged around 2.3 per cent. On the other hand the non-farm sector has grown faster. Considering the high growth of GDP in the recent past, a major reorientation in the policy is necessary to make this growth more inclusive. The decline in agricultural growth coupled with declining profitability in the agriculture sector, in the face of rapid growth of non-farm sector, is one of the major concerns. The declining profitability is partially due to fluctuating world prices of agricultural commodities and the efforts to keep the domestic prices low to protect consumers' interest, which resulted in decline in the terms of trade for the farm sector. This, coupled with the stagnating and declining yield levels, resulted in low income to the farmers (GOI, 2007b). The results of the study of agricultural development help the policy makers to formulate policies pertaining to the various aspects of increasing agricultural production. Therefore, it is important to take review of the past studies on measurement of growth and fluctuations.

3.2 Review of Literatures/Studies on Measurement of Growth & Fluctuations:

There have been a large number of studies examining the growth and fluctuation of agriculture growth and factors that have contributed to the growth of agriculture at region/state level as well as national level. Many research workers have directed their efforts towards evaluating the pace, pattern and impact of agricultural development either at the micro or macro level. Some of the selected studies are reviewed and presented. On the basis of methodology used towards measurement of growth, the literature is classified into three segments.

Growth and Instability in Area, Production and Productivity of Crops:

Pace of agricultural development of a region can be ascertained through measuring growth in area, production and yield of crops in the region. Agriculture growth and instability has remained the subject of intense debate in the agricultural economies literature in India. While the need for increasing agricultural production is considered adverse for several reasons. It raises the risk involved in farm production and affects farmers' income and decisions to adopt high paying technologies and make investments in farming. Instability in production affects price stability and the consumers, and it increases vulnerability of low income households to market. Instability in agricultural and food production is also important for food management and macro-economic stability (Chand and Raju, 2009).

There are number of studies on measurement of growth in area, production and productivity of crops at state level as well as national level by taking different time period. Most of the studies which covered 10 to 20 years since the adoption of new technology concluded that instability in agricultural production has increased with the adoption of new technology (Mehra, 1981; Hazell, 1982; Ray 1983; Rao *et.al*, 1988). In contrast to the finding in these studies Dev (1987) reported a progressive but marginal decline in instability in foodgrain production at the all India level, and mixed results at state level. All these studies covered the period up to late 1970s or mid 1980s which represents the initial phase of green revolution technology. Another set of studies on instability in Indian agriculture, extended over a longer post green revolution period or, covering the recent years. One of these studies (Larson *et al.*, 2004) concluded that green revolution has been instrumental in increasing production of foodgrains and other crops in India but this has come at a cost of greater instability in production and yield. This study estimated the impact

of green revolution technology on production variability by comparing the instability in agricultural production during the period 1950-51 to 1964-65 with the period 1967-68 to 2001-02.

In his study on sources of variation in agricultural productivity, Mukhopadhyay (1976) shows that conventional measured inputs account for only 40 percent of the variation in farm output among the major wheat growing districts in India during the period 1959-60 to 1968-69. Author documented the important factors associated with space and time to differences in agricultural productivity. Using a new methodology, initially developed by Balestra and Nerlove, Author has been able to partition much of the variation in output that is not explained by measured inputs among regional effects, such as those associated with differences in climate and resources, and time effects such as differential fluctuations in rainfall and other natural factors.

Easter *et al.*, (1977) discussed about the regional differences in agricultural productivity in rice and wheat regions of India for the period 1959-60 to 1968-69. He analyses the contribution to total output of not only the quantity of traditional inputs (land, labor, fertilizer, etc.) but also the quality of certain inputs, particularly irrigation, technology, environmental factors (soil types, rainfall, etc.), and infrastructure (transportation, markets, etc.) by the using of production functions. Authors observed that for the wheat region in India, continued increases in the quantity and quality of irrigation and improved crop varieties are promising sources of output growth. For the rice region, the development of rural roads and markets, increase in irrigation quality, and improved rice varieties are important sources of output growth. Author suggests that attention should be paid to improving roads and related market infrastructure in eastern region of India.

Nadkarni and Deshpande (1982) argue that the problem of unstable productivity in agriculture is of no less importance than the problem of growth in agriculture and instability in productivity or yields per hectare cannot be attributed exclusively to natural or climactic factors. The analysis was carried out for Karnataka state for the period from 1955-56 to 1975-76. Authors noted that concentrated growth efforts in areas with assured rainfall or irrigation can avert increased instability. However, such areas are limited. Indeed, no growth in agriculture could have taken place without farmers taking risks. The major problem

of the farm sector is not unfavorable prices so much as insecurity both on the production and the price fronts.

Sawant (1983) examined the performance of Indian agriculture and observed that deceleration trend in the growth of foodgrains production was set by the beginning of the sixties after an impressive performance of growth during the fifties which was mainly due to expansion in area. Deceleration in the growth of foodgrains production was arrested with the onset of the green revolution in Indian agriculture but reversal of the process of deceleration could not be sustained without interpretation beyond 1970-71. In terms of overall performance during the entire post-green revolution period, Punjab, Maharashtra, Haryana, Andhra Pradesh, Gujarat, and Karnataka did relatively much better than the remaining States. Among them, however, the performance was consistently good and substantive only for Punjab and Andhra Pradesh. The states, which substantially contributed in pushing up the all-India growth rate of foodgrain production particularly in the latter half of the seventies in comparison with the early seventies, were Punjab, Haryana, Maharashtra, Gujarat, Uttar Pradesh, Orissa and Jammu and Kashmir. On the contrary, the contribution of West Bengal, Rajasthan, Madhya Pradesh and Kerala was rather negative due to substantial deterioration in their process of growth since 1975-76. Foodgrains production in Assam and Bihar was almost totally stagnant after 1975-76. The major contribution to relatively accelerated growth in foodgrains production came from wheat followed by rice—that too mainly from the non-traditional rice growing states and Jowar. Among the non-foodgrains, cotton and jute experienced expansion in production at a higher rate during the late seventies but the production of sugarcane and groundnut either declined or remaining stagnant after 1975-76 in quite a few States. In general, the States with accelerated growth in foodgrains production in the latter part of the seventies performed better even in respect of growth in the production of non-foodgrains. The states lagging in the growth of foodgrains production generally failed even in stepping up the production of non-foodgrains, with a very few exception. In general, the growth rates in productivity of many foodgrain and non-foodgrain crops excluding wheat, Jowar and cotton were either higher or almost the same in the pre-green revolution period in comparison with the past 1967-68 period. The period between 1967-68 and 1975-76 was particularly more sluggish with respect to the growth in the productivity of all the major crops except wheat.

The situation improved after 1975-76 due to relatively increased growth rates of yield per hectare of rice, jowar, cotton, and sugarcane, in addition to, of course, wheat. Crops lagging behind were particularly bajra, maize and jute. Increased productivity played a major role in relative acceleration of growth in production of major foodgrains whereas the dominant contribution to relatively increased growth rates in production of groundnut, cotton and jute after 1975-76 was from area.

Bhalla and Tyagi (1989) estimated the spatial pattern of the levels and growth in agricultural output in the country by taking 19 major crops. Authors noted that with the adoption of new seed fertiliser technology, agriculture in major parts of India has undergone a significant transformation. The yield levels of some crops have experienced phenomenal rise, thereby accelerating the growth of agricultural output in states where these crops constitute an important component of cropping pattern. Whereas during 1962-65 to 1970-73, the green revolution was confined to only a few north-western states, it seems to have gradually extended to many other parts of India during the seventies. Punjab, Haryana and western Uttar Pradesh continue to be the main beneficiaries of the gains of new technology. During second period, the green-revolution technology was extended to southern region of Andhra Pradesh and central region of Gujarat. Some negative features of the recent growth pattern are worth noting. Firstly, major eastern states continue to have very low rates of growth in agricultural output. In fact, their growth rates in agriculture are perceptibly lower than their growth rate of population and even male workforce. Secondly, the performance of Tamil Nadu has deteriorated quite significantly. Although drought is being given as the main reason for deceleration, it appears that, of late, investment in infrastructure like irrigation, etc, has not been sustained at the same level as during the earlier period. Thirdly, it appears that the fluctuations in agricultural output continue to be very large in the central states like Maharashtra, Rajasthan and Madhya Pradesh. These negative features have primarily risen because of lack of adequate investments in irrigation and other rural infrastructure. It has been noticed that high level of yield as well as high growth rates are primarily associated with high use of modern inputs. Further, high use of modern inputs is dependent on availability of assured irrigation. Authors suggest that large investments will be required to increase irrigated area as also to undertake watershed management in the central arid region and also much larger attention will have to be paid to research in dry-land farming.

Mitra (1990) examined the growth and instability of agricultural production in Maharashtra for the period 1956-57 through 1984-85. Author observed that the annual compound rate of growth of agricultural production in the state as well as in all the regions, especially that of foodgrains, was relatively higher in the twelve year period ending 1984-85 after a near stagnancy in the sixteen year period ending 1971-72. Further, the overall rate of growth of around 2 per cent per annum in the production of foodgrains has been mainly brought about by growth rate in yield. Sugarcane shows a sustained high rate of growth in production brought about mainly by a steady rate of growth in area, especially in important sugarcane growing region of Poona. Groundnut and Cotton do not show any significant overall growth in production. Sugarcane is the only crop in the state about which it can be said that insofar yield of the crop is concerned a plateau seems to have been reached with the existing technology and that a steady growth rate in production is maintained by a corresponding growth in area under the crop. The analysis indicates that the development of irrigation and associated new technology during the last decade or so has not been effective in curbing the instability in crop production, particularly that of foodgrains, in the state as well as in different regions. As a matter of fact the agro-climatic and soil condition of the whole state is generally suitable for growing inferior cereals, pulses and oilseeds under rainfed condition.

A study by Sawant and Achutan (1995) on agricultural growth performance in India during 1967-68 to 1992-93 argues that there has been a significant upsurge in the production and productivity growth in Indian agriculture which cannot be attributed merely to a favourable weather. The aggregate growth rate in agriculture has remained fairly stable and unchanged in the first two decades of the post-green revolution period. Again unlike the past, enhancement in yield growth had been more impressive for non-foodgrains as compared to food grains and among the foodgrains for kharif foodgrains vis-a-vis the rabi foodgrains. With the wider dispersal of growth across crops and regions, agricultural growth has become more broad-based in recent years.

Ball *et al.*, (1997) described the procedures currently being implemented by the US Department of Agriculture to measure agricultural productivity. The purpose of paper was to describe production accounts for agriculture. They reported indexes of gross output, capital, labor, intermediate inputs, and total factor productivity for

the period 1948 to 1994. Labour input decreased at an average rate of 2.73 per cent per year over the 1948-94 period while capital input increased less than 1 per cent per year. In spite of the decline in labor input and only modest growth in capital input, the agricultural sector managed to record nearly a 2 per cent average annual rate of growth in output. They concluded that productivity growth was the principal factor responsible for economic growth in agriculture.

As analysis of state level data on area and output of 43 crops for 30 years from 1962-65 to 1992-95 was carried out by Bhalla and Singh (1997) and observed that there was a marked acceleration in the growth rate of agricultural output in India during 1980-83 to 1992-95 as compared with the earlier periods. Furthermore, agricultural growth had become regionally much more diversified. High labour productivity growth is likely not only to result in higher wages but also to trigger growth in the non-agricultural sector through input output and consumption linkages. They suggested that there is a need to give very high priority to investment in research and development and extension. Further, there are large potentialities in crop diversification and export and role of small and marginal farmers in this process cannot be underestimated.

Another study by Sawant *et al.*, (1999) noted distressing observation in Maharashtra agriculture that deceleration in the aggregate output and yield growth was accompanied by progressive increase in rates of expansion of many key inputs such as fertilizers, pesticides, electricity, etc. They observed that unfavorable rainfall conditions were only partly responsible for worsening of the growth environment during the 80's. However, crop pattern changes played an important role after 1981 in supporting the process of growth of crop output. Oilseeds were the major beneficiaries of these changes and were followed by other minor high value crops, pulses and sugarcane in descending order. A political commitment to promote investment for development of irrigation and other infrastructure and technologies for agriculture, without neglecting the development backlogs of various regions and districts within them is needed.

Bhalla and Singh (2001) analyzed the growth performance of Indian agriculture at the state and district level during 1962 to 1993 and observed that during 1962-65 to 1980-83, the impact of new technology in transforming traditional agriculture was confined largely, to the north-western and southern regions, and to Gujarat and a few irrigated parts of central and eastern India. These states

recorded high to very high growth in agricultural productivity and output. On the country, most of the rainfed states in the central and the eastern regions were unable to record any significant changes in crop yield and crop output. The period 1980-83 to 1992-95 marks a major departure from the earlier trend in several aspects. First, the growth rate of the value of output not only accelerated during this period, it also spread to many states that had hitherto been left out. In the central region many areas in Rajasthan and Madhya Pradesh, northern Maharashtra, North-western states continued to grow at a respectable rate, nevertheless there took place a slight slowdown in their growth in the 1980s. It clearly comes out that the spread of new technology was rather slow and halting during 1962-65 to 1980-83, and it was only districts in the irrigated north-western states and in the coastal parts of southern and western states that rapid increases in level and growth of output districts in the central states of Rajasthan, Madhya Pradesh, northern parts of Maharashtra, Karnataka and Tamil Nadu were all left out. The obvious result was an increase in region disparities in both the level and growth agricultural output. But during 1980-83 to 1992-95, because of the extension of new seed-fertiliser technology towards the eastern and central regions and its consolidation in north-western and southern regions, there took place a significant acceleration in agricultural output. Thus, during 1980-83 to 1990-93, agricultural output recorded a growth rate of 3.47 per cent per annum compared with only 2.21 per cent annum during the earlier 1962-65 to 1980-83. It further comes out that depicts a great deal of process, during 1990-93, 94 districts with 36.9 per cent share in total area in India continue to be underdeveloped with very low yield below Rs. 3500 per hectare. Most of the low-yield districts are concentrated in Madhya Pradesh, Maharashtra, Rajasthan, and Gujarat in the central region and in Bihar and Orissa in the Eastern region.

A comprehensive analysis of agricultural performance and productivity of Indian agriculture by Kumar (2001) has revealed that the changes in cropping pattern have been taking place as a result of substitution of low productivity crops by those which have shown impressive performance on productivity growth. The yield growth was main factor for output growth in India and a change in cropping pattern has also contributed considerably.

Panda (2002) observed in his study on Maharashtra agriculture that productivity of the different crops in the state is low compared to average yield in

the country except for sugarcane. He concluded that the reasons for this state of affairs are scanty or uncertain rainfall, underdevelopment of irrigation system, lack of wider dispersal of available irrigation water, large uncultivable land, inadequate development of research and extension services, lack of sufficient and timely availability of agricultural inputs and inadequate infrastructure facilities. He suggest that water planning should be undertaken keeping from multi-sectoral perspective. Sugarcane cultivation should be encouraged in water surplus regions like Konkan and eastern part of Nagpur and restrict the growth in Western Maharashtra. Also research outcome in experimental fields needs to be taken, through extension service, to the farmers who are the ultimate users of agricultural R&D. Land survey should be undertaken at the village level to know the physio-chemical properties of the soil and farmers should be guided for choice of right cropping pattern to suit soil and weather, for optimal use of inputs like water, fertilizers and pesticides.

Mahadevan (2003) examines India's productivity growth in the agricultural sector in the context of globalization. He argues that although India missed the opportunity to open up two decades ago, its attempts to do so now must be regarded as better late than never. India has adopted a 'victim mentality' when it really needs to adopt a 'winner mentality' has become less of a concern as over time, India has shown commitment to stay on the bandwagon of globalization. Having realized that globalization is a necessary but not a sufficient condition for high growth production, India has undertaken economic reforms, both internal and external. He suggests that training the farmers and educating them appropriately to change their mindset and reorienting them to take up new activities or adopt foreign technology is of utmost importance. In this context, it is necessary to involve non-governmental organizations in training and mobilizing the rural poor to face the challenge of liberalization.

Chand *et al.*, (2007) examines the trend in agricultural growth and factors underlying the slowdown in agriculture in India. The analysis shows that the initial years of reforms were somewhat favourable for agriculture growth, but the post WTO period witnessed a sharp decline in the growth rate of almost all sub-sectors and commodity groups in the agricultural sector. At the state level, the growth rate has turned negative in four out of 20 major states, while six states shows a growth rate ranging between 0.10 and 0.95 per cent. Further, the growth rate of agriculture in most of the low productivity states was much higher than that the national

average during 1984-85 to 1995-96. However, after 1995-96, their growth rates not only declined but also turned out to be much lower than the national average. The main reasons for deceleration and stagnation in agricultural output after 1995-96 are a slowdown in growth of fertilizer use, irrigation, and energy (electric power) in some cases, stagnation or even a decline in other cases. Diversification towards high value crops has also slowed down and in some cases farmers have been diversifying away from the high value crops towards low value, less risky and less input demanding crops. The terms of trade in agriculture have shown deterioration and agricultural income faces an increased instability in the recent years.

A recent study by Bhalla (2007) presents a review of the performance of the agricultural sector in India since Independence and tries to identify the main factors which are instrumental in accelerating agricultural growth after Independence. He noted that though new seed and fertilizer technology made significant impact on yields of the rice and wheat crops and made the country self-sufficient in food production, however, it also resulted in increasing regional disparities in the level and growth of agricultural output in various parts of the country. Also, the diversification in cropping pattern is more pronounced in the central and southern regions of India.

Chand and Raju (2009) analyzed the instability in Indian agriculture during different phases of technology (1951-65, 1968-88, and 1989-2007) and observed that yield instability was the major source of instability in foodgrain production in most of the states of India. Also, a major factor for interstate variations in instability in area, production and yield seems to be the variation in access to irrigation. Authors suggested that as the spread of improved technology is found to be associated with a decline in variability in production, there is a need to pay special attention to production and distribution of seed of improved varieties to bring stability in production.

Decomposition of Total Agricultural Output Growth:

Decomposition of growth in agricultural output in India has attracted the interest of researchers and policymakers since long. Various attempts have been made to explain the growth in agricultural output in terms of area and yield components. Numbers of additive and multiplicative models have been developed for this purpose. Minhas and Vaidyanathan (1965) were the first to decompose and compute the influence of individual components. They used a four-factor model and

later revised a seven factor decomposition model considering the other interaction terms since the four factor model was not useful when the interaction term is relatively larger. Later, work on the decomposition of growth in agricultural output become more refined and invoked the total productivity concept. Contribution of Evenson and Jha (1973), followed by Dey and Evenson (1991), Sidhu and Byerlee (1992), Kumar and Mrutyunjaya (1992), Rosegrant and Evenson (1992), Dholkia and Dholkia (1993), Kumar and Rosegrant (1994), Evenson *et al.*, (1999), *Fan et al.*, (1999), Ali and Byerlee (1999), Coelli and Rao (2003), Rozelle *et al.*, (2003) and few others have been the important parts of this genre (Kumar and Mittal, 2006).

Component Analysis:

Bhatia and Sinha (1975) studied the relative contribution of different components towards foodgrain production in Uttar Pradesh for the period 1950-51 to 1962-63 and 1960-61 to 1971-72. They observed that the total foodgrain production increased at the rate of 1.85 per cent per annum while for yield and area, growth rates were 1.30 per cent and 0.54 per cent per annum, respectively. During the period I (1950-51 to 1962-63), the additional foodgrain production was mainly contributed by the growth of productivity (54.46 per cent), whereas extension of area contributed 34.43 per cent. The contribution of change in cropping pattern was not significant during this period. In period II (1960-61 to 1971-72) also the contribution to the increased production of foodgrain was again due to increase in average yield which was as high as 61.56 per cent. The change in crop pattern contributed relatively more during period II than period I. Analysis indicated that the future scope for increasing production of foodgrain through extension of area is limited.

Sharma (1977) analyzed the change in the value of aggregate output of food crops and non-food crops in the country during the period of 1960-61 to 1970-71. The change in the value of output between these two years was decomposed among area, yield and changes in the prices. He observed that total increase in value of production of foodgrains during study period was about 63.191 million rupees, of which 13.56 per cent was due to increase in yield, 4.49 per cent was due to increase in area, 61.26 per cent was due to increases in prices and remaining 20.69 per cent was due to the interaction between area and yield, price and yield, price and area and the area, yield and prices.

Vidyasagar (1977) carried out the component analysis of the growth of productivity and production in Rajasthan for the period 1956-61 to 1969-74. Author observed that the overall growth in aggregate farm production during 1956-61 to 1969-74 in the study area approximated to 40 per cent. This implies an annual growth of 2.4 per cent. Yield increase alone accounted for 63.64 per cent or nearly two third of the total output growth. The contribution of area growth was 38.45 per cent of the output growth. The other positive components of output growth were 7.82 per cent due to price changes and 3.50 per cent due to interaction between changes in cropping pattern and yield. Negative components viz. cropping pattern, interaction between changes in area and price structure and interaction between yield and price added up to 13 per cent of the total output growth.

Narain (1988) analyzed growth of productivity in Agriculture in India by using decomposition analysis for the period 1952-53 to 1972-73 and revealed that almost 70 percent increase in productivity during 1952-53 to 1960-61 was produced by changes in cropping pattern and the locational shifts of areas under individual crops and only about 30 percent by the pure increases in per hectare yield. However, increase in yield accounted for over 60 percent and cropping pattern changes and locational shifts accounted together for remaining 40 percent of increase in productivity during 1961-62 to 1972-73. Among the non-price factors, apart from the new technology, the expansion of irrigation is an important force bearing upon cropping pattern change.

Narender *et al.*, (1989) analyzed the growth in agricultural output in Andhra Pradesh in four periods. They observed that the growth of crop output in Period I (1950-59 to 1962-65) was 1.55 per cent, which accelerated to highest 14.57 per cent in the period II (1962-65 to 1966-69) and declined to 4.79 per cent in period III (1966-69 to 1972-75) and slumped further to lowest (1.39 per cent) during period IV (1972-75 to 1978-81). It was 10.40 per cent over the overall period (1956-59 to 1978-81). The contribution towards output growth was negative in all the periods, except during the period I where it was of order 15.51 per cent, even for the overall period, there was a negative contribution of 21.25 per cent. In case of yield, contribution was 73.81 per cent in period I and 88.87 per cent in the period II and it touched an all time high of 107.45 per cent in period III, while overall period showed 63.22 per cent yield contribution toward output growth. The contribution of cropping pattern was not a significant factor in period I (8.43 per cent). It increased to 61.44

per cent in period IV, while overall period showed 84.84 per cent which is higher than yield similar to that of fourth period. The growth behaviour of the three components viz. area, yield and cropping pattern when considered independently, clearly indicated that in Andhra Pradesh for the state as whole, right from 1956 onwards the growth of yield overtook the area growth.

Pal and Sirohi (1989) studied the sources of growth and instability in Indian crop production by using decomposition analysis for the period 1950-51 to 1964-65 and 1967-68 at 1983-84, for two periods corresponding to the pre and post green revolution periods, respectively. The results of decomposition analysis indicated that in cereals the growth in area and yield was almost equally important for the increase in production. Contrary to cereals, the increase in production of oilseeds and sugarcane was mainly attributed to growth in area. The shift in area away from pulses especially gram to other favorable crop led to nearly 4.0 per cent decrease in mean production of these crops. The interaction between changes in mean area and mean yield was more important for the increase in cereal production. The changes in area yield covariance accounted for very small proportion of change in production of all the crops.

Kalamkar (2003) has examine the contribution of various components to the growth of agricultural output in Maharashtra during the period 1960-61 to 1997-98, by using a seven factor decomposition model developed by Minhas and Vaidyanathan. He noted that the productivity growth was the major factor that accounted for the growth of crop output in the state. The growth in the production of kharif Jowar, paddy, bajra, rabi jowar, wheat and cotton is mainly on account of growth in yield however, production of gram and tur increased due to the expansion of area.

Shanmugam and Soundararajan (2008) has decomposed the agricultural output growth obtained in 15 major states of India for the period 1994-95 to 2003-04. They concluded that technological progress and technical efficiency are the two key sources of agriculture growth and they are declined in recent periods. It is a necessary to invest in information dissemination tools because the major problem they have identified that of technical inefficiency, the rectification of which can provide a new channel of agricultural growth for India.

Input use and Sources of Productivity Growth by Total Factor Productivity Measurement:

Productivity is a measure of the efficiency with which inputs are used to produce output (Productivity Commission, 2005). The increased use of inputs, to a certain extent, allows the agricultural sector to move along the production surface by increasing productivity per unit area. The use of modern inputs may also induce an upward shift in the production function to the extent that a technological change is embodied in them. It has long been recognized that partial productivity measures, such as output per unit of individual inputs, are of limited use as indicators of real productivity change as defined by a shift in a production function (Kumar, *et al.*, 2008; Reddy, 2009). The Total Factor Productivity (TFP) concept which implies an index of output per unit of total factor input, measures properly these shifts or increases in output, holding all inputs constant.

In the past, major sources of growth in agricultural production were area and yield. However, the current and future growth has to be essentially driven by increase in yield. However, besides inputs, there are some other factors which account for increase in output. The increases in total output which is not accounted for by increases in total input measured as Total Factor Productivity (TFP). TFP index is computed as the ratio of index of aggregated output to an index of aggregate inputs. Growth in TFP is therefore the growth rate in total output less the growth rate in total inputs (Rosegrant and Evenson, 1995). There are three approaches to measure TFP, namely, parametric approach, accounting approach and non parametric approach (Kumar and Taneja, 2008). Most studies on agricultural productivity in India have relied on the growth accounting approach. Solow (1957) was the first to propose a growth accounting framework, which attributes the growth in TFP to that part of growth in factor inputs like land, labour, and capital (Kumar *et al.*, 2008). The total factor productivity (TFP) implies an index of output per unit of total factor inputs, measures shift in output holding all inputs constant. Thus, TFP measures the amount of increase in total output which is not accounted for by the increase in total inputs. The number of studies on the measurement of TFP and its sources of growth has been carried out for India. These studies have been reviewed for the agriculture sector for crops and livestock at aggregated level and at disaggregated level by crops.

Since the publication of Solows paper 1957, voluminous literature dealing with the measurement and analysis of productivity at different level of aggregation has appeared (Krishna, 1962). Until recently much of it related mainly to developed countries. However, during last two decades or so, quite a few studies on agricultural productivity have also been brought for India (Kumar and Mruthyunjaya, 1992; Kumar and Rosegrant, 1994). Most of the studies concentrated either TFP growth for each crop at state level of TFP growth at regional level. That too many studies are carried out for developed states like Punjab, Haryana and indo-gangatic plains (Reddy, 2009).

Kaul and Johl (1967) studied the factors responsible for the differential growth in productivity between different districts of Punjab over the period of three plans from 1950-51 through 1964-65. They observed that irrigation facilities were considered to be the most important factor contributing towards the differential growth. The districts where the growth of irrigational facilities was at a higher rate, the productivity of crops shifted to the higher level. Where the irrigation facilities did not grow, relative productivity level also did not change much. They concluded that for the extension of irrigation facilities especially in low growth areas. It will also bring in favorable changes in the crop pattern and facilitate and accelerate the adoption of new technology.

Rao (1968) have analyzed the fluctuations in agricultural growth. He argues that it is difficult to conceive of a neutral relationship between agricultural growth and the amplitude of, weather-induced fluctuations in yields. The analysis indicates that increase in productivity has become the major component of growth, which is depends largely on inputs other than assured irrigation. Author argues that if production and growth policy is ineffective in reducing the fluctuations in output and if, in fact, it accentuates fluctuations, then, the task of stabilizing consumption through procurement, storage and distribution of food grains assumes much greater importance. The presumption is that a larger State is likely to be more heterogonous with respect to its climatic composition than a smaller State and, other things remaining equal, the fluctuations in productivity should be relatively smaller in a larger State because of the compensatory movements in productivity as between the divergent climatic zones within the State

Acharya (1973) while discussing the scope for Green Revolution in Maharashtra observed that water supply is a critical factor in the "Green Revolution"

particularly in Maharashtra, where improved management of water resources is badly needed before yields can be increased as less than 10 per cent of total cropped acreage in the state is irrigated. He suggested that more rapid development of rural transport, improved farm practices, new efforts to achieve a breakthrough in HYV of such crops as cotton, millets and groundnut and more investment in mechanization is necessary.

Bhatia (1979) studied the changing pattern of resource structure and demand for inputs in Indian agriculture for the period 1950-51 to 1973-74. He observed that amount of different inputs used increased considerably over the study period. The changes in input used is that the use of purchased and new inputs such as, fertilizers, irrigation water, electricity, pesticides and petroleum product showed enormous increase particularly after the year 1965-66. On the other hand, the expenditure on other inputs which are traditional and mostly farm supplied, such as organic manures, feed of livestock, etc. have shown slow growth, it declined over the period from 78.49 per cent in 1950-51 to 60.10 per cent in 1973-74. The proportion of expenditure on purchased and new inputs has increased significantly. Fertilizer expenditure has increased from 1.12 per cent in 1950-51 to 5.01 per cent in 1965-66 and then to 12.49 per cent in 1973-74. The total fertilizer consumption in terms of plant nutrients in the country went up from 784 thousand tons in 1965-66 to 2,894 tonnes in 1975-76, showing an increase of over 250 per cent in a period of 10 years. Author suggested that the agricultural output can be further pushed up through increased use of fertilizer and irrigation particularly in states/area where the use of other inputs remained at relatively low levels.

Patil and Jha (1979) studied the district wise output growth and technological change in Maharashtra agriculture in the year 1951-52 to 1971-72. During the sub period 1951-52 to 1960-61, 18 out of 25 districts recorded positive output growth, growth in input between 0.82 per cent and 2.89 per cent per annum in different districts (average of 1.84 per cent) and negligible growth in modern inputs. Total factor productivity growth rates were positive in 14 districts (0.85 per cent to 5.92 per annum). During the sub-period of 1960-61 to 1971-72, the rate of growth decreased only in 9 of 23 districts, which showed growth rate of over 2.5 per cent per annum, 2.19 per cent of this increase was due to growth in modern input although growth output has rates of over 2.5 per cent per annum.

Dayal (1984), estimated regional agricultural productivity patterns in India and concluded that if we want to increase the agricultural productivity over large in India, a number of actions are required. First, there is urgent need of expanding irrigation resources and the fertilizer supply and for improving credit facilities in order to allow small farmers to benefit from the availability of physical inputs. Second, in the densely populated eastern states there is a desperate need for a transfer of population from agriculture to nonagricultural activities. This should lead to enlarged holdings and reduce the rate at which diminishing returns appear to be setting in. Third, the significance of urban-industrial development in this analysis suggests that a decentralized policy of urban-industrial development will benefit agriculture. It will also help to transfer of population from agriculture to non agricultural activities.

Sanyal (1984) discussed about the tentative hypothesis of agricultural productivity, unemployment and landholding structure and estimated the effect of land variables on productivity and on unemployment. Author observed that the land characteristics explain 60 per cent of the total variation in productivity and 38 per cent of that in unemployment rate, by no means insubstantial. Relatively, rural unemployment problems seem to be less affected by land structure than the agricultural productivity. The inter-relationship of the two variables productivity and unemployment is however not evident from models discussed, though factors conducive to productivity are found to be detrimental to the generation of employment. A few relationship reveled from the analysis deserve the attention of researchers. First, the significant positive effect of proportion of household neither having cattle nor buffaloes on agricultural output per hectare and secondly, the significant negative effect of landlessness on unemployment rate. Lastly, the inequalities in 'owned area' and 'operated area' are respectively positively related to productivity and unemployment, the correlations significantly different from zero. The common factor is the process of leasing out and leasing in which reduces inequality in operated area, at the same time being a resultant of highly unequal land owned distribution leading to absentee land-ownership.

Kumar and Rosegrant (1994) have assessed total factor productivity growth in different regions of India and examine the sources of productivity growth for rice in India. The Divisia-Tornqvist index was used for computing the total output, total input, TFP and input price indices for rice using farm level data from 1971-88 for 15

states in India. The introduction and rapid spread of high yielding varieties in the late 60s and early 70s resulted in steady output growth for food crops in India. The area under rice has increased only slightly during the 1980s. The gains in rice production have come essentially from the improved utilization of the available infra-structure and from the resulting increase in yield per unit of land. Increase in yield at increasing rate need not imply that the potential productivity from the inputs has been fully realized. Spread of inputs in the new areas where the existing level of application is relatively low will contribute to the rise in the productivity per unit of input as well as ensuring more equitable distribution of benefits. The eastern region of India followed the northern and the southern regions with a lag with respect to growth in input use and rice yield in these areas. Public policies such as investment in irrigation, infrastructure development and investment in research and pricing policies have lowered unit cost of production and rice prices in real terms and benefited both consumers and producers. Productivity of resources can be enhanced further by improving the management as well as by extending it to less developed areas and by introducing new technologies. Market infrastructure, research, canal irrigation and balanced use of fertilizers are the most important sources of growth in TFP. There is need to target public investment in research, irrigation and infrastructure.

Mishra and Chand, (1995) present the fact and an analysis of capital formation in agriculture and closer examination of the sources and methods of estimation, which shows that the CSO estimates of capital formation in the household sector (which account for bulk of production and investment activities in agriculture) are not only inadequate but also underestimates. Author concluded that public investment in and for agriculture in the form of agriculture is and will continue to be important on its own for agricultural growth.

Rosegrant and Evenson (1995) were one of the first to investigate the contributions of private sector research and development to productivity growth. The results show that significant TFP growth in the Indian crops sector was produced by investments primarily in research but also in extension, markets, and irrigation. The high rates of return, particularly to public agricultural research and extension, indicate that the Government of India is not over investing in agricultural research and investment, but rather that current levels of public investment could be profitably expanded. Substantial productivity gains, as measured by total factor

productivity indexes, have been realized in India's agriculture. The rate of change in TFP has been relatively high. Total factor productivity growth has contributed roughly 1.1 percent per year to crop production growth in India, matching the contribution from growth in conventional inputs since 1956. Public agricultural research and extension explains nearly 60 percent of TFP growth over the 1956-87 periods. The private sector research and development by foreign agribusiness firms in the farm machinery and farm chemical industries have made a large contribution to TFP growth, accounting for nearly one-fourth of TFP growth over the full period. Private sector research and development by Indian firms also contributed, partly by facilitating the foreign contributions and partly by complementing public sector research. Improved rural markets and irrigation investment have also contributed to TFP growth, with irrigation investment generating TFP growth over and above the contribution to output growth that irrigation makes as a "conventional" input. The marginal impact on productivity from the expansion of irrigated area has increased over time. This improvement can be attributed to rapid growth in the proportion of private tubewells (groundwater) irrigation compared to public canal irrigation. Modern crop varieties contributed to TFP growth in the 1967-1977 green-revolution period however decline thereafter. While public sector research and the irrigation contribution remained high appears to be reflective of a shift from early reliance on "foreign" origin modern varieties to Indian origin modern varieties, and a broadening of the mechanism by which research contributes to TFP. It is clear that this TFP growth was produced by investments primarily in research but also in extension, markets, and irrigation.

Dev (1996) reviewed the agricultural policy framework of Maharashtra and revealed that there are reduction in input subsidies particularly in irrigation and power; however increase in public investment in this area. The profitability was lower in Maharashtra for selected crops as compared to other states. He suggested diversification in agriculture towards high value crop in the state.

Desai and Namboodiri (1997) analyzed the determinants of Total Factor Productivity in Indian agriculture. Authors argue that relative farm prices would provide incentives for technical change. This has been reinforced by the present policy in the wake of reforms that reduce protection to trade and industry for advocating its prime role for technical change. This paper therefore develops a

more comprehensive framework of price and non-price factors for studying this change. Among the three agricultural strategy options of extensive farming, intensive agriculture, and technical change, it is technical change, which is universally accepted as the best strategy. Technical change is invariably embodied in new inputs like HYV seeds, fertilizers, etc, and services like appropriate timing and method of their application [for some illustrations on this, (Desai and Namboodiri 1997a). One, technical change is a superior strategy compared to either extensive farming or intensive agriculture as it, unlike the other two options, increases production at reduced unit-costs/prices in real terms which benefit the poor most. Moreover, it is agro- economically most sustainable. Though achieving technical change is complex, it could be organized by combining the role of agricultural research and extension with location-specific farmers own knowledge as this service alone explains as much as 86/ 87 per cent of variation in total factor productivity in post-GR period. Thus, current under-investment of the government in agricultural R and DI must be corrected on a priority basis. This would fetch handsome dividend as marginal return on such investment is over 20 per cent.

Desai *et al.*, (1999) suggests that government expenditure on both agricultural research (R and D) and extension must be significantly steeped up, priority be accorded to the latter in the short run to bridge the gap in the knowledge of farmers and scientists. The agricultural research and extension must proactively become farmer- friendly and farmer-partnership-oriented, farmers' representatives must have a direct link with the scientists. The government expenditure on rural roads network is necessary not just for integrating the villages with the rest of the state but also for timely delivery of inputs such as seeds, fertilisers, etc. And the credit institutions including credit cooperative banks must promote working capital credit at reasonable interest rates to the farm input distributors and dealers including village level primary credit cooperative to accelerate adequate and timely supply of farm inputs.

Evenson *et al.*, (1999) assessed the effects that public investment in agricultural research, extension, and irrigation and private domestic agricultural research have had on the growth of total factor productivity (TFP) in the Indian crop sector. The main sources of agricultural productivity growth in India during 1956–87 were public agricultural research and extension; expansion of irrigated area and rural infrastructure and improvement in human capital were also important

contributors. The report also shows that the public benefits from private research can be substantial, indicating that private firms capture only part of the real value of improved inputs through higher prices. Private agricultural research accounted for more than 10 per cent of growth of total factor productivity (TFP) during 1956–87, and in 1966–75, when India was more open to foreign technology, private research contributed 22 per cent of productivity growth. India's trade policy and technology policy, including intellectual property rights policy, will require careful evaluation and reform in order to encourage private investment in agriculture. Authors argue that barriers to technology transfer should be removed in order to stimulate technology transfer and growth. Nevertheless, public investment in agricultural research will likely retain its primary role. Contrary to concerns that growth in TFP has decreased over time, the report finds that during 1977–87, the period when the results in regions that adopted high yielding varieties early on could be expected to taper off, TFP growth was 50 per cent higher than before the Green Revolution and 17 per cent higher than in the early years of the Green Revolution, indicating that gains are far from over. The rates of return to public agricultural research are high, and it appears that the government is under investing in agricultural research. Expanding public investment in research and extension would lead to even greater gains. India has made significant gains in TFP. The high-yielding varieties of wheat and rice introduced in the late 1960s certainly contributed to these gains.

Chand (2001) studies the emerging trends and issues in public and private investments in Indian agriculture and observed that there is a widespread decline across the board in all the states in public sector capital expenditure for agriculture. The highest decline is observed in the resources allocated by the union government of agricultural infrastructure. The decline is not confined to investment in irrigation project; it is rather sharper in other heads related to agricultural development. This declining trend public sector agriculture investment should be reversed by increasing allocation in all the major states to check the adverse impact on agriculture output. There is also a need to improve the efficiency of public investment in agriculture so that they serve the intended purpose. The lack of complementarities between the private and public investments stands out prominently even when the definition of public investment is broadened to include all investments relevant to agriculture. Terms of trade for agriculture and the flow of institutional credit are found to be the strong determinants of a private investment in

agriculture. In particular the flow of institutional credit should be increased in low investments states like eastern states.

The agricultural performance and productivity for major cereals in India at the state level were examined by Kumar (2001). He observed that coarse cereals and pulses showed a sustainable decline in the area during the period under the study. Crops with low yield growth experience a decline in their proportion of area. Most of the increase in output was brought about by yield growth. Changes in cropping pattern also had a significant effect on output changes. The widespread decline across the states in public investment in agriculture is a matter of concern in light of food self-sufficiency. The declining trend in public sector agricultural investment should be reversed by increasing allocation in irrigation, power, education etc. in order to check any adverse impact on productivity and agricultural output. There is also a need to improve the efficiency of public investment in agriculture, especially in irrigation, by constructing public infrastructure, particularly field channels.

Rao (2005) compared the factors, which gave an impetus to growth of agriculture in some East Asian countries that have achieved higher agricultural growth than India. He noted that India is lagging behind them in terms of irrigation, rural electrification, rural roads apart from land reforms and redistribution measures as well as human resource development. It is suggested that public policy should focus on development of infrastructure in the relatively less developed regions, support agricultural research and extension and skill formation.

The studies examining agricultural growth in Peru, Kenya and China by Velazco (2006), Odhiambpo and Nzuma (2004) and Lezin and WEI Long-bao (2005) respectively explained important determinants that constitute to factor productivity growth in agriculture. It has been suggested that labour, capital, land, technological improvements are the major positive contributors for agricultural growth in China. For Peru, public investment, favourable expected prices, weather conditions are prerequisites for private investment and agricultural growth. For Kenya, it is the government on research and extension, etc. that is the key factor behind growth in total factor productivity growth (Mathur, et al., 2006).

Mathur, *et al.*, (2006) noted that role of public investment/government expenditure on agriculture as being the crucial determinant in stepping up the rate of growth of agricultural production in India. It is suggested that given other factor, a

consistent increase in public investment to 15 percent per annum should lead to agricultural growth of 4 percent, which is concomitant with the projected growth rate in the eleventh plan. The other factors that are important for a higher agricultural growth are fertilizers usage and agricultural prices. The focus should be on enhanced government expenditure particularly on investment in rural infrastructure comprising irrigation and water management, processing, storage and marketing, apart from timely supplied of improved inputs, credit, and research and extension services.

Narayanamoorthy (2007) argued that 'policy fatigue' was main reason for the slow growth of agriculture experienced since the mid 1990s, instead of "technology fatigue" as underlined by government. He mentioned that productivity or production of crops is determined by a number of factors and technology (seed) is one among them and supply of crops may have fallen because of cost and price related reasons. The cost of the cultivation of crop has been increasing over the year because of increase of wage rates of labour, input prices and other managerial costs due to which the value of output increases, farmers may not be inclined to adopt the assortment of recommended inputs for crop cultivation. Reduction in the use of various yield-increasing inputs obviously would lead to a decline in crop productivity. The increase in the cost of cultivation was much higher than that of the value of output. Besides the price policy fatigue, the sector has been encountering quite a few policy related problems that have hampered its growth over the last 10 years. The fixed capital formation by the public sector in agriculture has been continuously declining both in the absolute terms and also in relation to agricultural GDP. During the period 1981-91, growth of institutional credit to agriculture was about 6.64 per cent, but the same declined to 2.16 per cent during 1991-99. Non-availability of institutional credit in time has forced farmers to rely on non-institutional sources to meet their credit requirements for crop cultivation in most places in India. Farmers in most of the regions of India are fed up with crop cultivation because they have not been able to recover even the cost of cultivation in the past several years now. Remuneration from crop cultivation is the key problem and therefore needs to be addressed immediately to rescue agriculture from its current sludge.

Kumar and Taneja (2008) estimated total factor productivity (TFP) indices for major crops in Uttar Pradesh and noted that the significant deceleration in total

factor productivity growth during 1994-95 to 2003-04 period in respect of major crops has serious implications for the agricultural development of Uttar Pradesh, which indicate that future increases in output of various crops in immediate short run shall be realized only through an increase in inputs at a higher rate as technical up-gradation takes a relatively longer period of time. The deceleration in TFP growth assumes further seriousness when viewed in conjunction with the potential food deficiency in UP. The compound average growth rate of foodgrain output in Uttar Pradesh has grown only 1.28 per cent per annum over the period 1994-95 to 2003-04. This viewed against the exponential growth rate of population of about 2.29 per cent per annum during 1991-2001, points to a significant reduction in per capita availability of foodgrains in the state. There is a need for higher-level growth in total factor productivity in major crops. In order to attain and sustain higher level of total factor productivity, it needs to emphasize on various areas such as higher public and private investments in agriculture, making crop specific policy, increased focus on irrigation, increased expenditure on agriculture research and development, capacity expansion in states agricultural universities, diversification of crops, revamping of the agricultural extension system to assist farmers in adopting new technologies, building up rural infrastructure, enhancing sustainability and conserving biodiversity through IPM and promotion of agro-based industries.

Kumar *et al.*, (2008) has reviewed the developments in agricultural productivity related to the South Asian countries namely Bangladesh, India, Nepal, Pakistan and Sri Lanka. The most of the countries has concentrated on enhanced production of a few food commodities like rice and wheat. More and more cases of deceleration in total factor productivity growth are being reported in India, except for rice in its eastern and southern states.

Raghavan (2008) argues that during post reform period, the agrarian crisis ravaged Indian economy due to increase in input costs and high fluctuation in produce prices and no subsidiary income source. He estimated the changes in paid out cost of cultivation during 1970-71 to 2004-05 by using cost of cultivation data for Haryana, Madhya Pradesh, Punjab, Rajasthan and Uttar Pradesh. The study shows that not all items of costs have increased at the same pace. During the post-reform period, there has been a steep decline in the labour hours applied in cultivation as also stagnation in casual wages. Also there was deceleration in the rate of growth of chemical fertilizers applied in cultivation; however, the

corresponding rate of growth of fertilizer charges was three times higher than that of its physical application. Author concluded that even if the input subsidy regime continued the costs of cultivation of wheat, one of the most protected crops, could have increased faster than the increase in the general price level, which indicate weakness of that regime. However, when that regime was in fact discontinued, the paid-out costs of crucial items of agricultural inputs increase at a rate that had not been seen earlier.

Shroff and Kajale (2009) noted that budgetary resources allocated to the agriculture sector in Maharashtra showed a negative trend. It is suggested that investment in agriculture sector is required to promote growth in this sector.

Another set of studies presents the importance of various factors that have impacted growth of agriculture in India and other developing countries. A study by Bhatia (1999) established a strong relationship between rural infrastructural development and level of per hectare yield of foodgrains as also of the value of output from agriculture. Bhattarai and Narayanamoorthy (2003) have empirically shown that improvement in irrigation and rural literacy are the two most important factors for agricultural growth in India. Dev (2002) argues that there is greater need for public investment in agriculture, irrigation, credit availability, better marketing of the agricultural products, research and development (R and D) along with adequate pricing and other incentives for private investment that would help revive agricultural growth. Sahu and Rajashekhar (2005) emphasized the importance of administered allocation of credit to the priority sector at concessional interest rates for agriculture. Dhar and Kallumal (2004) suggested that throughout the 1990s, the share of agriculture in gross capital formation (at constant prices) has remained in single digits, which explains the slackening of its growth momentum during past decade. Gulati and Bathla (2001) observed that there has been an increasing role played by private sector investment in agriculture over time while there is a decline in public sector capital formation in the sector. Public sector investment along with terms of trade has inducement effect on private sector capital formation. Desai (2002) suggested that government expenditure should be focused on agricultural R and D, education and extension services, rural electricity, roads and marketing, irrigation and watershed development, etc.

Overall, past literature shows that technical change in agriculture is determined by non-price factors like government expenditure of research and

development and Infrastructure. The numbers of economist in the recent years have expressed grave concern about the decline in public sector capital formation in agriculture. The wide fluctuations in agriculture output experienced recently are generally attributed to the weather. This raises an important question regarding the character of the growth potential created, viz. whether it has built-in tendencies to counteract the adverse effects of weather or to accentuate them. Productivity growth is of central importance both to economic growth and to the role of government policy. Increase in productivity can be induced by public investments in research, extension, human capital development and infrastructure.

3.3 Methodology for Measuring the Determinates of Stagnation in Productivities across the Crops

The literature on methodology of measurement of productivity and efficiency is very rich and vast (Krishna, 2006). One of the most defensible methods of aggregation in productivity measurement is Divisia aggregation. Divisia indices have two important attractive properties, i) they satisfy the time reversal and factor reversal testes for index numbers, and ii) it is a discrete of the components, so that aggregates could be obtained by the aggregation of sub-aggregates. For discrete data, the most commonly used approximation to the (continuous) Divisia Index is the Tornqvist approximation. The Divisia Tornqvist or translog index of TFP is commonly used for computing the total output, total input and TFP indices by commodity/farm system/sector, etc. under different locations. The logarithmic form of index is given below.

$$\ln\left(\frac{TFP_t}{TFP_{t-1}}\right) = \frac{1}{2} \sum_j (R_{jt} + R_{j,t-1}) \ln\left(\frac{Q_{jt}}{Q_{j,t-1}}\right) - \frac{1}{2} \sum_i (S_{it} + S_{i,t-1}) \ln\left(\frac{X_{it}}{X_{i,t-1}}\right)$$

Where, R_{jt} is the share of output j in total value of output or revenue at time t

Q_{jt} is output j at time t

S_{jt} is the share of input j in total input cost at time t

X_{it} is input i at time t

On the right hand side, the first part of the equation provides output index and the second part provides input index. By specifying the index equal to 100 in a particular year, output, input and TFP indices were obtained. After calculation of TFP index, the factors affecting TFP at different phases of agricultural development determined by using regression analysis.

Trends and Patterns in Production and Productivity: District Level Analysis

4.1 Introduction:

The potential of green revolution technology in increasing productivity and production of various crops in India was recognized in the very early stages of adoption of technology. Along with this, concerns arose whether increase in production, brought about by improved crop technology was accompanied by a rise in year to year variability in production (Chand and Raju, 2009). Particularly the latter part of the eighties and early nineties experienced significant upsurge in production and productivity growth in Indian agriculture. It was result of much wider and accelerated diffusion of technology across the crops, the regions and the farmers covering the slow growth crops, the lagging regions and the farmers (i.e. small and marginal farmers) too (Sawant and Achutan, 1995). However what was observed at the aggregate level was not uniformly true for all the states. There were a few outliers like Gujarat and Maharashtra which indicated significant deceleration in the pace of growth in their agricultural sectors.

So far, we have seen the recent development in agriculture in the state. Despite various initiatives taken by the government to accelerate the growth of agriculture, owing to many constraints the performance of agricultural sector in the state is not very impressive as compared to many states in India. The contribution of agricultural sector to the state's income has gone down from about 31 percent in 1960-61 to 15.2 percent in 2007-08 partly because of poor agricultural growth. But, on the other hand, the percentage of population relying on agriculture has declined only marginally between 1960-61 and 2000-01. There are a number of factors which limit the growth of agriculture over the years in the state. That is why, more in-depth analysis of districtwise growth in production and productivity of major crops is called for. In this chapter, we analyze the district-wise growth of production and productivity of major crops and input use in the state during the period 1990-91 to 2004-2005. The overall period was divided into two sub-periods as Period I: 1990-91 to 1999-2000 and Period II: 2000-01 to 2004-05.

4.2: District-wise Growth of Production and Productivity

One of the important reasons for the limited growth of agriculture in Maharashtra state is the predominant cultivation of low value crops. Though the cropping pattern has been shifting in favour of high value crops in the state in the recent years as compared to seventies and eighties, this shift is not very impressive as compared to the same at the national level. For instance, coarse cereals (which are mainly low value crops) accounted for only about 15 percent of GCA at all India level during TE 2004-05, but the same accounted for over 30 percent in Maharashtra. Similarly, the share of area under pulses in GCA has declined about 1.31 percent points at all India level between TE 1970-71 and TE 2004-05, but the same has increased by about 2.31 percent points in Maharashtra during the same period. Area under oilseeds and cotton¹ is also higher in Maharashtra (a total of 17.98 percent of GCA in TE 2004-05) as compared to all India average (15.41 percent). The limited availability of irrigation is the main reason for the predominant cultivation of low value crops in state. Therefore, greater attention needs to be given to accelerate the availability of irrigation and moisture (through watershed development programme) to shift the crop pattern in favour high value crops.

Coarse Cereals:

Maharashtra state rank first in area and production of coarse cereals in India, accounts for 23.89 percent and 18.10 percent share respectively in total during the year 2006-07. The state of Maharashtra has about 6.9 million hectares area under coarse cereals and production of about 6.14 million tones. Jowar and Bajra are the two major coarse cereals grown in Maharashtra. Jowar is grown in arid and semi-arid regions, as it is drought resistant. Jowar is meant for both food and feed apart from the fact that it has nitrogen fixation in the soil and hence can be preferred as a rotation crop and the sugar in the stalk can be used for bio-fuel production (CACP, 2008).

Jowar is the main foodgrain crop in Maharashtra. The area under Jowar crop was 6.20 mha in TE 1962-63, which decreased 4.7 mha in TE 2004-05, resulted in falling share in gross cropped area from 32.71 to 20.61 percent in corresponding

¹ We are aware of the fact that oilseeds and cotton are generally treated as high value commercial crops. However, since these crops are cultivated predominantly under rainfed condition and also the productivity of these crops are very low in Maharashtra, we considered them as low value crops for the purpose of analysis.

years. The districtwise growth in area, production and productivity of Jowar crop is presented in Table 4.1. It can be seen from the table that during overall period, area, production and productivity of Jowar crop declined substantially. The decline in production of Jowar was due to decline in yield as well as reduction in area under this crop. Most of decline in area was noticed during the period 1990-91 to 1999-2000; however yield growth rate was almost stagnant, which resulted in decline in production at the rate of 1.86 percent per annum. During the period 2001-2005, production of Jowar declined at the rate of 4.86 per cent per annum, which is due to decrease in area under this crop and decline in productivity as well. The yield of Jowar remained stagnant at around 900 kg/ha during last one and half decade. Districtwise analysis shows that during overall period, area, production and productivity of Jowar crop has declined in almost all the districts of the state. Jowar which is stable food crop of the farmers and accounts for more than 20 percent of gross cropped area during TE 2004-05 and mostly grown under rainfed conditions, deceleration in production and productivity of this crops calls for urgent attention by the policy makers and administrators.

Maharashtra state ranks second position in area and third in production of bajra in the country. Bajra is well adapted to production systems characterized by low rainfall, low soil fertility and high temperature. It is mostly grown in Nashik, Pune and Aurangabad divisions. The districtwise growth in production and productivity of bajra crop is presented in Table 4.2. It can be seen from the table that growth in productivity of Bajra crop was positive during overall period; however area under crop has declined substantially at the rate of 2.12 percent per annum, which result in declined in production. During first and second periods, growth in area was negative; however, productivity growth rate during second sub-period was positive and much higher. Bajra crop is grown in Nashik, Dhule, Ahmednagar, Aurangabad, Beed districts. Except beed districts, in all other major bajra growing district, area and production has declined during overall period.

Table 4.1: District-wise Growth Rates of Area, Production and Yield of Jowar Crop in Maharashtra State: 1990-91 to 2004-05 (percent per annum)

District /Divisions	Crop- Jowar								
	Period I 1990-91 to 1999-00			Period II 2000-01 to 2004-05			Overall Period 1990-91 to 2004-05		
	A	P	Y	A	P	Y	A	P	Y
Nashik	-1.34	-0.80	0.55	-15.30 ^b	-14.19	1.30	-8.62 ^a	-10.23	-1.76
Dhule	-4.74 ^b	-3.58	1.22	-1.79 ^b	16.06	18.18	-3.48 ^a	-3.36 ^a	0.12
Jalgaon	-2.76 ^b	-1.31	1.49	1.09	12.57	11.36	-3.64 ^a	-3.16 ^c	0.5
Nashik Div.	-3.17^b	-1.74	1.48	-1.21	11.99	13.36^c	-4.06^a	-3.56	0.51
Ahmednagar	-1.24	-0.42	0.82	0.47	-1.74	-2.20	-0.66	-4.58	-3.95 ^c
Pune	-2.42	0.40	2.89	-5.28	-6.57	-1.36	-2.26	-3.57	-1.34
Solapur	-2.98	-3.13	-0.15	-2.23	-22.16	-20.39	-0.49	-5.71	-5.24
Pune Div.	-2.26	-1.03	1.26	-2.08	-11.06	-9.17	-1.01	-4.46	-3.49
Satara	-1.89 ^a	-0.18	1.74	-4.91	0.13	5.30	-2.24	-2.44 ^c	-0.20 ^c
Sangli	0.00	2.76	2.75	-4.33	-8.54	-4.40	-0.70	-4.47	-3.79
Kolhapur	-7.58 ^a	-10.05 ^a	-2.67	-5.47 ^c	-2.92	2.69	-7.20 ^a	-8.8	-1.73 ^c
Kolhapur Div.	-1.35^a	-0.14	1.23	-4.55	-3.28	1.34	-1.75^a	-3.86	-2.15^c
Aurangabad	-0.58	0.97	1.56	-7.14 ^c	-8.64	-1.61	-2.00 ^c	-3.11	-1.13
Jalna	-1.25	-0.63	0.63	-4.24 ^b	-8.07	-4.00	-1.00 ^c	-1.2	-0.21
Beed	-0.55	1.28	1.84	-0.89	-4.13	-3.28	-0.29	-1.71	-1.42
Aurangabad Div.	-0.79	0.58	1.39	-3.61	-6.63	-3.13	-1.01	-1.99	-0.99
Latur	-2.00 ^b	2.15	4.24	-3.91 ^a	-7.72	-3.96	-1.72 ^a	-0.72	1.01
Osmanabad	0.59	0.85	0.26	1.73	-16.33	-17.75	1.60 ^a	-1.33	-2.89
Nanded	-0.59	0.22	0.82	-4.48 ^b	-2.73	1.84	-2.23 ^a	-1.62	0.63
Parbhani	-2.95 ^b	-2.14	0.83	-0.21	-11.30	-11.11	-0.61	-1.74	-1.14
Latur Div.	-1.25^b	0.12	1.39	-1.13^c	-8.69^c	-7.65^c	-0.53^c	-1.29	-0.76
Buldhana	-3.51 ^a	-2.84	0.68	-4.55 ^a	-9.32	-5.00	-3.44 ^a	-5.12	-1.74
Akola	-5.99 ^a	-5.45 ^c	0.58	-1.66	-2.84	-1.19	-5.67 ^a	-6.39 ^a	-0.76
Amravati	-5.85 ^a	-4.37 ^c	1.58	-5.65	-12.82	-7.61	-4.77 ^a	-5.21 ^a	-0.45
Yavatmal	-4.87 ^a	-7.61 ^b	-2.88	-6.86	-9.55	-2.89	-4.57 ^a	-6.63 ^a	-2.16
Amravati Div.	-5.07^a	-5.12	-0.04	-4.61	-8.15	-3.71	-4.67^a	-5.99^a	-1.39
Wardha	-5.18 ^a	-5.87 ^b	-0.73	-12.49 ^a	-14.17 ^a	-1.93	-8.29 ^a	-8.81 ^a	-0.56
Nagpur	-10.96 ^a	-12.43 ^a	-1.65	-8.50 ^a	-10.06 ^c	-1.70	-8.07 ^a	-9.41 ^a	-1.45
Bhandara	-17.94 ^a	-15.85 ^a	2.55	-36.98 ^b	-26.36	16.85 ^c	-21.79 ^a	-19.64 ^a	2.75
Chandrapur	-5.25 ^a	-4.24	1.06	-14.14	-19.51	-6.25	-9.89 ^a	-8.21 ^a	1.87
Gadchiroli	-4.21 ^b	-6.82 ^b	-2.73	-12.27 ^b	-13.93	-1.90 ^a	-9.08 ^a	-9.78 ^a	-0.77
Nagpur Div.	-7.10^a	-7.80^a	-0.75	-11.61^b	-14.06^a	-2.77	-8.92^a	-8.95^a	-0.04
Maharashtra	-2.49^a	-1.86	0.65	-2.77^a	-4.86	-2.15	-2.02^a	-3.49^a	-1.51

Notes: A= Area, P=Production and Y=Yield; a, b and c are significant at 1, 5 and 10 percent significance level, respectively.

Sources: Computed from Season and Crop Report of Maharashtra (various issues) and GOM (2009).

Table 4.2: District-wise Growth Rates of Area, Production and Yield of Bajra Crop in Maharashtra State: 1990-91 to 2004-05 (percent per annum)

District /Divisions	Crop- Bajra								
	Period I 1990-91 to 1999-00			Period II 2000-01 to 2004-05			Overall Period 1990-91 to 2004-05		
	A	P	Y	A	P	Y	A	P	Y
Nashik	-0.05	3.31	3.36	-2.10 ^b	6.48	8.76	-0.97 ^a	-0.16	0.83
Dhule	-0.13	-1.03	-0.91	4.84	28.39	22.47	-0.16	0.19	0.35
Jalgaon	-5.18 ^a	-3.5	1.77	-1.81 ^c	11.70	13.76	-4.77 ^a	-5.05 ^a	-0.29
Nashik Div.	-0.82	0.92	1.76	-0.27	12.45^b	12.76	-1.29^a	-0.87	0.43
Ahmednagar	-0.47	1.14	1.62	-5.45	-6.57	-1.19	-3.21 ^a	-4.01	-0.82
Pune	-3.74	-0.85	3.0	-7.59	-6.35	1.34	-4.44 ^a	-3.13 ^b	1.37
Solapur	0.58	2.63	2.04	-14.92	-10.89	4.74	-4.75 ^c	-3.51	1.3
Pune Div.	-1.5	0.31	1.84	-6.86	-6.83	0.04	-3.71^a	-3.70^c	0.01
Satara	-2.38 ^b	6.49 ^b	9.09 ^a	-9.31	-7.80	1.66	-4.76 ^b	-3.04	1.8
Sangli	1.8	10.04 ^a	8.09 ^a	-14.18	-25.11	-12.74	-5.63	-10.54	-5.2
Kolhapur Div.	-0.36	8.00^a	8.4^a	-11.47	-12.05	-0.65	-5.06^c	-4.87	0.19
Aurangabad	-3.77 ^a	1.75	5.73	-4.97 ^c	0.26	5.50	-2.79 ^a	-0.52	2.34
Jalna	0.62	3.01	2.37	-4.97	0.05	5.28	-0.22	1.73	1.96
Beed	0.86	4.17	3.29	-2.07	-5.78	-3.79	0.35	1.24	0.88
Aurangabad Div.	-1.01	2.9	3.94	-3.69	-2.41	1.32	-0.98^b	0.6	1.59
Latur	-2.08	0.52	2.66	-7.52 ^a	-11.41	-4.20	-2.5 ^a	-1.89	0.63
Osmanabad	7.49 ^a	9.53	1.91	0.01	-9.04	-9.05	5.28 ^a	2.95	-2.21
Nanded	-16.3 ^b	-10.78	6.59	-6.09	-9.34	-3.46	-9.98 ^a	-8.54 ^b	1.59
Parbhani	-1.39	0.99	2.4	4.11 ^a	5.99	1.81	0.69	2.14	1.44
Latur Div.	1.55^a	3.52	1.94	-0.69	-4.89	-4.23	1.42^a	1.00	-0.41
Buldhana	-9.48 ^a	-7.81	1.84	-17.16 ^a	-20.69 ^b	-4.26	-8.9 ^a	-9.07 ^a	-0.19
Akola	-1.89	-1.43	0.47	-11.88 ^b	-15.50	-4.10	-2.52 ^b	-3.43	-0.93
Amravati	-10.56 ^a	-8.21	2.62	-7.00 ^b	-4.36	2.83	-11.75 ^a	-10.78 ^a	1.09
Yavatmal	-5.23 ^a	-8.51	-3.46	-20.30 ^a	-24.27 ^b	-4.99	-6.84 ^a	-7.83 ^a	-1.06
Amravati Div.	-6.59^a	-6.41^a	0.2	-16.53^a	-19.95^b	-4.09	-7.13^a	-7.56^a	-0.46
Maharashtra	-1.06^c	1.65	2.74	-3.74	1.47	5.41	-2.12^a	-1.30	0.85

Notes and Sources: Same as in Table 4.1.

In India, Maize has its significance as a source of a large number of industrial products besides its uses as human food and animal feed. Maharashtra was the fifth largest producer of maize in the country during the year 2006-07. The districtwise growth in production and productivity of maize crop in Maharashtra state is presented in Table 4.3. It can be seen from the table that unlike other coarse cereals crops, area, production and productivity of maize has increased significantly during overall period, at the rate of 9.44 percent, 12.09 percent and 2.42 percent, respectively. As like bajra crop, area under maize is mostly concentrated in Nashik, Pune, Aurangabad and Kolhapur divisions and Buldhana district of Amravati division. In all the major maize growing districts, area and

production of maize crop has increased, however productivity growth was negative in case of Ahmednagar and Solapur district of Pune division. In Pune and Nashik division, most of the poultry farms are located around the metropolitan cities like Pune and Nashik, and maize is the main feed source for poultry, which account for about 70 percent in total production cost of broiler. Therefore, increase in area was mostly due to ready demand for this crop in those areas. The increase in productivity was due to readily availability of new seed and inputs at the market.

Table 4.3: District-wise Growth Rates of Area, Production and Yield of Maize Crop in Maharashtra State: 1990-91 to 2004-05 (percent per annum)

District /Divisions	Crop- Maize								
	Period I 1990-91 to 1999-00			Period II 2000-01 to 2004-05			Overall Period 1990-91 to 2004-05		
	A	P	Y	A	P	Y	A	P	Y
Nashik	6.79 ^a	13.58 ^a	6.35 ^b	15.2 ^a	47.92 ^c	28.39	9.14 ^a	15.01 ^a	5.37 ^b
Dhule	2.54 ^a	6.21	3.58	9.49 ^a	50.04 ^b	37.03 ^c	3.76 ^a	7.42 ^b	3.53
Jalgaon	36.46 ^a	44.22 ^a	5.68 ^c	22.79 ^a	45.80 ^b	18.77	22.34 ^a	25.65 ^a	2.72
Nashik Div	6.75^a	11.57^a	4.52^c	14.55^a	48.16^c	29.31	7.7^a	11.80^a	3.81^c
Ahmednagar	10.65 ^a	14.27 ^a	3.27 ^c	2.03	5.13	3.03	10.82 ^a	10.11 ^a	-0.65
Pune	14.53 ^a	17.44 ^a	2.54 ^c	-5.00	16.59	22.74 ^c	7.28 ^a	9.74 ^a	2.30
Solapur	4.02	6.49 ^c	2.37	-5.29	-7.24	-2.03	2.38	-1.72	-4.00
Pune Division	7.99^a	10.71^a	2.52^c	-2.67	5.17	8.06	5.75^a	4.93^b	-0.78
Satara	19.65 ^a	21.46 ^a	1.51	6.14 ^c	21.71 ^c	14.63	15.13 ^a	17.53 ^a	2.09 ^c
Sangli	10.29 ^b	11.10 ^b	0.74	3.78	23.23 ^b	18.72	9.77 ^a	11.85 ^a	1.89
Kolhapur	15.00 ^b	13.86 ^c	-0.99	11.52 ^a	28.34 ^b	15.07 ^c	11.24 ^a	12.92 ^a	1.52
Kolhapur Div	13.72^a	14.27^a	0.48	6.12	23.87^b	16.74	11.40^a	13.30^a	1.71
Aurangabad	17.32 ^a	24.12 ^b	5.80 ^c	6.07 ^a	22.38 ^c	15.37	14.98 ^a	18.84 ^a	3.36 ^c
Jalna	26.39 ^b	34.69 ^b	6.56 ^b	10.23 ^b	32.61 ^b	20.29	17.00 ^a	21.51 ^a	3.85
Beed	1.49	10.24 ^a	8.61 ^a	-5.57	-10.38	-5.25	1.34	1.59	0.20
Aurangabad Div	17.59^a	25.34^b	6.59^b	7.00^b	24.83^c	16.67	13.98^a	18.3^a	3.79^b
Latur	-1.82	-1.71	0.11	-2.01	-8.69	-6.69	5.89 ^c	6.29 ^c	0.41
Osmanabad	4.91	-0.36	-5.02	43.15 ^c	-9.98	-37.11	5.51 ^c	2.00	-3.32
Nanded	7.78	2.49	-4.91	42.00 ^c	53.71	8.17	6.87	6.47	-0.38
Parbhani	1.56	0.92	-0.62	4.43 ^c	-0.26	-4.49	5.27	4.52	-0.71
Latur Div	2.49	-0.82	-3.23	3.36	-7.91	-10.92	6.29	4.09	-2.07
Buldhana	26.45 ^a	23.14	-2.62	13.13 ^a	17.51	3.85	16.6	19.13 ^a	2.17
Akola	-3.62	0.98	4.77	21.82	21.5	-0.27	4.83	12.19 ^b	7.02 ^a
Amravati	3.96 ^c	5.55	1.53	13.18 ^a	20.11	6.4	6.35	11.33 ^a	4.79 ^c
Yavatmal	-3.61	-3.57	0.04	-18.77	-20.57	-2.21	-3.96	-1.08	3.29
Amravati Div	21.74^a	20.06^c	-1.38	13.11^a	17.47	3.84	14.41	17.64^a	2.83
Nagpur	-7.37 ^a	-9.40 ^b	-0.65	-7.79	-4.59	3.47	-3.06 ^b	1.85	5.72
Bhandara	-5.43 ^b	-7.35	-2.02	12.93 ^b	10.44	-2.21	-3.52 ^b	0.88	4.56
Gadchiroli	5.16 ^c	3.44	-1.63	-1.59	1.52	3.15	2.49 ^c	6.54 ^b	3.97
Nagpur Div	1.31	3.64	2.30	-4.67	-2.07	2.74	-0.68	4.46^c	5.19^b
Maharashtra	10.59^a	13.85^a	2.95^c	6.80^b	23.84^b	15.94	9.44^a	12.09^a	2.42^c

Notes and Sources: Same as in Table 4.1.

Ragi is another coarse cereal crops mostly grown in the districts of Konkan, Nashik and Kolhapur divisions of the state. As like other coarse cereals crops, area under ragi crop has been decelerated during the period under study. It can be seen from the Table 4.4 that production of ragi crop has declined significantly at the rate of 1.47 percent per annum during overall period; however, growth in productivity was positive. Thus, declined in production was mainly accounted by decline in area under this crops (2.06 percent per annum). In all major ragi growing districts, particularly in the districts of Konkan region, production has decreased significantly due to significant decline in area under this crop. Except Thane and Pune district, marginal increase in productivity was recorded in some districts, however, almost stagnant in others. During sub-periods also, same kind of picture was noticed.

Table 4.4: District-wise Growth Rates of Area, Production and Yield of Ragi Crop in Maharashtra State: 1990-91 to 2004-05 (percent per annum)

District /Divisions	Crop- Ragi								
	Period I 1990-91 to 1999-00			Period II 2000-01 to 2004-05			Overall Period 1990-91 to 2004-05		
	A	P	Y	A	P	Y	A	P	Y
Thane	-1.49 ^b	-0.84	0.66	-1.21	15.64 ^c	17.06 ^c	-2.06 ^a	-2.17 ^c	-0.12
Raigad	-7.46 ^c	-6.05 ^c	1.52 ^c	-2.33 ^b	0.13	2.52	-4.33 ^a	-3.15 ^a	1.23 ^b
Ratnagiri	-6.02 ^c	-7.41 ^c	-1.48 ^c	-1.73 ^b	-0.50	1.26	-4.69 ^a	-4.40 ^a	0.31
Sindhudurg	-13.37 ^c	-13.53 ^c	-0.18	-3.68 ^b	-0.67	3.12	-7.99 ^a	-7.47 ^a	0.57
Konkan Div	-5.71 ^c	-6.13 ^c	-0.45	-1.82 ^b	3.38	5.30	-4.15 ^a	-3.90 ^a	0.26
Nashik	-0.22	0.24	0.46	-2.13 ^a	11.53	13.97	-0.75 ^b	-0.14	0.61
Dhule	-1.79	-2.48	-0.70	-4.30 ^b	12.65	17.71	-2.94 ^a	-2.58	0.37
Nashik Div	-0.46	-0.21	0.25	-2.48 ^a	11.55	14.39	-1.07 ^a	-0.55	0.53
Ahmednagar	-3.94	-4.48	-0.56	-8.97	-16.51	-8.28	1.29	3.00	1.69
Pune	-1.60	-2.78	-1.20	2.43 ^b	-0.07	-2.44 ^b	0.78	0.63	-0.15
Pune Div	-2.11	-3.14	-1.05	-0.30	-4.73 ^c	-4.44	0.90	1.31	0.41
Satara	-4.41	-2.88	1.60	0.50	-2.36	-2.84	-0.60	0.66	1.26
Sangli	2.19	4.14	1.92	-22.42 ^b	-22.22 ^b	0.25	-1.02	0.25	1.28
Kolhapur	-1.73	-0.71	1.03	-1.12	-4.76	-3.69	-1.21	-0.14	1.08
Kolhapur Div	-2.47	-1.28	1.22	-1.11 ^b	-4.30	-3.23	-1.12	-0.02	1.11
Maharashtra	-3.03 ^c	-2.89 ^c	0.15	-1.76 ^a	1.88	3.70	-2.06 ^a	-1.47 ^b	0.61

Notes and Sources: Same as in Table 4.1.

Though wheat is not major crop as per Crop Concentration ratio, but is important crop as far as food security and use of land in summer on availability of water is concern. Wheat crop accounts for more than 3 percent gross cropped area of the state during TE 2004-05. The districtwise growth in area, production and

productivity of wheat crop is presented in Table 4.5. It can be seen from the table that production and productivity of wheat has increased during overall period, but area has declined marginally. The most of the decline in area, production and productivity of this crop was noticed during second period. Except Konkan division, wheat crop is grown on small scale/area in all the division wherever irrigation facility is available. Ahmednagar district accounts for highest area under wheat crop followed by Pune and Nashik district. These three districts has recorded decline in area under wheat crop during overall period.

Table 4.5: District-wise Growth Rates of Area, Production and Yield of Wheat Crop in Maharashtra State: 1990-91 to 2004-05 (percent per annum)

District /Divisions	Crop - Wheat								
	Period I 1990-91 to 1999-00			Period II 2000-01 to 2004-05			Overall Period 1990-91 to 2004-05		
	A	P	Y	A	P	Y	A	P	Y
Nashik	1.16	5.05	3.85	6.75	10.92	3.91	-4.60	-3.37	1.28
Dhule	-4.05	-1.35	2.82	22.08	40.14	14.79	0.20	1.28	1.07
Jalgaon	2.86	4.63	1.72	14.88	25.20	8.98	-0.58	0.54	1.12
Nashik Div	0.71	3.93	3.19	12.72	22.19	8.40	-2.36	-0.28	2.13
Ahmednagar	5.48	7.12	1.55	-9.42	-10.56	-1.25	-1.33	0.56	1.91
Pune	2.48	5.1	2.55	-5.24	0.87	6.46	-0.75	0.85	1.61
Solapur	6.56	8.03	1.38	-5.71	-14.30	-9.12	1.28	0.67	-0.60
Pune Div	4.85	6.65	1.72	-7.10	-7.71	-0.65	-0.45	0.83	1.29
Satara	4.00	7.60	3.46	-1.20	-0.82	0.38	0.97	2.93	1.94
Sangli	2.88	6.11	3.14	-5.68	-6.26	-0.62	-0.48	2.45	2.95
Kolhapur	-4.01	-1.85	2.25	1.71	5.50	3.72	-0.66	0.59	1.25
Kolhapur Div	2.5	5.62	3.04	-2.28	-1.70	0.60	0.28	2.42	2.13
Aurangabad	2.56	5.35	2.72	9.48	11.62	1.95	-1.06	0.40	1.48
Jalna	-1.99	2.25	4.33	-8.37	-19.14	-11.75	-3.29	1.71	5.18
Beed	7.41	10.82	3.18	-9.33	-18.40	-10.01	2.77	2.48	-0.28
Aurangabad Div	2.47	5.63	3.09	-3.08	-9.06	-6.17	-0.54	1.43	1.99
Latur	8.5	9.14	0.58	0.93	-1.74	-2.64	4.34	4.47	0.12
Osmanabad	6.87	8.78	1.79	-7.67	-24.33	-18.04	0.92	0.54	-0.38
Nanded	3.51	4.4	0.86	5.63	8.86	3.05	2.52	5.19	2.60
Parbhani	5.16	8.63	3.3	-0.68	-7.67	-7.03	4.90	6.85	1.86
Latur Div	5.99	7.59	1.51	-0.56	-5.05	-4.51	3.69	5.37	1.62
Buldhana	4.59	6.91	2.21	6.74	-9.70	-15.40	2.59	1.83	-0.74
Akola	5.73	7.46	1.64	-23.92	-28.07	-5.46	-0.71	-0.52	0.19
Amravati	0.58	1.31	0.73	-5.02	-7.22	-2.32	-3.38	-3.97	-0.61
Yavatmal	5.26	1.74	-3.35	-21.27	-22.90	-2.07	-1.58	-3.29	-1.74
Amravati Div	4.1	4.88	0.75	-8.08	-15.64	-8.23	-0.03	-0.69	-0.66
Wardha	0.07	-2.81	-2.87	-3.52	-4.23	-0.74	0.44	0.74	0.30
Nagpur	4.53	2.39	-2.05	0.97	3.55	2.55	-3.19	-2.42	0.80
Bhandara	-0.04	0.76	0.8	-12.10	-9.92	2.47	-5.54	-3.14	2.55
Chandrapur	3.96	2.96	-0.96	0.98	-4.60	-5.52	0.73	-5.65	-6.33
Gadchiroli	-6.59	-4.02	2.75	-10.66	-15.41	-5.32	-6.36	-6.16	0.22
Nagpur Div	2.75	1.07	-1.64	-1.91	-1.74	0.18	-2.01	-2.00	0.01
Maharashtra	3.42	5.2	1.72	-1.52	-1.83	-0.32	-0.07	1.23	1.30

Notes and Sources: Same as in Table 4.1.

Table 4.6 presents the districtwise growth in area, production and productivity of Total Cereals in Maharashtra during the period 1990-91 to 2004-05. It can be seen from the table that productivity of total cereals was stagnant during the overall period. As there was reduction in area under total cereals at the rate of 1.32 percent per annum, the production has also declined at the same rate during overall period. The substantial declined in productivity has recorded in Solapur, Yavatmal, Osmanabad and Ahmednagar districts.

Table 4.6: District-wise Growth Rates of Area, Production and Yield of Total Cereals in Maharashtra State: 1990-91 to 2004-05 (percent per annum)

District /Divisions	Total Cereals								
	Period I 1990-91 to 1999-00			Period II 2000-01 to 2004-05			Overall Period 1990-91 to 2004-05		
	A	F	Y	A	P	Y	A	P	Y
Thane	0.00	1.73	1.72	-0.71	14.42	15.24	-0.67 ^a	-0.54	0.14
Raigad	-1.40 ^b	2.11 ^b	3.57 ^a	-0.95	0.63	1.6	-1.2 ^a	0.45	1.68 ^b
Ratnagiri	-1.92 ^a	-0.35	1.60 ^t	-0.49	2.85	3.36	-1.21 ^a	-0.53	0.70
Sindhudurg	-0.70	3.02 ^a	3.75 ^a	-0.37	4.14	4.52	-0.51 ^b	2.19 ^a	2.71 ^a
Konkan Div	-0.94 ^a	1.60 ^a	2.57 ^a	-0.68	5.38	6.11	-0.93 ^a	0.30	1.23
Nashik	0.05	3.17	3.12	-1.09	10.38 ^b	11.6 ^b	-1.27 ^a	-0.18	1.1
Dhule	-1.37	-1.38	0.00	0.22	20.76 ^c	20.5 ^c	-1.11	-0.85	0.27
Jalgaon	-2.57 ^a	-0.68	1.94	2.73 ^c	16.3 ^c	13.21 ^c	-3.27 ^a	-2.46	0.84
Nashik Div	-1.06 ^c	0.61	1.68	0.21	15.03 ^b	14.79 ^b	-1.76 ^a	-1.18	0.59
Ahmednagar	-0.01	1.82	1.83	-2.24	-5.41	-3.24	-1.18 ^b	-2.86	-1.70
Pune	-1.80	1.24	3.10 ^b	-5.03	-2.13	3.05	-2.13 ^a	-1.65	0.53
Solapur	-1.72	-0.33	1.42	-2.96	-19.21	-16.75	-0.36	-4.25	-3.90
Pune Div	-1.09	1.09	2.21	-3.28	-7.00	-3.84	-1.22 ^b	-2.53	-1.33
Satara	-1.02	1.91	2.97 ^b	-3.89	2.16	6.30 ^c	-1.63 ^b	-0.58	1.07
Sangli	1.11	4.52 ^a	3.38 ^b	-5.11	-4.01	1.17	-0.87	-1.6	-0.73
Kolhapur	-1.17	-1.13	0.04	-0.04	1.99	2.03	-0.91 ^a	-0.99 ^c	-0.08
Kolhapur Div	-0.19	1.71	1.90 ^c	-3.6	0.51	4.37	-1.15	-0.87	0.28
Aurangabad	-0.71	3.56	4.30	-3.06 ^b	4.5	7.80 ^c	-0.78	1.77	2.57 ^c
Jalna	0.23	3.16	2.92	-2.69 ^b	0.87	3.66	0.21	2.64 ^c	2.42 ^b
Beed	0.10	2.62	2.51	-2.19	-6.38	-4.29	-0.05	-0.67	-0.62
Aurangabad Div	-0.17	3.09	3.26	-2.62 ^b	-0.28	2.4	-0.25	1.26	1.51
Latur	-0.66	1.91	2.59	-3.25 ^a	-7.53	-4.43	-1.11 ^b	-0.58	0.53
Osmanabad	1.41 ^b	1.46	0.05	1.07	-16.28	-17.17	1.80 ^a	-1.15	-2.91
Nanded	-0.41	0.39	0.80	-3.73 ^b	-2.41	1.37	-1.83 ^a	-1.11	0.74
Parbhani	-1.74 ^b	-0.56	1.20	-0.5	-10.43	-9.98	0.09	-0.49	-0.59
Latur Div	-0.51	0.64	1.15	-1.17	-8.43 ^b	-7.34	-0.09	-0.69	-0.60
Buldhana	-1.97 ^b	-1.11	0.88	-1.45 ^c	-6.18	-4.8	-2.0 ^a	-2.91	-0.92
Akola	-5.08 ^a	-4.55	0.56	-4.13	-5.22	-1.14	-5.22 ^a	-5.91 ^a	-0.73
Amravati	-4.91 ^a	-3.48	1.49	-6.18 ^a	-12.24 ^b	-6.45	-4.47 ^a	-4.89 ^a	-0.44
Yavatmal	-4.11 ^a	-6.90 ^b	-2.92	-8.64 ^a	-11.18 ^b	-2.78	-4.46 ^a	-6.4 ^a	-2.02
Amravati Div	-4.01 ^a	-3.98	0.02	-4.88 ^a	-8.21	-3.49	-4.02 ^a	-5.06 ^a	-1.09
Wardha	-4.38 ^a	-4.88 ^c	-0.53	-9.71 ^a	-10.5 ^a	-0.87	-6.3 ^a	-6.14 ^a	0.17
Nagpur	-4.19 ^a	-4.60 ^c	-0.42	-2.55 ^c	-1.54	1.04	-4.69 ^a	-4.73 ^a	-0.04
Bhandara	-1.23 ^c	0.47	1.72	0.22	-4.44	-4.65	-0.58 ^c	-1.43	-0.86
Chandrapur	-2.44 ^a	-0.51	1.98	-3.72	-9.01	-5.5	-3.52 ^a	-3.72 ^b	-0.21
Gadchiroli	-0.23	3.86 ^c	4.10 ^c	-0.08	2.79	2.88	-0.53 ^a	-0.75	-0.22
Nagpur Div	-2.16 ^a	-0.48	1.72	-1.8	-4.25	-2.5	-2.42 ^a	-2.68 ^b	-0.27
Maharashtra	-1.16 ^a	0.39	1.57	-2.21	-0.29	1.96	-1.32 ^a	-1.32	0.0

Notes and Sources: Same as in Table 4.1.

Pulses:

Pulses are the major source of protein and occupy a prominent place in the food basket as well as consumption profile of the people in India. Pulses are generally grown in rainfed conditions, in the vast domain of arid and semi arid regions. Maharashtra is the second largest producer of pulses after Madhya Pradesh. The area under Pulses in the state has gone up from 2.39 mha in TE 1962-63 to 3.46 mha in TE 2004-05. Among the various pulses grown in the state, kharif pulses occupy a major share both in terms of area and production and they are grown as mixed as well as pure crops. Tur (*C. cajan*), Mung/Moong (*V. radiata*) and Udid (*V. mungo*) are among the major kharif pulses of Maharashtra. In rabi season, Gram (*C. arietinum*) forms the major rabi pulse. Tur and gram are the two important pulse crops grown in most of the districts of the state. Due to different agro-climatic conditions in the state, the changes in area, production and productivity are not uniform in all the districts in Maharashtra. The per cent contribution of pulses in total foodgrains production in Maharashtra has increased during the last three decades by 4.65 per cent in 2000 over 1960. Cereals pulses ratio decreased from 7:1 to 5:1, however, percentage contribution of pulses in foodgrains increased from 12.78 per cent in 1960-61 to 16.15 per cent in 1999-2000:

Among the pulse crops, Tur is the major crop grown in all the districts in the state. Tur generally grown as intercrop with Cotton, Jowar, Soybean and other crops. It is very rarely taken as sole crop, mostly on inferior land. Thus cultivation of tur crop is not major activity; rather it is complementary with other crop production. Despite these aspects, tur crop accounts more than 5 percent gross cropped area of the state and about 15 percent in national total tur production. It can be seen from the Table 4.7 that production of tur crop increased significantly during overall period at the rate of 3.75 percent per annum. The increase in production was mainly due to significant increase in productivity (3.37 percent per annum) followed by increase in area (0.37 percent per annum). Among the divisions, Amravati, Latur and Aurangabad accounts major share in area under tur crop. In all these major divisions and their districts, increase in production and productivity of tur crop is recorded.

Table 4.7: Districtwise Growth Rates of Area, Production and Yield of Tur Crop in Maharashtra State: 1990-91 to 2004-05 (percent per annum)

District /Divisions	Crop-Tur								
	Period I 1990-91 to 1999-00			Period II 2000-01 to 2004-05			Overall Period 1990-91 to 2004-05		
	A	P	Y	A	P	Y	A	P	Y
Thane	-4.52 ^a	-5.58 ^c	-1.11	-2.09	7.25 ^b	9.54 ^b	-3.29 ^a	-5.28 ^a	-2.06
Raigad	-6.27 ^a	-7.72 ^c	-1.55	1.92	10.89 ^a	8.80 ^b	-4.50 ^a	-6.89 ^a	-2.51 ^c
Ratnagiri	-2.43	-3.10	-0.69	3.71	8.45	4.56	0.40	-1.93	-2.32 ^c
Konkan Div	-4.86^a	-6.08^c	-1.28	-0.45	8.22^b	8.71^b	-3.27^a	-5.44^a	-2.24
Nashik	0.74	-3.90	-4.61 ^c	0.89	15.77	14.74	0.76 ^c	-2.07	-2.80 ^c
Dhule	4.12 ^a	1.42	-2.59	1.68	3.74	2.02	3.08 ^a	-2.60	-5.51 ^a
Jalgaon	1.09	-5.59	-6.61 ^c	-0.80	16.90	17.84	1.20	-1.14	-2.31
Nashik Div	2.33^a	-2.37	-4.59^c	0.59	11.01^b	10.37^b	1.95^a	-1.71	-3.59^a
Ahmednagar	-0.67	3.58	4.28	-14.06 ^c	-25.98	-13.87	-4.48 ^a	-4.41	0.07
Pune	-1.58	2.40	4.04	-4.09	14.18	19.04 ^b	-2.70 ^a	0.61	3.40
Solapur	-3.19 ^c	0.52	3.83	-12.17	-20.95	-10.00	-10.41 ^a	-9.22 ^c	1.32
Pune Div	-2.23^c	2.04	4.37	-13.41	-17.88	-5.17	-7.24^a	-5.03^c	2.37
Satara	-2.92 ^c	-7.06	-4.26	-8.36	-9.50	-1.24	-3.70 ^a	-6.33 ^b	-2.73 ^c
Sangli	-1.04	-4.98	-3.98	-8.25	-8.78	-0.58	-2.37	-4.86 ^c	-2.55
Kolhapur	-7.36 ^a	-11.18	-4.12	11.56 ^a	14.87 ^c	2.96	-4.42 ^a	-7.16 ^a	-2.87 ^c
Kolhapur Div	-2.57	-6.54	-4.08	-5.91	-6.46	-0.59	-3.03^b	-5.59^b	-2.64
Aurangabad	-3.00 ^a	2.67	5.84	-4.49	11.46	16.71 ^a	-2.37 ^a	1.49	3.95
Jalna	1.19	7.70	6.44	2.13	1.01	-1.10	1.32 ^a	6.95 ^b	5.56 ^b
Beed	-1.38 ^c	4.66	6.12	-3.57	3.29	7.12	-1.00	0.99	2.00
Aurangabad Div	-1.13	4.54	5.73	-2.04	4.44	6.62	-0.71^c	3.09	3.82^c
Latur	0.86	14.46	13.49	-1.95 ^b	15.97 ^c	18.28 ^c	0.83 ^b	10.33 ^c	9.42 ^c
Osmanabad	-0.49	9.27	9.81	0.95	-14.09	-14.89	-0.12	7.31	7.44
Nanded	1.48 ^c	8.85	7.26	0.50	14.75	14.18	1.66 ^a	8.74 ^b	6.97 ^c
Parbhani	-0.25	1.29	1.55	3.38 ^a	2.07	-1.27	1.15 ^b	5.34	4.14
Latur Div	0.25	7.99	7.72	0.79	3.90	3.08	0.03	7.77^c	7.73^c
Buldhana	1.73	6.50	4.69	1.04	10.26	9.13	0.54	1.13	0.59
Akola	0.64	10.34 ^a	9.64 ^b	3.43 ^b	0.44	-2.89	1.90 ^a	5.17 ^a	3.22 ^c
Amravati	0.87	6.49 ^b	5.58 ^c	-1.63	1.09	2.77	1.04 ^a	2.88 ^c	1.83
Yavatmal	3.13 ^a	8.45 ^a	5.16 ^b	1.82 ^c	-13.37 ^b	-14.91 ^b	2.37 ^a	4.54 ^b	2.12
Amravati Div	1.68^b	8.02^b	6.24^b	1.20^c	-4.07	-5.21	1.58^a	3.74^b	2.12
Wardha	-0.89	0.28	1.18	-0.22	-3.68	-3.47	0.21	5.41 ^b	5.19 ^b
Nagpur	-0.74 ^b	2.20	2.96	1.61 ^b	-6.30	-7.79	-0.39 ^b	2.60	3.00
Bhandara	1.39 ^a	3.45	2.04	6.00 ^b	0.10	-5.57	1.86 ^a	5.61 ^b	3.68 ^c
Chandrapur	2.64 ^b	3.78	1.11	-1.58 ^b	-10.20	-8.76	1.27	0.17	-1.08
Gadchiroli	7.57 ^a	9.99 ^b	2.26	9.13 ^c	3.24	-5.40	1.26	4.93 ^b	3.62 ^c
Nagpur Div	0.07	1.76	1.69	0.74	-4.84	-5.54	0.30^c	3.87^c	3.55^c
Maharashtra	0.35^c	6.20^c	5.82	-0.13	-1.31	-1.18	0.37^a	3.75^b	3.37^b

Notes and Sources: Same as in Table 4.1.

Mung/Moong is another important pulse crop grown in Amravati, Latur, Aurangabad and Nashik divisions of the state. The districtwise growth in area, production and productivity of mung crop during 1990-91 to 2004-05 is presented in Table 4.7. It can be seen from the table that at the state level, area, production and productivity of mung crop decreased during 1990 to 2005. Mung is short duration crop, generally grown in kharif season as intercrop with cotton or sole crop under rainfed conditions. Also the availability of improved and hybrid varieties are limited. Also due to increasing area under Soybean crops, area under mung crop is declining.

Same as in Mung, Udid is another pulse crop grown in the Kharif season, mostly in the districts of Amravati, Nagpur and Nashik divisions, particularly Buldhana, Latur, Jalgaon and Osmanabad districts. It can be seen from the Table 4.8 that the area, production and productivity of udid crop increased during overall period. Buldhana district recorded increase in area, production and productivity of udid crop, however, production and productivity declined in Latur and Jalgaon district. Other districts recorded higher positive growth in area and production in udid crop due to low base/less area in base year. Udid crop is also grown in kharif season as intercrop with cotton and other crops under rainfed conditions. Non availability of improved and hybrid seed is also one of the constraints in cultivation of this crop.

The growth in area, production and productivity of Gram crop is presented in Table 4.10. It can be seen from the table that except Nashik, Jalgaon and Aurangabad, all other major gram growing districts have recorded increase in area and production. However, productivity deceleration is recorded in some districts such as Ahmednagar, Pune, Solapur, Aurangabad, Buldhana, Osmanabad and Parbhani. Gram crop generally grown in Rabi season and mostly on depend on soil moisture as far as water is concern. Therefore gram productivity keeps fluctuating heavily from year to year. Despite low level of irrigation, growth in production and productivity of gram crop was positive during overall period.

Table 4.8: Districtwise Growth Rates of Area, Production and Yield of Mung Crop in Maharashtra State: 1990-91 to 2004-05 (percent per annum)

District /Divisions	Crop-Mung								
	Period I 1990-91 to 1999-00			Period II 2000-01 to 2004-05			Overall Period 1990-91 to 2004-05		
	A	P	Y	A	P	Y	A	P	Y
Raigad	-5.66	-5.19	0.49	-34.8 ^b	-25.1 ^a	14.87	-16.38 ^a	-9.29 ^b	8.48 ^b
Konkan Div	-7.68^b	-9.02	-1.45	-9.47^b	-9.53^c	-0.06	-4.86^a	-0.44	4.64
Nashik	-0.09	7.16	7.26	2.55 ^b	20.68 ^a	17.68 ^a	0.89	5.45 ^b	4.52 ^b
Dhule	-4.06 ^a	1.44	5.73	2.87 ^c	12.25	9.12	-1.41 ^b	-0.44	0.98
Jalgaon	-3.50 ^b	-2.76	0.77	0.70	3.26	2.54	-0.46	-1.03	-0.57
Nashik Div	-3.45^a	0.48	4.08	1.87	10.34	8.32	-0.78	-0.06	0.72
Ahmednagar	-6.41 ^b	-10.61	-4.49	-15.55	-25.40	-11.66	-3.63 ^b	-7.50	-4.01
Pune	-4.13	0.59	4.92	-13.35	-5.85	8.65	-4.49 ^b	-5.06	-0.60
Solapur	-1.71	-6.27	-4.64	-7.55	4.94	13.51	-3.96	-8.53 ^b	-4.76
Pune Div	-5.64^c	-6.25	-1.28	-14.31	-16.47	-2.51	-3.85^b	-6.79^b	-3.06
Satara	-2.19	16.61 ^b	19.21 ^b	-6.55	-3.86	2.87	-1.21	9.32 ^a	10.65 ^a
Sangli	6.08	-0.34	-6.05	-7.87	-30.90	-25.00	1.29	-7.46	-8.64 ^b
Kolhapur	-11.83 ^b	-9.90	2.20	13.82 ^c	-6.14	-17.54	-0.23	-1.61	-1.38
Kolhapur Div	-0.50	2.48	3.00	-3.43	-16.29	-13.32	-0.05	-0.10	-0.04
Aurangabad	-11.50	-15.34 ^b	-4.33	-12.54 ^b	4.11	19.04	-6.50 ^a	-8.62 ^b	-2.27
Jalna	-2.11 ^b	-1.14	1.00	-4.99 ^a	-1.54	3.63	-1.22 ^b	-0.70	0.53
Beed	-8.18 ^a	-15.16	-7.60	-17.2 ^a	15.65	39.68 ^c	-7.06 ^a	-5.59	1.58
Aurangabad Div	-5.40^a	-6.62	-1.28	-8.39^a	2.20	11.56	-3.45^a	-3.38	0.08
Latur	0.76	-4.54	-5.27	0.29	15.88	15.54	0.11	-6.52 ^b	-6.62 ^b
Osmanabad	-2.00	-10.03	-8.20	6.53 ^a	28.02	20.17	3.35 ^b	-1.21	-4.41
Nanded	4.54 ^b	5.48	0.90	-5.08	8.98	14.81	1.51	3.41	1.87
Parbhani	-4.17 ^a	-7.66	-3.64	-0.42	14.35	14.84	-0.35	0.03	0.38
Latur Div	-1.11	-3.80	-2.72	-0.48	14.09	14.64	0.49	-0.01	-0.49
Buldhana	0.25	0.79	0.54	4.13 ^c	9.05	4.72	2.41 ^a	2.14	-0.26
Akola	0.22	4.10	3.87	-0.91	-6.17	-5.31	-0.51	2.42	2.94
Amravati	-1.87	0.55	2.47	-0.95	-12.17	-11.33	1.18	-1.59	-2.73
Yavatmal	-0.62	3.64	4.29	-9.66 ^b	-11.94	-2.52	-2.40 ^b	-3.82	-1.45
Amravati Div	-0.37	2.22	2.60	-0.79	-4.56	-3.79	0.19	0.10	-0.08
Wardha	-10.53 ^a	-7.61	3.26	-7.58	6.49	15.22 ^c	-7.49 ^a	-3.76	4.03
Nagpur	-10.32 ^a	-12.22 ^c	-2.11	-4.40 ^b	-6.93	-2.65	-6.69 ^a	-5.34 ^b	1.45
Bhandara	6.12 ^b	2.97	-2.97	-57.65 ^a	-54.94 ^b	6.41 ^b	-12.34 ^b	-9.45	3.30
Chandrapur	-3.28 ^c	-1.40	1.94	-42.37 ^a	-41.83 ^a	0.93	-14.56 ^a	-12.77 ^a	2.10
Gadchiroli	-4.56	-6.17	-1.69	-55.92 ^a	-54.62 ^a	2.95 ^b	-16.22 ^a	-14.36 ^b	2.22
Nagpur Div	-2.86^b	-1.97	0.91	-34.98^a	-34.21^a	1.19	-10.66^a	-8.68^b	2.22
Maharashtra	-1.95^b	-0.54	1.44	-2.54^b	0.11	2.73	-0.78^b	-0.81	-0.03

Notes and Sources: Same as in Table 4.1.

Table 4.9: Districtwise Growth Rates of Area, Production and Yield of Udid Crop in Maharashtra State: 1990-91 to 2004-05 (percent per annum)

District /Divisions	Crop- Udid								
	Period I 1990-91 to 1999-00			Period II 2000-01 to 2004-05			Overall Period 1990-91 to 2004-05		
	A	P	Y	A	P	Y	A	P	Y
Thane	-0.42	1.14	1.56	-2.80 ^a	7.05	10.13 ^b	-0.88	0.24	1.12
Konkan Div	-1.62	1.21	2.88	-2.46^b	6.72	9.41^c	-1.41^c	0.16	1.59
Nashik	1.53	6.45	4.84	-0.41	13.27 ^c	13.74 ^c	0.52	4.96 ^b	4.41 ^b
Dhule	-0.35	5.71	6.08	-1.60	1.05	2.70	-0.76 ^a	0.53	1.30
Jalgaon	-1.91 ^a	-1.13	0.80	3.43	15.10	11.28	-0.15	-1.03	-0.88
Nashik Div	-1.03^b	2.36	3.42	1.47	10.48	8.89	-0.26	0.36	0.62
Ahmednagar	2.20	1.57	-0.62	5.34	19.49	13.43	8.57 ^a	8.40 ^a	-0.16
Pune	-2.65 ^c	10.77 ^c	13.78 ^b	4.51	4.52	0.00	-1.86 ^b	5.12 ^c	7.11 ^b
Solapur	2.13	13.60 ^c	11.23 ^b	2.13	47.14	44.07	1.42	3.00	1.56
Pune Div	0.38	8.34^c	7.93	3.51	19.11	15.07	2.62^c	5.59^c	2.89
Satara	-3.80	-2.95	0.89	0.56	-5.65	-6.18 ^c	0.45	0.65	0.20
Sangli	5.07	11.43 ^c	6.05	-10.49	-22.45	-13.37	0.17	-7.04	-7.20
Kolhapur	3.61 ^c	8.89 ^c	5.10	-6.63 ^b	5.97	13.50	0.04	-1.45	-1.49
Kolhapur Div	1.85	5.71	3.79	-5.60	-4.13	1.55	0.32	-1.11	-1.43
Aurangabad	-13.05 ^a	-10.0 ^b	3.51	-6.70 ^b	5.92	13.53	-9.13 ^a	-7.18 ^a	2.14
Jalna	-0.82	2.97	3.82	-2.14	-1.87	0.28	0.36	1.96	1.59
Beed	10.57 ^b	4.60	-5.40	-13.80 ^a	4.69 ^c	21.45	4.44 ^c	6.78 ^c	2.24
Aurangabad Div	-3.32^a	-1.83	1.55	-6.71^b	2.06	9.39	-2.02^a	-0.57	1.48
Latur	8.75 ^a	8.34	-0.38	-4.02	-0.96	3.19	5.31 ^a	-1.42	-6.39 ^c
Osmanabad	10.80 ^a	4.48	-5.70	3.57 ^b	17.76	13.70	10.42 ^a	4.45	-5.41
Nanded	15.11 ^a	21.79 ^b	5.80	-3.71	10.15	14.39	10.11 ^a	13.37 ^a	2.97
Parbhani	4.86 ^b	5.50	0.61	-2.03	0.17	2.25	4.57 ^a	8.12 ^b	3.39
Latur Div	9.71^a	10.40^c	0.63	-1.94	8.09	10.22	7.18^a	5.88^b	-1.21
Buldhana	2.69 ^b	4.77	2.03	3.65	17.44	13.30	2.35 ^a	3.39	1.02
Akola	4.69 ^b	7.05 ^c	2.25	-3.90	-8.38	-4.65	1.32	3.21	1.86
Amravati	2.92	7.71 ^b	4.66 ^c	-3.16	1.62	4.94	1.86	2.85	0.97
Yavatmal	3.61 ^a	7.18	3.45	-8.54	-14.48	-6.49	1.48 ^c	0.99	-0.48
Amravati Div	3.65^a	6.18	2.44	-1.35	-0.17	1.20	1.77	3.05	1.25
Wardha	-16.95 ^a	-17.17 ^c	-0.26	8.70	2.92	-5.32	-9.12 ^a	-7.94	1.30
Nagpur	-0.18	-5.35	-5.18	-5.11 ^b	-13.75 ^c	-9.10 ^c	-1.69	-0.82	0.88
Bhandara	1.84	7.43	5.48	-57.04 ^a	-60.55 ^b	-8.17	-14.32 ^a	-12.47 ^b	2.17
Chandrapur	-2.01 ^c	2.81	4.92	-46.44 ^a	-48.05 ^a	-3.01	-15.05 ^a	-13.16 ^a	2.23
Gadchiroli	-0.87	5.13	6.06	-52.44 ^a	-51.68 ^a	1.61	-14.31 ^a	-11.15 ^b	3.69 ^b
Nagpur Div	-0.91	2.58	3.53	-37.13^a	-40.77^a	-5.78	-10.54^a	-8.85^b	1.88
Maharashtra	3.27^a	5.50	2.16	-2.18	3.39	5.69	2.23^a	2.44	0.21

Notes and Sources: Same as in Table 4.1.

Table 4.10: Districtwise Growth Rates of Area, Production and Yield of Gram Crop in Maharashtra State: 1990-91 to 2004-05 (percent per annum)

District /Divisions	Crop- Gram								
	Period I 1990-91 to 1999-00			Period II 2000-01 to 2004-05			Overall Period 1990-91 to 2004-05		
	A	P	Y	A	P	Y	A	P	Y
Thane	1.89	5.4	3.45 ^c	-8.35	-1.55	7.43	1.86	3.22 ^c	1.33
Raigad	-0.46	2.41	2.88	-20.78 ^a	-14.9 ^b	7.42 ^c	-2.67 ^c	-1.62	1.09
Konkan Div	1.03	4.29	3.22^c	-15.06^c	-8.92	7.23	0.37	1.55	1.18
Nashik	3.2 ^b	6.62 ^b	3.31 ^b	6.81 ^c	14.97 ^b	7.64	-3.22 ^b	-2.49	0.75
Dhule	2.62	3.83	1.18	-1.23	13.93	15.35	0.62	1.15	0.53
Jalgaon	3.67 ^c	3.76	0.09	11.16	18.57 ^b	6.67	-0.99	1.07	2.08 ^b
Nashik Div	3.25^c	4.79^c	1.49	5.94	16.41^b	9.89^c	-1.41	0.08	1.51^c
Ahmednagar	8.6 ^a	10.35	1.61	-2.77	-0.19	2.65	7.13 ^a	5.85 ^a	-1.2
Pune	3.83	6.25 ^a	2.33	-12.21 ^c	-12.61	-0.46	2.02 ^c	1.46	-0.55
Solapur	7.27 ^b	11.35	3.81	2.72	-10.73	-13.1	2.21	-0.59	-2.74
Pune Div	6.46^a	9.10^a	2.47	-4.73	-6.75	-2.12	3.99^a	2.81	-1.13
Satara	7.64 ^a	11.26 ^a	3.36 ^c	-14.35	-6.21	9.5	4.39 ^b	5.44 ^b	1.00
Sangli	3.48 ^b	8.91	5.25	-6.54	-12.13	-5.98	1.81 ^c	2.43	0.61
Kolhapur	-0.31	0.06	0.37	-9.53 ^a	-2.55	7.72 ^b	1.58	2.15 ^b	0.56
Kolhapur Div	4.02^a	7.35^a	3.2	-10.03	-7.64	2.66	2.62^b	3.26^c	0.62
Aurangabad	2.23	1.7	-0.51	7.26	11.2	3.67	-0.22	-1.23	-1.01
Jalna	4.48 ^b	5.28	0.77	-0.87	-1.29	-0.43	2.12 ^b	2.83	0.7
Beed	2.42	4.16	1.7	-1.32	-2.48	-1.18	3.38 ^a	3.48	0.1
Aurangabad Div	2.67	2.9	0.22	2.25	3.31	1.03	1.29	0.82	-0.46
Latur	6.2	7.35	1.09	4.6 ^c	2.0	-2.48	5.84 ^a	5.97 ^c	0.12
Osmanabad	4.82	4.63	-0.18	-0.66	-11.9	-11.32	4.63 ^a	2.44	-2.09
Nanded	12.67 ^a	13.22	0.49	16.48 ^a	27.29	9.29	7.50 ^a	10.32 ^a	2.62
Parbhani	6.66 ^a	6.64	-0.02	7.1	1.79	-4.96	5.93 ^a	5.88 ^a	-0.04
Latur Div	7.0^a	7.27	0.25	5.73	2.06	-3.48	5.74^a	6.0^b	0.24
Buldhana	11.65 ^b	14.69	2.72	10.75	0.43	-9.32	3.21	0.8	-2.33
Akola	12.79 ^b	14.79 ^c	1.78	3.24	3.64	0.38	7.68 ^a	6.61 ^c	-0.99
Amravati	10.29 ^b	11.41 ^c	1.01	0.44	0.15	-0.29	2.61	3.26	0.63
Yavatmal	6.44 ^b	3.82	-2.46	-1.05	-7.95	-6.97	3.48 ^b	5.18 ^b	1.64
Amravati Div	10.79^b	12.16^c	1.24	3.39	-0.12	-3.4	4.49^b	3.97	-0.5
Wardha	3.15	-0.89	-3.92	9.08	8.12	-0.89	4.07 ^b	4.79 ^c	0.69
Nagpur	5.35 ^a	5.07	-0.26	8.14 ^a	7.98	-0.15	2.56 ^a	3.92 ^b	1.32
Bhandara	-2.03	-2.94	-0.93	-12.16 ^c	-18.59	-7.31	-5.66 ^a	-5.35 ^b	0.33
Chandrapur	6.45 ^a	8.83	2.24	17.45	18.51	0.9	4.86 ^a	6.53 ^a	1.6
Gadchiroli	-0.28	1.14	1.43	-27.95	-39.47 ^b	-15.99 ^c	-2.74	-2.18	0.57
Nagpur Div	3.68	2.79	-0.87	5.84	4.64	-1.14	2.23^b	3.48^b	1.22
Maharashtra	5.59^a	6.90^c	1.24	1.52	1.81	0.29	2.91^a	3.03^c	0.12

Notes and Sources: Same as in Table 4.1.

The districtwise growth in area, production and productivity of total pulses and foodgrains during 1990-2005 is presented in Table 4.11 and 4.12 respectively. Though there is significant growth in area under total pulses, area under foodgrains has declined significantly at the rate of 2.91 percent per annum, which may be due decrease in area under coarse cereal crops. Same the case of production and productivity of total pulses and foodgrains. The production and productivity of total pulses has increased, however, same has declined in case of foodgrains. The cropping pattern of the state has been dominated by foodgrains crops, however, during last few years, cropping patterns is diversifying from coarse cereals towards commercial and horticultural crops. Therefore, area under foodgrains crops is declined. However declined in productivity of foodgrains which is attributed to decline in productivity of coarse cereal crops need to be address immediately.

The various studies shows that technical change in pulse crops is very slow compared to superior cereals and other cash crops due to hosts of factors. Pulses have to compete with the superior cereals and cash crops for resources, research and infrastructure. Evidences indicates that displacement of acreage of these crops has been marked in areas which have witnessed the introduction of high yielding varieties (HYV's) seeds, use of chemical fertilizers and better farming practices (Singh, 1979). Inadequate production technology, price variability, production risk and low level of irrigation are the important influencing factors responsible for decline in acreage and stagnation in the productivity of pulse crops. (Ramasamy and Selvaraj, 2002). Non availability of good high-yielding varieties, as in case of paddy and wheat, was one of the main reasons for slow growth in pulse production. Despite all these problems, growth in production and productivity of tur crop was positive during overall period. Thus, the problems of increasing production of pulses in the state are confronted with various economic constraints in the form of low yield, income, rainfed condition under high risk situation and low level of technology with poor management (Kalamkar, 2003a and 2003b). In order to increase the production of pulses, particularly yield per hectare, it would be essential to develop some new high yielding varieties suitable to agro-climatic condition of the regions. Also biotechnology and gene transfer technology can be adopted to enhance pulse crop productivity.

Table 4.11: Districtwise Growth Rates of Area, Production and Yield of Total Pulses in Maharashtra State: 1990-91 to 2004-05 (percent per annum)

District /Divisions	Total Pulses								
	Period I 1990-91 to 1999-00			Period II 2000-01 to 2004-05			Overall Period 1990-91 to 2004-05		
	A	P	Y	A	P	Y	A	P	Y
Thane	-2.17	0.32	2.55 ^c	-3.79	2.68	6.72 ^a	0.64	1.12	0.48
Raigad	-0.81	2.12	2.96	-3.62	-2.2	1.47	0.95	1.21	0.26
Ratnagiri	-1.31	1.94	3.29	-2.15	1.04	3.26	5.61 ^a	6.1 ^b	0.45
Sindhudurg	-6.23	-0.5	6.11 ^c	4.82	3.4	-1.35	5.22	7.76 ^c	2.41 ^c
Konkan Div	-2.07	0.87	3.01 ^c	-2.45	1.22	3.77 ^b	1.79	2.21 ^c	0.42
Nashik	1.19	4.64 ^c	3.41	-1.64	8.66	10.47 ^c	-1.8 ^b	0.05	1.89 ^c
Dhule	0.19	3.35	3.16	-2.88	3.91	7	-0.02	-0.25	-0.23
Jalgaon	-0.33	0	0.34	2.26	12.52	10.03	-0.47	-0.11	0.36
Nashik Div	0.2	2.18	1.98	-0.53	8.82	9.4	-0.63 ^b	-0.1	0.54
Ahmednagar	2.16 ^b	4.63	2.41	-7.47	-10.09	-2.84	0.81	1.14	0.33
Pune	-0.15	3.64	3.79 ^b	-10.08	-11.4	-1.46	-0.59	0.42	1.02
Solapur	-0.81	4.18	5.03	-7.66	-15.31	-8.29	-4.94 ^a	-3.75	1.25
Pune Div	0.41	4.24	3.81	-8.32	-11.39	-3.34	-1.45 ^c	-0.29	1.18
Satara	5.57 ^a	7.4 ^a	1.74	-7.39	-3.98	3.69	0.11	1.22	1.11
Sangli	1.55	4.4 ^c	2.8	-11.02	-15.51	-5.04	-1.61	-2.2	-0.6
Kolhapur	-3.67 ^c	-1.7	2.05	-2.85	0.34	3.28	-0.85	0.06	0.92
Kolhapur Div	2.47 ^b	4.62 ^b	2.1	-8.03	-7.89	0.15	-0.76	-0.3	0.46
Aurangabad	-4.45 ^a	-2.78	1.74	-3.88 ^b	7.17 ^c	11.5 ^b	-3.75	-2.45	1.35
Jalna	-0.28	2.83	3.11	-2.23 ^b	-2.06	0.18	-0.76	1.95	2.74
Beed	-3.2 ^a	-0.55	2.74	-5.93 ^b	1.35	7.73	-1.57 ^a	0.37	1.96
Aurangabad Div	-2.55 ^a	-0.11	2.51	-3.89 ^a	1.74	5.85	-2.00 ^a	0.05	2.09
Latur	4.05 ^a	10.37	6.07	-1.93 ^c	8.77	10.91	2.79 ^a	4.98 ^c	2.12
Osmanabad	2.23 ^a	6.03	3.71	1.42	-6.39	-8.2	3.14 ^a	5.5	2.29
Nanded	6.63 ^a	11.48	4.55	0.41	13.59	13.13	4.54 ^a	9.00 ^a	4.27 ^c
Parbhani	-0.16	0.63	0.8	2.02	4.53	2.47	1.83 ^a	4.36	2.48
Latur Division	2.78 ^a	6.69	3.8	0.55	5.33	4.75	2.88 ^a	5.94 ^b	2.97
Buldhana	2.3 ^c	5.25	2.87	3.53	10.13	6.37	2.17 ^b	1.39	-0.76
Akola	2.66 ^b	7.97 ^b	5.17	0.09	-3.07	-3.16	1.39 ^b	3.22	1.8
Amravati	1.87 ^c	6.35 ^c	4.39	-0.91	-1.04	-0.14	1.26	2.08	0.81
Yavatmal	2.26 ^b	7.06 ^b	4.69	-2.06	-12.83 ^b	-11.0 ^b	1.08 ^b	2.95 ^c	1.85
Amravati Div	2.31 ^b	6.76 ^c	4.36	0.28	-3.12	-3.39	1.34	2.51	1.16
Wardha	-1.16	-0.56	0.61	1.54	-1.97	-3.45	0.37	3.79 ^c	3.41 ^c
Nagpur	0.95 ^b	3.03	2.05	2.13	-38.74 ^c	-40.01 ^c	-0.23	4.54	4.78
Bhandara	2.76 ^b	6.08 ^b	3.23	-12.65 ^c	-16.99	-4.96	-2.61	-0.51	2.15 ^c
Chandrapur	1.2 ^c	3.87	2.64	-1.74	-8.18	-6.55	-1.03	-1.2	-0.17
Gadchiroli	-2.67 ^c	1.77	4.56	-7.08	-18.0	-11.75 ^c	-2.8	-1.77	1.06
Nagpur Div	0.58	2.65	2.05	-1.9	-5.89	-4.07	-0.81 ^c	1.8	2.63 ^c
Maharashtra	1.13 ^b	4.74	3.57	-1.49 ^a	-0.34	1.17	0.51 ^b	2.21	1.68

Notes and Sources: Same as in Table 4.1.

Table 4.12: Districtwise Growth Rates of Area, Production and Yield of Foodgrains in Maharashtra State: 1990-91 to 2004-05 (percent per annum)

District /Divisions	Total Foodgrains								
	Period I 1990-91 to 1999-00			Period II 2000-01 to 2004-05			Overall Period 1990-91 to 2004-05		
	A	P	Y	A	P	Y	A	P	Y
Thane	-0.18	1.68	1.87	-1.05	13.94	15.14	-0.55 ^a	-0.47	0.07
Raigad	-1.36 ^b	2.1 ^b	3.51 ^a	-1.17	0.58	1.77	-1.09 ^a	0.46	1.57
Ratnagiri	-1.91 ^a	-0.34	1.6 ^b	-0.62	2.82	3.46	-0.9 ^a	-0.46	0.45
Sindhudurg	-0.93	2.98 ^a	3.94 ^a	-0.04	4.13	4.17	-0.27	2.22 ^a	2.50 ^a
Konkan Div	-1.02 ^a	1.58 ^a	2.62 ^a	-0.84	5.29	6.18	-0.74 ^a	0.33	1.08
Nashik	1.26	3.32	2.03	-1.17	10.22 ^b	11.52 ^b	0.48	-0.17	-0.64
Dhule	-0.91	-0.44	0.47	-0.75	17.16	18.05 ^c	-0.8 ^b	-0.73	0.06
Jalgaon	-1.84 ^b	-0.58	1.29	2.55 ^c	15.55 ^c	12.67	-2.32 ^a	-2.06	0.27
Nashik Div	-0.51	0.84	1.36	0.02	14.03	14.01 ^c	-1.07	-1.02	0.05
Ahmednagar	0.21	2.03	1.81	-2.84	-5.88	-3.12	-0.97	-2.51	-1.56
Pune	-1.65	1.39	3.09 ^b	-5.57	-2.92	2.8	-2.03 ^b	-1.51	0.53
Solapur	-1.59 ^c	0.11	1.73	-3.35	-18.84	-16.02	-0.81	-4.17	-3.39
Pune Div	-0.92	1.33	2.28	-3.80	-7.4	-3.75	-1.24 ^b	-2.35	-1.13
Satara	0.1	2.35	2.25	-4.50	1.6	6.39 ^c	-1.36 ^c	-0.44	0.93
Sangli	1.18	4.50 ^a	3.28 ^b	-6.11	-5.28	0.88	-0.99	-1.66	-0.67
Kolhapur	-1.51	-1.16	0.35	-0.43	1.91	2.35	-0.91 ^a	-0.96 ^c	-0.05
Kolhapur Div	0.26	1.91	1.65	-4.35	-0.09	4.46	-1.09	-0.83	0.26
Aurangabad	-1.6	2.72	4.39	-3.22 ^a	4.75	8.23	-1.45 ^a	1.33	2.81
Jalna	0.06	3.17	3.1	-2.56 ^a	0.43	3.07	-0.1	2.52	2.62
Beed	-0.5	2.32	2.84	-2.82 ^c	-5.54	-2.79	-0.33	-0.57	-0.24
Aurangabad Div	-0.74	2.69	3.46	-2.89 ^b	-0.04	2.93	-0.66 ^c	1.09	1.76
Latur	0.84	3.74	2.88	-2.63 ^a	-3.7	-1.1	0.46	0.59	0.13
Osmanabad	1.67 ^a	2.38	0.69	1.19	-13.87	-14.88	2.23 ^a	0.24	-1.94
Nanded	1.67 ^c	2.19	0.52	-2.07	1.28	3.43	0.29	0.71	0.42
Parbhani	-1.19 ^c	-0.13	1.07	0.44	-7.45	-7.86	0.71	0.43	-0.28
Latur Division	0.6	1.86	1.26	-0.5	-5.3	-4.82	0.96 ^a	0.62	-0.34
Buldhana	0.09	0.51	0.42	1.31	-1.67	-2.94	-0.18	-1.74	-1.56
Akola	-1.02 ^c	-0.63	0.4	-1.35	-4.35	-3.03	-1.49 ^a	-2.9	-1.44
Amravati	-1.52 ^a	-0.08	1.47	-3.02 ^b	-7.53	-4.65	-1.43 ^a	-2.36	-0.94
Yavatmal	-1.18 ^c	-2.62	-1.46	-4.97	-11.96 ^b	-7.36	-0.73	-3.24 ^b	-2.53
Amravati Div	-0.89 ^c	-0.78	0.12	-1.81	-6.17	-4.44	-1.2 ^a	-2.64	-1.46
Wardha	-2.97 ^a	-3.24	-0.28	-3.23	-5.84	-2.7	-2.91 ^a	-1.51	1.45
Nagpur	-2.39 ^a	-2.78	-0.4	-0.57	-2.05	-1.49	-3.05 ^a	-3.11 ^b	-0.06
Bhandara	-0.64	0.79	1.44	-1.42	-5.29	-3.93	-0.81 ^a	-1.38	-0.57
Chandrapur	-1.66 ^a	-0.01	1.68	-3.22	-8.91	-5.88	-2.97 ^a	-3.44 ^b	-0.49
Gadchiroli	-0.58	3.74	4.35 ^c	-1.03	1.29	2.35	-0.82 ^a	-0.79	0.03
Nagpur Div	-1.51 ^a	-0.05	1.48	-1.82	-4.54	-2.77	-2.03 ^a	-2.03	0.00
Maharashtra	-0.57	1.01	1.59	-2.01 ^c	-0.28	1.77	-0.81 ^a	-0.8	0.01

Notes and Sources: Same as in Table 4.1.

Oilseed Crops:

Oilseeds occupy an important place in India's economy. The oilseed scenario has undergone a dramatic change in the last fifteen years with the setting up of Technology Mission on Oilseeds (TMO) in May, 1986. In the span of decade from 1985-86, oilseed production increased more than doubled. However, in the last couple of years, oilseed production has virtually declined. As seen earlier, oilseed crops accounts for about more than 12 percent of gross cropped area in Maharashtra state during TE 2004-05. The main oilseed crops grown in the state are Soybean, Groundnut, Safflower, Sunflower and Sesamum. Among oilseed crops, Soybean crop accounts highest share in area, accounting about 58 percent of total area under oilseeds in the state during the period TE 2004-05, followed by groundnut (14.2 percent), sunflower (10.3 per cent), safflower (8.9 percent) and Sesamum (4.0 percent). The districtwise growth in area, production and productivity of groundnut crop during 1990-91 to 2004-05 is presented in Table 4.13. As seen in earlier chapter, the area under groundnut crop has declined at the rate of 4.89 percent per annum and productivity was almost stagnant, which results in substantial decline of production of groundnut crop (4.27 percent per annum). Groundnut was major oilseed crop till 1990s, but thereafter availability of substitute in the form of Soybean crop, has brought decline in groundnut area. Satara, Kolhapur, Pune, Nashik, Dhule and Sangli are major groundnut growing districts. All the major growing districts have recorded decline in area, production and productivity (except in case on area in Pune district). Despite drastic decline in area under groundnut crop at the district levels as well as state level, which resulted in reduction in production, growth in productivity of groundnut was positive during the overall period. During period I, productivity growth was positive but very low as compared to decline in area, which could not offset (decline in) negative effect on production. However, during period II, despite very high growth in productivity, production declined at the rate of 1.68 percent per annum due to drastic decline in area under this crop (4.58 per cent per annum).

Safflower is another important oilseed crop grown in mainly the district of Latur, Aurangabad and Nashik divisions. It can be seen from the Table 4.14 that as like groundnut crop, there was decline in area, production and productivity of

safflower crop during the period 1990-91 to 2004-05. All the major safflower growing districts have recorded decline in production and productivity of safflower.

Table 4.13: Districtwise Growth Rates of Area, Production and Yield of Groundnut crop in Maharashtra State: 1990-91 to 2004-05 (percent per annum)

District /Divisions	Crop- Groundnut								
	Period I 1990-91 to 1999-00			Period II 2000-01 to 2004-05			Overall Period 1990-91 to 2004-05		
	A	P	Y	A	P	Y	A	P	Y
Ratnagiri	-3.23	-9.15 ^b	-6.11 ^b	-18.08	-14.57	4.16	0.06	-2.82	-2.88
Sindhudurg	0.87	-3.72	-4.56 ^b	2.31	1.44	-0.85	0.31	-1.13	-1.43
Konkan Div	0.17	-4.06^c	-4.22^b	-0.82	-0.93	-0.12	0.41	-1.08	-1.49^c
Nashik	-1.29 ^b	0.95	2.26	0.22	9.3	9.06	-2.35 ^a	-2.28	0.07
Dhule	-3.44 ^a	-2.68	0.78	1.43	33.06 ^b	31.18 ^c	-5.08 ^a	-4.86 ^c	0.24
Jalgaon	-12.09 ^a	-10.44 ^a	1.87	-6.0	9.27	16.25 ^b	-14.86 ^a	-15.16 ^a	-0.35
Nashik Div	-4.7^a	-3.6	1.16	0.26	19.96^b	19.65^b	-5.89^a	-5.95^a	-0.07
Ahmednagar	-5.31	-4.6	0.75	-13.76	-19.68	-6.87	-6.05 ^b	-8.72 ^a	-2.85 ^b
Pune	1.64	0.61	-1.01	-0.5	-5.57	-5.09	0.7 ^c	-1.64 ^c	-2.33 ^a
Solapur	1.71	1.72	0.01	-23.8	-30.81	-9.2	-12.51 ^a	-15.58 ^a	-3.5 ^c
Pune Div	-0.13	-1.15	-1.02	-6.13	-10.23	-4.37	-3.24^a	-5.36^a	-2.19^a
Satara	-3.73 ^b	-1.44	2.38	0.41	3.25	2.83	-0.99	0.11	1.11
Sangli	-3.69 ^b	-0.61	3.2	-10.62	-17.89	-8.13	-3.45 ^b	-5.06 ^b	-1.67
Kolhapur	-1.90	-1.35	0.56	-0.12	0.24	0.36	0.38	0.04	-0.34
Kolhapur Div	-3.07^b	-1.27	1.85	-1.92	-1.06	0.88	-0.96	-0.62	0.34
Aurangabad	-4.05 ^a	-0.69	3.5	-5.51	1.92	7.86	-6.25 ^a	-6.36 ^b	-0.12
Jalna	-11.74 ^a	-12.76 ^a	-1.16	-10.52	-7.22	3.69	-13.85 ^a	-13.63 ^a	0.25
Beed	-7.89 ^a	-7.79	0.11	-15.17 ^a	-17.01 ^c	-2.18	-8.73 ^a	-9.7 ^a	-1.07
Aurangabad Div	-7.17^a	-6.39	0.83	-10.93	-9.21	1.94	-8.45^a	-9.18^a	-0.8
Latur	-6.93 ^a	-1.93	5.38	-6.31 ^a	-19.04 ^c	-13.59	-6.2 ^a	-8.42 ^a	-2.37
Osmanabad	-3.27	-4.0	-0.76	-9.09	-10.66	-1.72	-6.78 ^a	-8.44 ^a	-1.79
Nanded	-7.88 ^c	-8.47 ^c	-0.64	-10.8	3.87	16.45	-5.65 ^b	-3.11	2.69
Parbhani	-11.88 ^a	-13.42 ^b	-1.76	-18.66	-23.12	-5.47	-12.22 ^a	-14.49	-2.58 ^c
Latur Div	-7.71^a	-8.87^b	-1.26	-9.99^a	-11.3	-1.46	-7.85^a	-9.24	-1.51
Buldhana	-7.98 ^b	-5.09	3.15	-45.03 ^a	-43.46 ^a	2.85	-17.49 ^a	-17.51 ^a	-0.02
Akola	-11.6 ^a	-11.49 ^b	0.13	-29.27 ^a	-29.78 ^c	-0.72	-15.23 ^a	-12.38 ^a	3.36
Amravati	-13.71 ^a	-6.85	7.94 ^c	-25.75 ^b	-21.14	6.21	-19.13 ^a	-16.91 ^a	2.75
Yavatmal	-8.57 ^b	-8.38 ^b	0.21	-28.42	-30.07	-2.31	-9.44 ^a	-8.82 ^b	0.68
Amravati Div	-10.63^a	-6.71^c	4.38	-30.81^a	-27.38^c	4.96	-15.16^a	-12.97^a	2.58
Wardha	-12.61 ^a	-10.61 ^b	2.29	-12.14	-8.97	3.6	-14.69 ^a	-12.8 ^a	2.21
Nagpur	-5.82 ^a	-0.92	5.21	-11.45 ^b	-12.63	-1.34	-8.12 ^a	-7.86 ^a	0.27
Bhandara	-8.52 ^a	-11.79 ^a	-3.57	-16.58	-22.32	-6.89	-10.19 ^a	-13.17 ^a	-3.32 ^b
Nagpur Div	-8.16^a	-4.96^c	3.48	-12.45^b	-13.47^b	-1.17	-10.3^a	-9.81^a	0.54
Maharashtra	-4.65^a	-3.15	1.57	-4.58	-1.68	3.04	-4.89^a	-4.27^a	0.65

Notes and Sources: Same as in Table 4.1.

Table 4.14: Districtwise Growth Rates of Area, Production and Yield of Safflower crop in Maharashtra State: 1990-91 to 2004-05 (percent per annum)

District /Divisions	Crop: Safflower								
	Period I 1990-91 to 1999-00			Period II 2000-01 to 2004-05			Overall Period 1990-91 to 2004-05		
	A	P	Y	A	P	Y	A	P	Y
Ahmednagar	-5.38 ^a	-9.34	-4.19	-10.05 ^a	-14.35	-4.78	-7.26 ^a	-8.86 ^b	-1.73
Pune	-9.28 ^a	-20.54 ^b	-12.41	-28.89 ^c	-56.50	-38.82	-11.42 ^a	-18.68 ^a	-8.20
Solapur	-11.02 ^a	-8.93	2.35	-6.21 ^c	-10.28	-4.34	-9.70 ^a	-12.59 ^a	-3.20
Pune Div	-8.08 ^a	-11.53 ^c	-3.75	-12.99 ^b	-22.29	-10.68	-8.90 ^a	-11.53 ^a	-2.89
Satara	2.36	-1.50	-3.78	-28.18 ^b	-34.17	-8.33	-3.03	-6.53	-3.61
Sangli	-6.57	-8.77	-2.35	-38.50 ^b	-41.96	-5.63	-10.45 ^a	-13.75 ^b	-3.68
Kolhapur Div	-2.61	-6.11	-3.60	-34.45 ^a	-38.89	-6.77	-7.46 ^a	-10.94 ^b	-3.76
Aurangabad	-4.13	-11.82	-8.01	-8.62	4.80	14.69	-8.01 ^a	-9.35 ^b	-1.45
Jalna	-3.74	-11.71	-8.28	-3.19	8.37	11.94	-7.05 ^a	-3.91	3.38
Beed	-0.76	-1.63	-0.88	-6.22 ^b	-6.22	-0.01	-1.31	-2.38	-1.09
Aurangabad Div	-3.13	-9.04	-6.10	-6.04 ^c	2.42	9.00	-5.58 ^a	-5.26	0.34
Latur	7.73	9.84	1.96	2.71 ^c	1.50	-1.18	3.06	3.74	0.65
Osmanabad	1.00	-3.19	-4.15	1.04	-0.14	-1.17	-0.35	-1.28	-0.94
Nanded	-0.23	-0.26	-0.02	5.81 ^a	12.97	6.76	-1.48	0.72	2.23
Parbhani	-2.21	-14.63	-12.70	6.79 ^b	-0.64	-6.96	-1.37	-2.50	-1.14
Latur Div	0.22	-5.08	-5.29	4.37 ^a	1.48	-2.77	-0.52	-0.79	-0.28
Buldhana	-9.50	-18.79	-10.26	-23.91 ^b	-25.03 ^a	-1.48	-23.94 ^a	-26.47 ^a	-3.33
Akola	1.44	-8.29	-9.60	-24.11 ^a	-21.67 ^b	3.21	-13.34 ^a	-14.82 ^a	-1.71
Amravati	28.19 ^b	14.95	-10.33	-3.82	-2.37	1.50	-1.17	-3.65	-2.51
Yavatmal	-11.40	-13.90	-2.82	-32.10 ^a	-18.77 ^b	19.62 ^c	-19.74	-17.30 ^a	3.05
Amravati Div	-2.56	-12.07	-9.75	-19.59 ^b	-18.05 ^a	1.91	-16.70 ^a	-18.56 ^a	-2.24
Maharashtra	-3.91	-9.38	-5.69	-4.70 ^b	-4.90	-0.21	-6.02 ^a	-7.02 ^b	-1.06

Notes and Sources: Same as in Table 4.1.

Area under Sunflower crop is mainly concentrated in Latur, Aurangabad and Pune divisions. It can be seen from the Table 4.15 that negative growth in area, production and productivity was also observed in case of sunflower crop. Almost all the districts have recorded declined in area, production and productivity of sunflower crop, The Table 4.16 also same kind of picture in case of Sesamum crop. There was substantial reduction in area under Sesamum (7.76 percent per annum), resulted in reduction in production at same rate due to positive but stagnant productivity level. All the district have recorded declined in area under Sesamum, however, except Nashik and Aurangabad divisions, all the divisions recorded marginal increase in productivity, which could not substitute the decline in area.

Table 4.15: Districtwise Growth Rates of Area, Production and Yield of Sunflower crop in Maharashtra State: 1990-91 to 2004-05 (percent per annum)

District /Divisions	Crop: Sunflower								
	Period I 1990-91 to 1999-00			Period II 2000-01 to 2004-05			Overall Period 1990-91 to 2004-05		
	A	P	Y	A	P	Y	A	P	Y
Nashik	3.27	-9.04	-11.92	-16.71	-19.21	-3.00	-5.22	-7.55	-2.46
Dhule	-4.91	-16.19	-11.85	-3.78	-6.7	-3.04	-6.35	-8.42	-2.21
Jalgaon	-11.6	-25.36	-15.56	-12.98	-9.82	3.63	-15.11	-17.61	-2.94
Nashik Div	-6.44	-19.43	-13.88	-10.84	-11.36	-0.58	-10.40	-13.02	-2.92
Ahmednagar	-8.27 ^a	-16.11	-8.55	-9.29	-16.07	-7.47	-8.35	-9.67	-1.43
Pune	-0.28	-8.23	-7.97	-10.88	-14.16	-3.68	-3.74	-6.02	-2.37
Solapur	-5.44	-14.3	-9.37	-7.88	-17.48	-10.42	-7.54	-11.62	-4.42
Pune Div	-5.95	-14.5	-9.09	-8.46	-16.3	-8.57	-7.59	-10.54	-3.20
Satara	2.11	-4.73	-6.70	3.8	-2.41	-5.98	1.71	-1.49	-3.15
Sangli	6.02	-4.24	-9.68	-3.17	-11.26	-8.35	3.86	-0.05	-3.76
Kolhapur	13.84	6.62	-6.34	30.41	26.41	-3.07	15.57	16.21	0.56
Kolhapur Div	5.06	-3.86	-8.49	-0.32	-5.59	-5.29	3.56	0.71	-2.75
Aurangabad	3.84	-3.34	-6.92	22.08	21.45	-0.52	-4.49	-6.84	-2.47
Jalna	4.09	-4.32	-8.09	-1.77	-3.01	-1.26	-4.53	-7.36	-2.96
Beed	-2.51	-9.96	-7.64	1.54	-1.14	-2.64	-5.85	-7.95	-2.23
Aurangabad Div	-0.02	-7.31	-7.30	4.54	2.62	-1.83	-5.35	-7.60	-2.38
Latur	2.01	-7.14	-8.97	3.23	1.87	-1.32	-0.98	-3.18	-2.23
Osmanabad	1.54	-5.87	-7.30	-0.14	-6.25	-6.13	-1.92	-4.77	-2.91
Nanded	-1.51	-10.95	-9.59	11.75	16.33	4.10	-4.07	-4.69	-0.64
Parbhani	-2.83	-11.48	-8.90	-1.06	-6.9	-5.91	-3.96	-3.41	0.57
Latur Div	0.56	-7.81	-8.32	2.07	-0.27	-2.29	-2.22	-3.72	-1.53
Buldhana	1.2	-9.43	-10.50	-26.83	-30.75	-5.36	-15.37	-15.95	-0.69
Akola	5.27	-3.61	-8.44	-24.94	-27.00	-2.75	-6.75	-7.30	-0.59
Amravati	15.02	7.27	-6.74	-10.39	-13.86	-3.87	0.60	0.05	-0.54
Yavatmal	-11.02	-15.93	-5.51	-32.95	-34.80	-2.76	-18.45	-19.49	-1.28
Amravati Div	1.59	-6.67	-8.13	-23.25	-26.02	-3.60	-10.41	-10.99	-0.65
Nagpur	36.61	30.58	-4.41	5.97	4.14	-1.73	9.31	9.00	-0.29
Nagpur Div	17.93	12.74	-4.40	2.82	-7.79	-10.32	-1.51	-0.52	1.00
Maharashtra	-0.94	-9.29	-8.42	-0.89	-3.78	-2.93	-4.32	-6.13	-1.88

Notes and Sources: Same as in Table 4.1.

Maharashtra is the second largest Soybean growing state in the country, accounts for about 25 percent area and 33 percent of production of national basket in the year 2996-07. In Maharashtra, area under soybean crop was around 26 lakh hectares in 2007-08. Soybean crop is mostly grown in Vidarbha region (i.e. Amravati and Nagpur divisions) and Latur division. Vidarbha region contributes 66 percent area under soybean of the state and it becoming popular day by day. It can be seen from the Table 4.17 that area, production and productivity of soybean crop

increased significantly at the rate of 15.48, 18.01 and 2.19 percent per annum respectively during the period 1990-91 to 2004-05. Except Bhandara district, all other major soybean districts have recorded substantial increase in area and production of soybean crop during the period under study. It is observed that farmers in Vidarbha region are gradually switching over to soybean from cotton, Jowar, tur and other traditional crops. One of the most important economic factors which act as an incentive to the farmer for shifting area from cotton, Jowar, tur, groundnut to its substitute (Soybean) crop, due to higher yield and remunerative price for soybean crop.

Table 4.16: Districtwise Growth Rates of Area, Production and Yield of Sesamum crop in Maharashtra State: 1990-91 to 2004-05 (percent per annum)

District /Divisions	Crop: Sesamum								
	Period I 1990-91 to 1999-00			Period II 2000-01 to 2004-05			Overall Period 1990-91 to 2004-05		
	A	P	Y	A	P	Y	A	P	Y
Konkan Div	-11.99^c	-7.30	5.34	-6.24	-10.59^c	-4.64	-9.86^a	-7.89^a	2.19
Dhule	-1.85	-0.34	1.03	1.16	18.38	17.02	-0.46	0.56	1.02
Jalgaon	-13.30 ^a	-13.12 ^a	0.20	0.95	5.78	4.78	-8.84 ^a	-9.12 ^a	-0.32
Nashik Div	-10.83^a	-10.84^a	-0.02	1.02	8.88	7.78	-6.96^a	-7.21^a	-0.26
Ahmednagar	-10.80 ^a	-10.90	-0.11	-6.48	5.92	13.26 ^c	-6.02 ^a	-4.08	2.07
Pune	-1.01	-2.75	-1.76	-8.49 ^b	-0.06	9.21	0.47	1.15	0.68
Pune Div	-4.87^c	-6.31	-1.51	-9.29	-0.24	9.97	-2.97^b	-1.91	1.09
Kolhapur Div	25.69	14.21	-9.13^b	-10.89	-12.94	-2.30	0.18	-2.90	-3.07
Aurangabad	-10.68 ^a	-11.87 ^a	-1.34	-6.45	-7.17	-0.77	-7.22 ^a	-8.72 ^a	-1.61
Jalna	-5.46 ^a	-5.02	0.47	-5.68 ^b	-5.90	-0.23	-3.85 ^a	-4.54 ^a	-0.72
Beed	-3.45 ^b	-6.45 ^c	-3.11	-10.10	-11.31	-1.34	-4.24 ^a	-6.27 ^a	-2.13
Aurangabad Div	-6.89^a	-8.51^b	-1.74	-7.92	-8.77	-0.93	-5.41^a	-6.97^a	-1.64
Latur	-4.32 ^c	1.32	5.90	-9.15 ^a	-15.40	-6.88	-5.95 ^a	-6.37 ^b	-0.45
Osmanabad	-2.50	-2.74	-0.24	0.07	-0.53	-0.60	-2.26 ^b	-0.92	1.37
Nanded	-5.17 ^a	-3.78	1.46	-6.13	-9.37	-3.45	-4.36 ^a	-3.03	1.39
Parbhani	-5.63 ^a	-4.47	1.23	5.95 ^b	1.79	-3.93	-2.05 ^c	-0.56	1.53
Latur Div	-4.63^a	-2.00	2.75	-2.99	-5.74	-2.83	-4.06^a	-2.87	1.23
Buldhana	-12.15 ^b	-7.12	5.74 ^c	-4.47 ^a	-10.82	-6.65	-10.80 ^a	-8.70 ^a	2.35
Akola	-11.24 ^b	-5.84	6.09	-7.02	-15.59 ^c	-9.21	-8.47 ^a	-7.75 ^b	0.78
Amravati	-12.72 ^a	-13.72 ^a	-1.14	-29.98 ^a	-35.06	-7.26	-12.18 ^a	-14.39 ^a	-2.52
Yavatmal	-8.44 ^a	-4.83	3.94	-13.3 ^a	-21.01 ^c	-8.89	-6.83 ^a	-6.49 ^a	0.37
Amravati Div	-10.69^a	-6.43	4.77^c	-11.15^a	-17.93^b	-7.63	-9.40^a	-8.56^a	0.93
Bhandara	0.91	5.42	4.47	-0.97	-17.68 ^b	-16.88 ^b	-0.85	0.36	1.22
Chandrapur	-26.81 ^a	-20.31 ^b	8.88	-17.08 ^b	-23.72	-8.01	-24.71 ^a	-21.99 ^a	3.61
Gadchiroli	3.31 ^c	7.54	4.09	10.55 ^a	8.45 ^b	-1.90	-7.67 ^a	-5.23	2.64
Nagpur Div	-15.64^a	-11.94^b	4.38	-3.35^b	-11.55	-8.48^c	-17.28^a	-15.2^{a1}	2.50
Maharashtra	-9.39^a	-8.06^a	1.47	-4.29^c	-3.57	0.75	-7.76^a	-7.14^a	0.68

Notes and Sources: Same as in Table 4.1.

Table 4.17: Districtwise Growth Rates of Area, Production and Yield of Soybean crop in Maharashtra State: 1990-91 to 2004-05 (percent per annum)

District /Divisions	Crop- Soybean								
	Period I 1990-91 to 1999-00			Period II 2000-01 to 2004-05			Overall Period 1990-91 to 2004-05		
	A	P	Y	A	P	Y	A	P	Y
Nashik	26.16 ^a	33.88 ^a	6.13 ^a	28.05 ^c	43.15 ^c	11.79	23.67 ^a	29.76 ^a	4.93 ^a
Dhule	36.54 ^a	43.47 ^a	5.08 ^b	2.64	15.00	12.04	19.07 ^a	21.95 ^a	2.42
Jalgaon	30.85 ^b	38.77 ^a	6.06 ^c	25.86 ^c	54.77 ^a	22.96 ^c	18.53 ^a	25.70 ^a	6.05 ^a
Nashik Div	27.5 ^a	35.35	6.16 ^b	20.95	39.80 ^a	15.58 ^c	19.37 ^a	25.10 ^a	4.80 ^a
Ahmednagar	53.15 ^a	60.38	4.72	49.89 ^a	64.32 ^a	9.62	46.01 ^a	50.50 ^a	3.08 ^c
Pune	0.87	4.91	4.00	15.99	64.38 ^b	41.71 ^a	3.43	11.4 ^b	7.71 ^a
Solapur	23.35 ^b	27.22 ^b	3.14	33.79	40.94	5.34	11.98 ^b	16.64 ^b	4.16 ^c
Pune Div	30.52 ^a	35.41 ^a	3.75	47.08 ^a	62.18 ^a	10.26 ^c	30.83	34.99	3.18 ^c
Satara	22.26 ^a	33.98 ^a	9.59 ^a	15.05 ^c	6.87	-7.11 ^c	16.22 ^a	24.46 ^a	7.09 ^a
Sangli	12.74 ^a	17.04 ^a	3.81	3.00	-8.15	-10.83	7.63 ^a	10.32 ^a	2.5
Kolhapur	16.3 ^a	21.57 ^a	4.53	4.46 ^c	1.06	-3.26	10.04 ^a	12.68 ^a	2.4
Kolhapur Div	15.01 ^a	19.88 ^a	4.24	5.33	-2.71	-7.63	9.48 ^a	12.38 ^a	2.65 ^c
Aurangabad	37.57 ^b	42.52 ^b	3.60	15.58	24.33	7.57	16.9 ^b	18.37 ^b	1.26
Jalna	62.92 ^a	57.9 ^b	-3.08	38.65 ^a	64.85 ^a	18.90	37.63 ^a	37.58 ^a	-0.03
Beed	4.79	5.67	0.84	74.66 ^a	59.66 ^b	-8.59	24.76 ^a	26.75 ^a	1.6
Aurangabad Div	26.5 ^b	29.8 ^b	2.61	47.49 ^a	53.10 ^b	3.81	23.92 ^a	25.04 ^a	0.9
Latur	46.06 ^b	48.34 ^a	1.56	127.97 ^a	105.13 ^b	-10.02	44.03 ^a	42.69 ^a	-0.93
Osmanabad	69.81 ^a	56.38 ^a	-7.91 ^c	101.18 ^a	136.77 ^b	17.69	44.29 ^a	39.16 ^a	-3.55
Nanded	57.64 ^a	65.67 ^a	5.09 ^c	81.29 ^a	78.55 ^a	-1.52	55.87 ^a	58.90 ^a	1.94
Parbhani	57.7 ^a	68.22 ^a	6.67 ^c	61.51 ^a	50.66 ^b	-6.72	55.98 ^a	60.26 ^a	2.75
Latur Div	58.79 ^a	64.9 ^a	3.85	81.19 ^a	69.26 ^a	-6.58	52.28 ^a	55.38 ^a	2.04
Buldhana	105.98 ^a	112.28 ^a	3.06	18.28 ^b	25.52 ^b	6.12	58.60 ^a	62.18 ^a	2.25
Akola	49.32 ^a	56.33 ^a	4.69 ^c	18.96 ^b	13.00 ^a	-5.01	38.46 ^a	41.39 ^a	2.12
Amravati	21.72 ^a	32.72 ^a	9.03	-1.39	-4.74	-3.39	13.79 ^a	14.82 ^a	0.91
Yavatmal	45.81 ^a	57.69 ^a	8.15 ^b	22.47 ^b	5.64	-13.74	29.80 ^a	31.19 ^a	1.07
Amravati Div	30.83 ^a	41.86 ^a	8.42	12.53 ^c	9.29	-2.88	22.80 ^a	25.81 ^a	2.45
Wardha	22.21 ^a	27.32 ^a	4.18	10.91 ^a	9.27	-1.48	15.57 ^a	18.79 ^a	2.79 ^b
Nagpur	12.46 ^a	15.29 ^a	2.52	2.39	3.47	1.05	5.83 ^a	7.72 ^a	1.79
Bhandara	3.7	10.74 ^b	6.79 ^b	1.22	8.76	7.45	-1.19	2.03	3.26 ^c
Chandrapur	13.23 ^c	33.19 ^a	17.63 ^c	9.21	3.78 ^c	-4.98	16.08 ^a	19.97 ^a	3.36
Gadchiroli	50.24 ^a	51.5 ^a	0.84	13.79 ^a	15.17 ^b	1.21	29.05 ^a	29.71 ^a	0.51
Nagpur Div	14.77 ^a	21.73 ^a	6.07 ^b	6.66 ^b	5.79	-0.82	9.89 ^a	12.97 ^a	2.79 ^b
Maharashtra	19.31 ^a	26.31 ^a	5.87 ^b	17.17 ^b	12.57 ^b	-3.93	15.48 ^a	18.01 ^a	2.19 ^c

Notes and Sources: Same as in Table 4.1.

Due to substantial increase in area and production of soybean crop in all the districts of the state, the total oilseed production in the state increased at the rate of 3.85 per cent per annum during 1990-91 to 2004-05 (Table 4.18). It is very surprise to note that productivity of total oilseed has increased significantly at the rate of 3.4 percent per annum. It is welcome shift of area from coarse cereals, cotton to soybean crop, which give some ray of hopes to farmers of rainfed area.

Table 4.18: Districtwise Growth Rates of Area, Production and Yield of Total Oilseeds in Maharashtra State: 1990-91 to 2004-05 (percent per annum)

District /Divisions	Total Oilseeds								
	Period I 1990-91 to 1999-00			Period II 2000-01 to 2004-05			Overall Period 1990-91 to 2004-05		
	A	P	Y	A	P	Y	A	P	Y
Thane	-0.13	0.02	0.16	-16.41 ^b	4.64	25.19 ^c	-1.14	0.68	1.84
Raigad	2.49	-4.22	-6.55 ^c	-35.03	5.92	63.04 ^b	-3.96	0.78	4.93
Ratnagiri	-1.26	-4.25 ^c	-3.03	-20.28 ^b	0.60	26.20 ^b	-6.16 ^b	-3.73 ^a	2.58
Sindhudurg	1.42 ^c	-2.85	-4.21 ^b	-24.61 ^b	1.65	34.84 ^c	-4.55 ^b	-1.08	3.64
Konkan Div	0.45	-2.72	-3.15	-22.99 ^b	2.10	32.57 ^b	-4.23	-1.26	3.11
Nashik	-0.35	2.89	3.26	4.16	19.89 ^a	15.11 ^a	0.10	1.83	1.73
Dhule	-2.79 ^a	-1.98	0.83	1.01	29.13 ^b	27.84 ^c	-4.10 ^a	-3.73 ^c	0.38
Jalgaon	-13.16 ^a	-12.05	1.28	1.47	20.27 ^a	18.53 ^b	-10.98 ^a	-10.32 ^a	0.74
Nashik Div	-5.76 ^a	-3.97 ^c	1.89	2.34 ^c	22.95 ^a	20.14 ^b	-5.06 ^a	-4.04 ^b	1.08
Ahmednagar	-5.47 ^a	-3.82	1.75	0.25	3.79	3.53	-4.26 ^a	-3.76 ^b	0.52
Pune	-2.25 ^b	-1.82	0.43	-5.93 ^c	-7.87 ^c	-2.06	-2.68 ^a	-2.97 ^a	-0.30
Solapur	-5.30 ^b	-4.93	0.39	-9.73	-17.84	-8.98	-8.50 ^a	-11.72 ^a	-3.53
Pune Div	-4.48 ^a	-3.67 ^c	0.85	-4.98	-4.46	0.54	-5.28 ^a	-5.30 ^a	-0.02
Satara	-1.50	1.53	3.08	2.00	3.87	1.83	0.60	2.59 ^b	1.98 ^b
Sangli	2.57 ^b	7.98 ^a	5.28 ^b	-4.25	-5.75	-1.57	1.11	3.63 ^b	2.49 ^b
Kolhapur	4.36 ^a	6.44 ^b	1.99	2.16 ^c	0.64	-1.48	3.62 ^a	4.19 ^a	0.55
Kolhapur Div	2.01 ^a	5.50 ^b	3.42 ^c	0.21	-0.50	-0.71	1.94 ^a	3.61 ^a	1.64 ^c
Aurangabad	-3.81	-2.36	1.51	-2.97	7.16 ^c	10.43 ^c	-6.77 ^a	-6.05 ^b	0.76
Jalna	-2.48	-3.17	-0.72	3.30 ^c	15.48 ^a	11.80	-4.89 ^a	-2.19	2.84
Beed	-4.63	-5.17	-0.56	1.70	6.93	5.14	-3.89 ^a	-2.94	0.98
Aurangabad Div	-3.85	-3.83	0.03	0.79	9.31	8.45 ^c	-4.99 ^a	-3.61	1.45
Latur	-0.34	-0.36	-0.02	22.48 ^b	30.36 ^c	6.43	1.12	3.14	2.00
Osmanabad	0.32	-2.09	-2.40	3.57	5.74	2.09	-1.61 ^c	-1.36	0.25
Nanded	-2.83 ^b	-2.45	0.40	31.78 ^a	48.00 ^b	12.31	2.62	7.72 ^b	4.97 ^b
Parbhani	-4.37 ^c	-6.26	-1.98	23.78 ^a	26.13	1.90	1.58	4.54	2.91
Latur Div	-1.56	-3.01	-1.47	19.30 ^a	27.07 ^b	6.52	0.82	3.84	3.00
Buldhana	-1.34	5.14	6.57 ^c	10.86	20.47 ^b	8.66	-0.37	7.09 ^b	7.49 ^a
Akola	8.21 ^a	17.63 ^a	8.70 ^b	13.23	10.64 ^a	-2.28	8.86 ^a	16.61 ^c	7.12 ^a
Amravati	12.17 ^a	24.59 ^a	11.08 ^a	-2.94	-5.22	-2.36	7.17 ^a	9.76 ^a	2.42
Yavatmal	10.57 ^a	24.72 ^a	12.79 ^a	17.45 ^c	3.91	-11.53	10.21 ^a	15.20 ^a	4.53 ^c
Amravati Div	7.07 ^a	18.79 ^a	10.95 ^a	8.38	7.24	-1.06	6.04 ^a	11.93 ^a	5.55 ^a
Wardha	9.84 ^a	19.73 ^a	9.00 ^a	10.10 ^b	8.83	-1.15	8.44 ^a	14.45 ^a	5.54 ^a
Nagpur	7.38 ^a	12.28 ^a	4.57	1.13	2.73	1.58	2.58 ^b	5.82 ^a	3.15 ^b
Bhandara	-1.76	4.68 ^c	6.56 ^c	-6.22 ^a	2.80	9.62	-6.32 ^a	-1.76	4.87 ^a
Chandrapur	6.02 ^b	28.26 ^a	20.97 ^a	9.12 ^b	3.95 ^c	-4.74 ^c	5.60 ^a	15.49	9.36 ^a
Gadchiroli	7.13 ^b	11.44 ^a	4.02	5.46	7.39	1.83	-2.93	5.01 ^b	8.18 ^a
Nagpur Div	6.90 ^a	17.25 ^a	9.69 ^a	5.45 ^c	5.26	-0.18	3.95 ^a	9.88 ^a	5.71 ^a
Maharashtra	0.36	5.24 ^c	4.86 ^b	6.71 ^c	8.05 ^b	1.25	0.44	3.85 ^a	3.40 ^a

Notes and Sources: Same as in Table 4.1.

Commercial Crops:

Cotton is one of the important and ancient cash crops of the country. It occupies a significant place both in the agricultural and industrial (textile) economy of the country. Though India is the third-largest producer of cotton in the world,

cotton yield in India is one of the lowest in the world because its cultivation is predominantly under rainfed condition. The major cotton producing states are Maharashtra, Gujarat and Andhra Pradesh. While these three states together occupied about 71 percent of India's total area in 2006-07, Maharashtra State alone accounted for 34 percent during the same period. Unlike other commercial crops, at the national level, almost 66 percent of area under cotton was cultivated under rainfed condition as late as during 2005-06 (GOI, 2008), however, only 4.8 percent cotton area is irrigated in Maharashtra. The districtwise growth in area, production and productivity of cotton crop is presented in Table 4.19. It can be seen from the table that though area under cotton crop is almost stable during the period 1990-91 to 2004-05, production and productivity level has increased significantly at the rate of 3.55 percent and 2.80 percent per annum. Farmers cultivating cotton crop have been encountering many problems, some of which are totally different from other crops. While predominant cultivation of cotton under rainfed condition increases the uncertainty in getting expected yield, different kinds of pests attack significantly reduce the yield of crop. Controlling bollworms was major as well as a persistent problem standing before the farmers. Bt cotton varieties were released in Maharashtra during the agricultural season 2002-03, which leads to significant increase in production and productivity of cotton crop in the state (see Table 4.19). The expenditure towards control of bollworm has come down after introduction of Bt cotton, but attack of sucking pest on cotton during last two years has again increase cost of insecticide as well as cost of cultivation of cotton. Cotton crop is heavily grown in Amravati, Akola, Yavatmal, Buldhana, Jalna, Aurangabad and Jalgaon districts. Except Jalna, Aurangabad and Jalgaon, area and production of cotton has decreased in all other major cotton growing districts. Despite increase in productivity and production of cotton, one disconcerting factor which is a subject of major concern and can hardly be overlooked is the reports of agrarian distress in the Vidarbha region associated with cotton farming. The cause and effect relationships are drawn from the vulnerability of cotton crop to the vagaries of nature and pest infestation, particularly in the low productivity region. Since most of cotton grown in the area is rainfed, irrigation potential should be increased by completing ongoing projects besides taking up lift irrigation through wells, pumps sets and creating water reservoirs. Also drought tolerance varieties should be developed.

Table 4.19: Districtwise Growth Rates of Area, Production and Yield of Cotton in Maharashtra State: 1990-91 to 2004-05 (percent per annum)

District /Divisions	Crop: Cotton								
	Period I 1990-91 to 1999-00			Period II 2000-01 to 2004-05			Overall Period 1990-91 to 2004-05		
	A	P	Y	A	P	Y	A	P	Y
Nashik	28.18 ^b	24.4 ^c	-2.94	21.24 ^c	30.50	7.64	23.58 ^a	19.18 ^a	-3.56 ^c
Dhule	5.37 ^a	8.58 ^a	3.04	3.11 ^a	26.85 ^b	23.02 ^c	3.87 ^a	4.57 ^b	0.67
Jalgaon	7.52 ^a	13.85 ^a	5.89 ^c	-1.25	17.26 ^b	18.75	6.17 ^a	8.92 ^a	2.59
Nashik Div	7.13^a	12.91^a	5.39^c	-0.03	18.98^b	19.02	5.77^a	8.23^a	2.33
Ahmednagar	31.3 ^a	36.83 ^a	4.21	-2.58	-4.04	-1.51	23.89 ^a	22.44 ^a	-1.17
Pune	12.06 ^b	18.24 ^b	5.52	-38.44 ^b	-38.06 ^b	0.62	3.16	5.66	2.42
Solapur	7.70 ^a	12.57 ^a	4.52 ^b	-23.49	-36.45 ^c	-16.94	-4.63	-1.79	2.98
Pune Div	18.05^a	22.81^a	4.04^c	-10.30	-11.05	-0.83	12.21^a	11.82^a	-0.34
Satara	25.73 ^a	26.19 ^a	0.36	-45.91 ^b	-50.27 ^a	-8.06	1.60	-2.63	-4.16 ^a
Sangli	5.88 ^a	8.69 ^b	2.66	-34.65 ^c	-58.31 ^a	-36.20	-0.39	-7.08	-6.72
Kolhapur	1.27	7.29	5.95 ^c	-19.73	-12.94	8.45	0.93	0.60	-0.33
Kolhapur Div	14.94^a	17.21^a	1.97	-39.53^b	-51.99^a	-20.61	0.19	-4.72	-4.91
Aurangabad	13.71 ^a	13.07 ^a	-0.56	11.44 ^b	42.82	28.16	9.07 ^a	8.50 ^a	-0.52
Jalna	4.26 ^a	8.73 ^a	4.28	4.68 ^c	15.82	10.64	2.30 ^a	7.33 ^a	4.92 ^a
Beed	17.38 ^a	19.61 ^a	1.9	2.67	22.88	19.68 ^c	8.28 ^a	8.89 ^a	0.56
Aurangabad Div	9.64^a	12.01^a	2.16	6.81^c	26.37	18.31	5.63^a	7.99^a	2.24
Latur	3.22 ^b	8.88 ^c	5.49	-29.0 ^b	-27.49 ^c	2.12	-8.61 ^a	-4.71	4.27 ^b
Nanded	1.87 ^b	5.39	3.46	-4.15	20.74	25.97 ^c	-0.42	2.54	2.98
Parbhani	2.24 ^a	7.88 ^c	5.52	-3.97 ^b	12.95	17.62	0.00	4.24 ^c	4.24 ^c
Latur Div	2.20^a	6.92	4.63	-4.58^c	14.42	19.91	-0.39	3.39	3.79^c
Buldhana	0.97	7.35 ^c	6.32	-3.82	13.65	18.16	-1.96 ^b	2.63	4.67 ^c
Akola	0.89	4.38	3.45	-4.89 ^a	-3.03	1.95	-0.89	0.37	1.28
Amravati	-0.7	-3.0	-2.31	-4.69 ^c	9.49	14.88	-2.03 ^a	-1.31	0.74
Yavatmal	1.38 ^b	4.63	3.2	-7.17 ^a	5.96	14.14	-0.61	2.17	2.80
Amravati Div	0.66	3.11	2.44	-5.40^a	5.52	11.54	-1.27^b	0.86	2.16
Wardha	0.09	-0.45	-0.54	-9.34 ^b	-3.25	6.72	-1.67 ^b	-0.28	1.41
Nagpur	-0.02	6.42	6.44	0.40	15.15	14.69	2.25 ^a	6.54 ^a	4.20 ^b
Chandrapur	-2.32 ^b	2.61	5.05 ^c	-3.84	9.92	14.31 ^c	-1.58 ^a	0.68	2.30
Nagpur Div	-0.47	1.78	2.26	-5.33^c	4.25	10.13	-0.65	1.63	2.29
Maharashtra	2.61^a	6.39^c	3.68	-2.77^c	12.10^c	15.29	0.73	3.55^b	2.80^c

Notes and Sources: Same as in Table 4.1.

Sugarcane is another important crop of state agriculture as far as its contribution to total national production is concern. Maharashtra state accounts for about 22 percent of total national production in the year 2006-07. However, predominant practice of mono-cropping pattern is one of the problems of Maharashtra's agriculture. Sugarcane has been cultivated repeatedly in Western Maharashtra over the last four decades. Pune and Kolhapur divisions' together account for nearly 62 percent of sugarcane area in TE 2004-05. Despite severe water scarcity in the state, area under sugarcane has increased nearly four times between TE 1962-63 (1.48 lakh ha) and TE 2001-02 (5.87 lakh ha) in the state. The

share of sugarcane area in GCA has also increased from just 0.78 percent to 2.63 percent during this period. It can be seen from the Table 4.20 that area under sugar crop has decreased at the rate of 1.06 percent per annum, also the sugarcane production by 0.29 percent per annum. The sugarcane productivity is almost stagnant during last one and half decade. This is because of sugarcane mono-cropping. Due to which, not only the soil fertility has deteriorated over the years but the productivity has also stagnated or declined due to certain pests and diseases associated with mono-cropping pattern.

Table 4.20: Districtwise Growth Rates of Area, Production and Yield of Sugarcane crop in Maharashtra State: 1990-91 to 2004-05 (percent per annum)

District /Divisions	Crop: Sugarcane								
	Period I 1990-91 to 1999-00			Period II 2000-01 to 2004-05			Overall Period 1990-91 to 2004-05		
	A	P	Y	A	P	Y	A	P	Y
Nashik	-6.67 ^b	-8.09 ^b	-1.51	-19.58 ^a	-25.25	-7.05 ^b	-5.32 ^a	-7.48 ^a	-2.28 ^a
Dhule	-2.92	0.46	3.48 ^a	-14.68 ^a	-14.62 ^b	0.07	-5.64 ^a	-5.14 ^b	0.52
Jalgaon	-4.38	-0.67	3.88 ^b	-2.89	-12.72	-10.12	-2.50 ^c	-2.79 ^c	-0.30
Nashik Div	-5.15^c	-4.43^c	0.76	-13.12^a	-18.29^a	-5.95	-4.56^a	-5.68	-1.18
Ahmednagar	0.82	3.14	2.30	-32.09 ^a	-34.05 ^a	-2.89	-5.12 ^b	-5.75 ^c	-0.66
Pune	3.08 ^c	6.89 ^a	3.69 ^c	-18.26 ^b	-15.86 ^b	2.93	-0.60	1.54	2.16 ^b
Solapur	6.86 ^a	10.72 ^a	3.62 ^a	-16.34 ^a	-18.96 ^a	-3.13	1.47	2.52	1.04
Pune Div	3.33	6.59^b	3.15	-21.83^a	-21.92^a	-0.11	-1.47	-0.53	0.96
Satara	0.21	6.16 ^a	5.94 ^a	-16.28 ^a	-16.65 ^b	-0.44	-3.31 ^a	-1.62	1.74 ^c
Sangli	5.5 ^b	10.48 ^a	4.72 ^a	-14.15 ^a	-13.56 ^b	0.69	0.71	2.92	2.20 ^a
Kolhapur	5.15 ^a	6.03 ^a	0.84	-6.76 ^c	-10.15	-3.64	2.22 ^b	2.16	-0.06
Kolhapur Div	3.82^b	7.14^a	3.2^b	-10.71^b	-12.29	-1.77	0.42	1.43	1.00
Aurangabad	-8.16 ^b	-5.34	3.08	-23.09 ^a	-19.49	4.68	-10.33 ^a	-9.56 ^a	0.86
Jalna	-4.78	-3.5	1.35	-27.55	-28.48 ^b	-1.27	-5.72 ^b	-4.54 ^c	1.25
Beed	2.72	4.3	1.53	-22.67	-26.94 ^b	-5.52	1.50	1.76	0.25
Aurangabad Div	-3.36	-1.38	2.05	-23.95^a	-25.76^b	-2.38	-4.35^b	-3.65^c	0.73
Latur	7.35 ^b	6.72	-0.59	-18.43	-21.94 ^a	-4.31	4.95 ^b	5.59	0.61
Osmanabad	2.01	6.3	4.21 ^b	-37.33	-44.0 ^a	-10.65	-2.43	-3.41	-1.00
Nanded	0.98	8.24 ^b	7.20 ^a	-12.55	-12.34	0.23	-1.00	1.43	2.45 ^c
Parbhani	5.67 ^b	9.72 ^b	3.83 ^c	-12.45	-16.49	-4.62	5.01 ^a	6.99 ^a	1.89 ^c
Latur Div	4.12^c	8.14^b	3.87^c	-19.27^b	-22.69^b	-4.23^a	2.04	3.25	1.19
Buldhana	-12.56 ^b	-12.84 ^a	-0.31	-12.54 ^c	-13.48 ^a	-1.07	-9.29 ^a	-7.28 ^a	2.21
Akola	-0.46	3.28	3.76	-20.02 ^c	-18.62	1.75	-1.74	-1.00	0.75
Amravati	7.04 ^c	12.82 ^b	5.4	-22.88 ^a	-29.15 ^b	-8.14	3.11	3.70	0.57
Yavatmal	-8.54	-2.59	6.51 ^b	-19.57 ^b	-21.48 ^b	-2.38	-5.75	-2.56	3.38 ^b
Amravati Div	-4.43	0.1	4.75^c	-19.77^a	-21.45^a	-2.09	-4.14^b	-2.33	1.88
Wardha	8.60 ^a	18.72 ^b	9.32	-22.17	-21.85 ^c	0.41	5.50 ^b	8.84 ^b	3.16
Nagpur	4.42	11.42	6.7 ^c	-19.17	-16.02 ^b	3.9	0.65	2.70	2.04
Bhandara	4.18	9.56 ^b	5.16 ^b	-16.34 ^b	-8.92	8.87	0.22	-0.73	-0.95
Nagpur Div	6.06^b	12.51^a	6.08^c	-19.68^b	-16.64^b	3.78	2.38	3.07	0.67
Maharashtra	1.78	4.86^b	3.02^b	-17.07^a	-18.31^b	-1.5	-1.06	-0.29	0.78

Notes and Sources: Same as in Table 4.1.

As mentioned earlier Chapter, though net returns per unit of water generated by sugarcane is very low when compared to most of the foodgrain crops (Rath and Mitra, 1989), estimates show that this crop alone consumes nearly two-third of irrigation water available in the state (World Bank, 2002). Unlimited supply of canal water for cultivating sugarcane crop and the support by the sugar industries for cultivating sugarcane are the two main reasons for the prevalence of mono-cropping pattern in the state. Continued support of the sugar industries (through state government) encourages the farmers to cultivate this water intensive crop. Keeping in view the water balance of the state, strict rules need to be enacted to discourage the cultivation of sugarcane under flood or conventional method of irrigation. By introducing volumetric pricing for canal water, cultivation of sugarcane may be discouraged in those areas where the productivity is stagnating or has started declining.

Horticultural Crops:

One of the significant changes that have taken place in the cropping pattern of the state especially in recent years is development in horticultural crops. Area under fruit and vegetable crops has increased by about 6.04 times (from 1.47 lakh in 1960-61 ha to 8.66 lakh ha in 2001-02) over the last 40 years. That is, area under fruits and vegetables accounted for only about 0.80 percent in TE 1962-63, but the same increased to nearly 7.82 percent in TE 2004-05. Within the group of fruits and vegetables, some significant changes have taken place over the years. While the share of area under grapes, mango and cashewnut has increased, the share of orange and guava has declined. Similar kind of changes is noticed in vegetable crops as well. The districtwise growth in area under total fruit and vegetable crops is presented in Table 4.21 and growth in area under chillies, condiments and spices crop is presented in Table 4.22. It can be seen from the Table 4.21 that area total fruits and total vegetables increased significantly at the rate of 7.24 percent and 2.48 percent per annum respectively. However, area under chillies crops as well as condiments and spices has declined at the rate of 1.62 and 1.74 percent per annum during 1990-91 to 2001-02 (Table 4.22).

Table 4.21: Districtwise Growth in Area under Total Fruits and Total Vegetables in Maharashtra State: 1990-91 to 2001-02 (percent per annum)

District /Divisions	Total Fruit Crops		Total Vegetable Crops	
	1990-91 to 1999-00	1990-91 to 2001-02	1990-91 to 1999-00	1990-91 to 2001-02
Thane	16.07 ^a	15.84 ^a	0.73	0.52
Raigad	23.31 ^a	22.35 ^a	-0.21	2.39
Ratnagiri	8.01 ^b	8.48 ^a	8.69	13.89
Sindhudurg	3.70 ^b	3.53 ^b	-13.86 ^a	-5.98
Konkan Division	8.42	8.34^a	0.65	1.94
Nashik	9.35 ^a	8.72 ^a	3.34 ^a	2.96 ^a
Dhule	9.32 ^c	11.49	-1.62	0.92
Jalgaon	-3.12 ^b	-1.50	4.28	5.57 ^a
Nashik Division	2.00^a	2.94^a	2.93^a	2.99^a
Ahmednagar	6.68 ^b	8.45 ^a	7.06 ^a	7.86 ^a
Pune	5.91 ^a	6.05 ^a	2.55 ^b	2.60 ^a
Solapur	7.21 ^a	7.72 ^a	8.24 ^a	6.25 ^a
Pune Division	6.65^a	7.39^a	4.29^a	4.28^a
Satara	21.83 ^a	17.93 ^a	-1.05	0.78
Sangli	5.95 ^a	8.29 ^a	9.41 ^b	12.3 ^a
Kolhapur	19.53 ^a	20.52 ^a	-9.62 ^b	-1.41
Kolhapur Division	13.99^a	14.28^a	-0.58	2.27
Aurangabad	14.90 ^a	15.39 ^a	1.56	5.66 ^b
Jalna	12.83 ^b	12.96 ^a	-1.59	1.27
Beed	-2.12 ^c	0.61	-1.15	-4.58 ^c
Aurangabad Division	8.85^a	9.98^a	-0.93	-2.28
Latur	28.24 ^b	18.92 ^b	10.68 ^b	12.8 ^a
Osmanabad	-1.84 ^b	0.68	-0.66	-0.39
Nanded	-2.04	0.05	-0.97	2.36
Parbhani	1.26	4.60	0.73	5.35 ^c
Latur Division	1.12	2.68	2.18	4.62^b
Buldhana	10.42 ^a	12.89 ^a	-8.37 ^a	-3.43
Akola	15.87 ^a	17.05 ^a	-1.02	4.11 ^c
Amravati	8.53 ^a	8.25 ^a	-1.74	1.17
Yavatmal	25.18 ^a	20.20	-3.54 ^b	0.19
Amravati Division	11.25^a	10.67^a	-3.73^a	0.35
Wardha	5.85 ^b	8.12 ^a	-0.72	-0.07
Nagpur	9.06 ^a	7.90 ^a	-0.08	-0.13
Bhandara	5.32 ^a	6.02 ^a	5.66 ^b	4.56
Chandrapur	0.33	1.50	4.02 ^a	2.22
Gadchiroli	-3.58	-1.87	3.25 ^c	4.89 ^a
Nagpur Division	8.13^a	7.75^a	2.07^c	1.58^c
Maharashtra	6.87^a	7.24^a	1.88^b	2.48^a

Notes: a, b and c are significant at 1, 5 and 10 percent significance level, respectively.

Source: Computed from Season and Crop Report of Maharashtra (various issues) and GOM (2009).

Table 4.22: Districtwise Growth in Area under Chillies, Condiments and Spices crop in Maharashtra State: 1990-91 to 2001-02 (percent per annum)

District /Divisions	Chillies		Condiments and Spices	
	1990-91 to 1999-00	1990-91 to 2001-02	1990-91 to 1999-00	1990-91 to 2001-02
Thane	4.51 ^a	1.67	4.35 ^b	2.47 ^c
Raigad	11.94 ^a	6.44 ^b	5.83 ^a	4.24 ^a
Ratnagiri	-3.30	0.97	-0.15	1.54
Sindhudurg	-8.95 ^b	-4.98 ^c	1.25	2.95 ^b
Kokan Division	1.40	0.61	2.67^a	2.81^a
Nashik	-3.78 ^a	-2.18 ^b	-2.12	-1.14
Dhule	1.39	0.30	1.27	0.11
Jalgaon	-0.02	0.27	-1.97	-1.12
Nashik Division	-0.16	-0.29	-0.63	-0.63
Ahmednagar	0.51	1.08	2.76	2.15
Pune	-0.47	-0.53	0.29	-0.29
Solapur	-2.35	-1.22	-0.91	-0.18
Pune Division	-0.89	-0.46	0.49	0.29
Satara	-3.45	-2.15	-2.07	-3.73 ^c
Sangli	-8.32 ^a	-4.95 ^b	-6.43 ^a	-3.87 ^b
Kolhapur	-0.79	-1.03	0.86	-0.33
Kolhapur Division	-3.41^b	-2.41^b	-2.16^c	-2.42^a
Aurangabad	-0.61	-1.00 ^b	-0.03	-0.22
Jalna	0.04	-0.72	0.68	0.22
Beed	-7.62 ^a	-4.36 ^b	-8.37 ^a	-6.15 ^a
Aurangabad Division	-3.62^a	-2.48^a	-4.92^a	-3.71
Latur	-4.46 ^c	-2.80 ^c	-4.59	-3.2
Osmanabad	0.22	-0.56	-0.08	-1.34
Nanded	-4.78	-3.25	-4.24	-2.84
Parbhani	-3.69	-1.53	-4.51 ^b	-2.79 ^b
Latur Division	-3.80	-2.57	-3.37	-2.60^c
Buldhana	0.69	-1.05	0.97	-0.77
Akola	-6.01	-2.00	-6.01	-2.25
Amravati	4.08 ^b	1.78	3.06	1.19
Yavatmal	0.76	0.39	1.89	1.02
Amravati Division	1.20	0.05	1.15	0.07
Wardha	-1.70	-1.84	-0.09	-0.48
Nagpur	-3.48	-2.82	-2.9	-2.23
Bhandara	-1.92	-1.99 ^b	-0.66	-0.97
Chandrabur	-3.20 ^b	-3.09 ^a	-2.52 ^b	-2.49
Gadchiroli	0.79	0.76	1.23	1.37
Nagpur Division	-2.87	-2.55^c	-2.12	-1.87^c
Maharashtra	-2.04^b	-1.74^b	-1.78^b	-1.62^a

Notes: a, b and c are significant at 1, 5 and 10 percent significance level, respectively.

Source: Computed from Season and Crop Report of Maharashtra (various issues) and GOM (2009).

Though significant growth has taken place in area under horticultural crops in the state between 1980-81 and 2001-02, the horticulture sector is not free from problems. The major problems that are expected to limit the growth of horticultural sector in Maharashtra are, less diversification of crops in non-traditional regions; deceleration in area and productivity of certain crops and poor post harvesting infrastructure facilities. Despite significant potential for horticulture crops in different regions in Maharashtra, the growth in area under horticulture crops in non-traditional districts is not very impressive as of today. For instance, horticulture crops have been traditionally and also predominantly cultivated in districts like Ratnagiri, Nasik, Jalgaon, Ahmednagar, Pune, Solapur, Satara, Amravati and Nagpur. These nine districts accounted for over 68 percent of the total area under horticulture crops in the state during TE 1966-67 and in fact these same districts have also accounted for about 61 percent in TE 2001-02 as well. Importantly, the share of area under horticulture crops to state total has marginally declined between TE 1966-67 and TE 2001-02 (from 39.5 percent to 28.7 percent points) in Western Maharashtra (Ahmednagar, Pune, Solapur, Satara, Sangli and Kolhapur districts), where water is heavily used for cultivating sugarcane. As mentioned earlier, since the limited availability of irrigation water is the main constraint for agricultural growth in the state, required steps need to be taken to increase the area under horticulture crops in those areas where sugarcane is cultivated predominantly so that the surplus water arising due to the cultivation of horticulture crops can be transferred to other regions/ for other crops.

Though lot of euphoria has been created in the state quoting that linking of EGS with horticulture development programme has made significant improvement in the growth of area under horticulture crops, our growth analysis does not completely support this. While the growth rate of area under grapes and banana either declined or decelerated during the period 1992-93 to 2001-02 as compared to eighties (1982-83 to 1992-93), the same is found to be decelerated in almost all vegetable crops during the nineties as compared to the growth realized during the eighties. As future growth of agriculture in the state is heavily dependent on the performance of horticultural sector because of its natural advantages, it is essential to examine why the growth rate of area under certain horticultural crops decelerated during the nineties. Another important problem associated with horticulture sector is declining productivity of horticulture crops. Productivity of

important horticulture crops namely orange and mango has declined between 1990-91 and 2001-02. Reduction in productivity would not only affect the growth of the horticultural sector but would also affect the overall performance of agricultural growth in the state. Therefore, it is essential to examine the causes for declining productivity of major horticulture crops in those regions where it started declining.

4.2.1 Wide Variation in Productivity of Crop across Districts:

Wide variation in productivity of different crops across districts is also another feature of Maharashtra's agriculture (Table 4.23 and 4.24). More importantly, the growth rate of productivity of almost all major crops either decelerated or declined during the second part of green revolution. Except sugarcane and some horticulture crops, productivity of all other crops is very low in Maharashtra as compared to the national average. Apart from reducing farmers' income, the low productivity of crops pulls down the overall growth rate of state's agriculture. Since low irrigation facility and variation in rainfall are considered to be the important factors responsible for low and varied productivity level, major initiatives need to be taken to increase irrigation facility wherever possible. Introduction of drought resistance cum high yielding varieties, promoting balanced use of fertilisers (appropriate ratio of NPK) and well designed location specific policies/programmes can help to increase the productivity of crops appreciably.

Table 4.23: Variation in Productivity of Major Crops in Maharashtra (kg/ha): TE 2004-05

Districts	Highest (H)		Lowest (L)		Ratio (H/L)	M.S. Yield
	District	Yield (kg/ha)	District	Yield		
Kharif Jowar	Solapur	1900	Jalgaon	514	3.70	764
Bajra	Jalgaon	1036	Sangli	326	3.18	720
Maize	Dhule	2576	Osmanabad	566	4.55	1896
Paddy	Sindhudurg	2691	Osmanabad	273	9.86	1498
Ragi	Sangli	1533	Pune	808	1.90	1120
Wheat	Kolhapur	1970	Chandrapur	384	5.13	1333
Tur	Wardha	1242	Solapur	293	4.24	669
Rabi Jowar	Jalgaon	1554	Solapur	282	5.51	443
Gram	Jalgaon	958	Osmanabad	292	3.28	540
Groundnut	Ratnagiri	1923	Latur	294	6.54	1109
Safflower	Yavatmal	750	Satara	293	2.56	426
Sunflower	Kolhapur	1027	Osmanabad	330	3.11	442
Soybean	Pune	2864	Latur	820	3.49	1150
Cotton	Pune	425	Latur	134	3.17	174
Sugarcane	Sangli	84601	Osmanabad	44784	1.89	69422

Chand, *et al.*, (2009) estimated districtwise agricultural productivity (in Rs/ha NSA) in India during the period 2003-05. They found that there is considerable

variation in productivity level of various districts within a state. The study results show that Jalgaon was found to be the most productive district in the state of Maharashtra with per hectare crop output of Rs. 47.8 thousand. The next districts are Ratnagiri and Sindhudurg with productivity level of Rs. 46345 and Rs. 36378 per hectare of net sown area. A majority of the districts in Maharashtra show productivity between Rs. 9-17 thousand. Osmanabad, Beed, and Nandurbar come at the bottom with productivity level below Rs. 10 thousand per hectare (Fig. 4.1). Out of the 31 districts considered for analysis, 16 districts falls under Very Low Productivity/ha NSA (< Rs. 18199) category (Ahmednagar, Aurangabad, Buldhana, Gadchiroli, Latur, Washim, Akola, Beed, Jalna, Osmanabad, Yavatmal, Dhule, Nandurbar, Solapur, Parbhani, and Chandrapur); 7 districts were under Low Productivity /ha NSA (Rs.18199–27955) category (Nagpur, Sangli, Nanded, Satara, Amravati, Bhandara, and Wardha); 6 districts under Average Productivity /ha NSA (Rs. 27955–37712) category (Pune, Raigad, Thane, Kolhapur, Sindhudurg, and Nashik); 2 districts under High Productivity/ha NSA (Rs.37712–57225) category (Ratnagiri and Jalgaon) and none of the districts falls under Very High Productivity /ha NSA category (> Rs.57225). Authors suggest that most of the districts that are in very low or low productivity range offers immense opportunities for raising agricultural production and therefore there is need of regionally differentiated strategy for future growth and development of agriculture sector (for details, please see Chand, *et al.*, 2009).

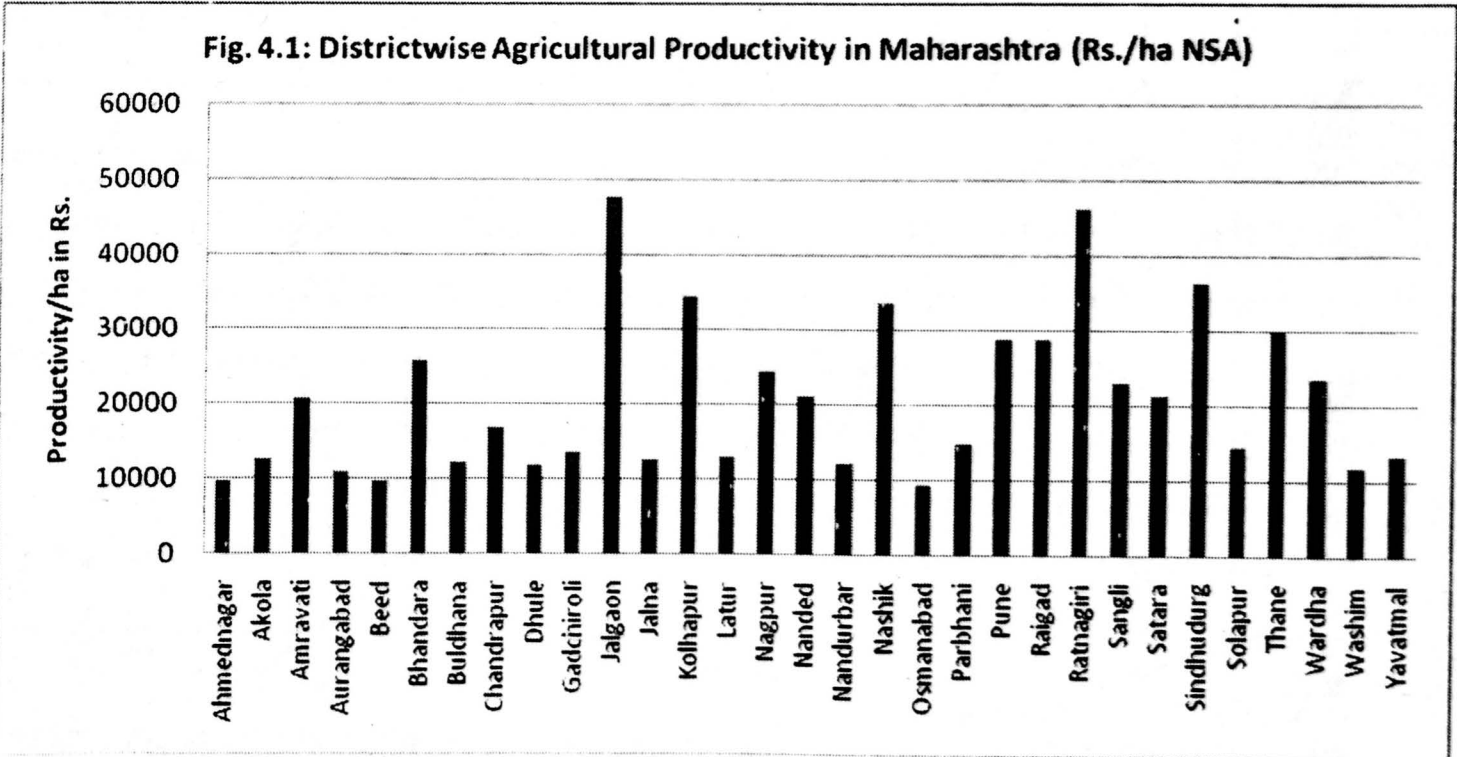


Table 4.24: Districtwise Variation in Productivity of Major Crops in Maharashtra: TE 2004-05 (kg/ha)

Districts	K.f Jowar	Bajra	Maize	Paddy	Ragi	Wheat	Tur	Mung	Udid
Mumbai	-	-	-	-	-	-	-	-	-
Thane	-	-	1667	2114	860	1000	519	653	825
Raigad	-	-	-	2382	841	-	516	1000	821
Ratnagiri	-	-	1600	2423	1387	-	500	875	840
Sindhudurg	-	-	1667	2691	1413	-	-	1000	833
Konkan Div.	-	-	1647	2359	1086	1000	515	746	826
Nashik	950	735	2308	1199	966	1359	629	821	854
Dhule	700	947	2576	1078	1169	1481	368	728	685
Nandurbar	817	777	2385	661	895	1379	322	736	725
Jalgaon	514	1036	1812	1045	1000	1843	717	509	539
Nashik Div.	576	824	2254	1042	990	1731	520	640	624
Ahmednagar	750	563	1229	583	939	1685	377	269	500
Pune	948	707	1914	1130	808	1663	706	382	729
Solapur	1900	462	969	455	-	1175	293	586	670
Pune Div.	1027	603	1294	1066	839	1539	383	333	612
Satara	627	590	1909	1627	1414	1771	382	570	618
Sangli	967	326	2112	2164	1533	1813	391	227	370
Kolhapur	537	-	2246	2358	1532	1970	372	360	464
Kolhapur Div.	772	470	2069	2147	1498	1817	385	387	486
Aurangabad	744	857	2011	400	-	1294	377	468	797
Jalna	805	959	2212	333	-	1694	493	466	505
Beed	1134	673	873	306	-	848	370	610	557
Aurangabad Div.	977	793	2050	324	-	1231	417	485	573
Latur	736	532	1018	367	-	895	693	279	296
Osmanabad	1392	343	566	273	-	764	422	283	289
Nanded	710	600	1310	578	-	1452	904	588	611
Parbhani	859	710	1000	394	-	1125	456	383	442
Hingoli	778	640	821	479	-	1570	756	506	534
Latur Div.	806	486	783	420	1000	1169	695	410	407
Buldhana	682	525	1805	1000	-	1354	673	528	553
Akola	573	544	1762	-	-	1534	756	398	493
Washim	854	517	1833	480	-	1388	866	568	643
Amravati	787	565	1829	565	-	1131	870	337	475
Yavatmal	935	514	1857	553	-	1102	823	410	438
Amravati Div.	751	525	1805	558	-	1290	807	452	556
Wardha	1071	-	2000	700	-	1181	1242	541	463
Nagpur	1135	-	1958	1131	-	1084	572	456	449
Bhandara	1000	-	1750	1161	-	833	815	481	528
Gondiya	1000	-	1600	1055	-	1701	815	586	370
Chandrapur	950	-	-	991	-	384	433	489	478
Gadchiroli	-	-	1889	878	-	667	817	486	500
Nagpur Div.	1081	-	1882	1039	-	863	816	490	469
M.S.	764	720	1896	1498	1120	1333	669	465	512

Source: Compiled from Agricultural Statistical Information of Maharashtra State, Govt. of Maharashtra.

Table 4.24 continues...

Districts	Rabi Jowar	Gram	Ground-nut	Sesamum	Safflower	Sunflower	Soybean	Cotton	Sugarcane
Mumbai	-	-	-	-	-	-	-	-	-
Thane	-	682	1583	333	-	-	-	-	-
Raigad	-	667	1333	400	-	-	-	-	-
Ratnagiri	-	-	1923	667	-	-	-	-	-
Sindhudurg	-	-	1883	500	-	-	-	-	-
Konkan Div.	-	678	1838	368	-	-	-	-	-
Nashik	503	568	854	366	429	400	1766	200	62461
Dhule	1286	782	899	368	-	500	1551	178	60850
Nandurbar	849	705	1063	342	500	490	1386	154	65021
Jalgaon	1554	958	1020	368	-	500	2284	234	55576
Nashik Div.	1163	778	919	368	455	466	1833	220	60352
Ahmednagar	285	462	1082	345	359	470	1301	208	59340
Pune	392	463	1063	295	310	450	2864	425	80857
Solapur	282	295	777	429	300	378	1735	285	67301
Pune Div.	310	422	1040	315	330	408	1367	221	69708
Satara	653	594	1412	231	293	427	1825	198	81269
Sangli	376	551	735	545	323	434	1801	153	84601
Kolhapur	1500	806	1687	-	-	1027	1805	170	79774
Kolhapur Div.	541	618	1406	324	306	466	1806	177	81246
Aurangabad	517	461	638	235	382	415	1208	160	60970
Jalna	730	493	808	247	682	412	1183	204	64687
Beed	526	431	557	238	394	403	1041	143	57344
Aurangabad Div.	579	458	613	239	486	407	1101	173	59797
Latur	585	445	294	196	378	492	820	134	51334
Osmanabad	418	292	515	203	362	330	880	137	44784
Nanded	953	646	1337	281	632	605	1124	134	66292
Parbhani	594	456	1069	297	510	573	1201	175	59136
Hingoli	677	544	1152	239	388	565	1210	198	66546
Latur Div.	530	455	706	240	432	456	1053	160	56602
Buldhana	671	426	789	291	429	500	1236	185	70100
Akola	1000	568	1318	228	492	479	1010	147	56000
Washim	636	548	1200	267	519	489	1120	136	58083
Amravati	1000	709	815	168	453	470	932	153	54516
Yavatmal	1000	702	1291	256	750	429	975	150	63139
Amravati Div.	673	586	1107	257	480	481	1048	155	61063
Wardha	333	648	899	194	-	600	1181	200	56631
Nagpur	418	613	714	286	-	511	1019	222	50577
Bhandara	429	505	857	207	-	-	1200	-	50385
Gondiya	-	467	-	197	-	-	1000	-	56214
Chandrapur	338	477	1500	211	-	500	1101	167	-
Gadchiroli	377	385	1000	206	-	1000	1070	170	-
Nagpur Div.	358	582	766	207	-	525	1095	199	54135
M.S.	443	540	1109	289	426	442	1150	174	69422

Source: Compiled from Agricultural Statistical Information of Maharashtra State, Govt. of Maharashtra.

4.3: Rate and Growth of Inputs Used

In the previous section, an attempt was made to analyze the growth in area, production and productivity of important crops in the state since 1990-91 to 2004-05. The growth and level of agricultural output to a large extent is determined by the pattern of resource structure or input mix in the agricultural sector.

Technological developments shift the production function up and to the right enabling the farmers to make greater use of yield increasing inputs. As it is well known, the pace of agricultural development in India was increased with the introduction of new production technology (Bhatia, 1979). The rapid rise in demand for HYV seeds and fertilisers, irrigation, power and credit after the introduction of new technology during the mid sixties underlined the need to increase supplies of these crucial inputs. An increase in per hectare yield and total production of a crop over a period of time is due to the increased use of inputs like land, irrigation, chemical fertilizers and high yielding variety seeds. Sen and Bhatia (2004) have shown that the growth of per hectare input use at constant prices decelerated from 3.66 per cent per annum during 1980s to 0.94 percent per annum during the 1990s. Mid Term appraisal of the Tenth Five Year Plan also attributed a part of the decline in agricultural growth to lower input-use, which in turn, was due to lower profitability in the post reform period (Dev, 2009). It is therefore, imperative to study the growth in these inputs over a same time period time to get an idea about the process of agricultural development.

Land:

Land is the most important input in agricultural production. Growth in the cropped area, particularly net-cropped area/area sown more than once adequately indicates the pace of agricultural development of a region/state. As we have seen in Chapter II that pattern of land use has been fairly stable at the state level since 1961, with marginal downward change in the share of forest area or simply upward movement in the proportion of area under non agricultural use. Since crops are cultivated predominantly under rainfed condition in Maharashtra, net sown area has marginally declined by 1.03 percent over base year between 1960-61 and 2007-08. Therefore, it is important to see the districtwise growth in net cropped area, area sown more than once and gross cropped area. The districtwise growth in net sown area, area sown more than once, gross cropped area during 1990-91 to 2004-05 and their coefficient of variation (CV) and cropping intensity at two point periods (TE 1992-93 and TE 2004-05) is presented in Table 4.25. As indicated above, unlike in other states, the net cropped area in the Maharashtra state has decreased marginally at the rate of 0.35 percent per annum during the period 1990-91 to 2004-05. Except Ratnagiri, Sindhudurg and Sangali districts, net sown area

decreased in all other districts. Thane, Osmanabad, Bhandara and Dhule districts recorded highest variations during the period. Despite decline in area sown, gross cropped area significantly increased at the rate of 0.45 percent per annum, which is obvious due to significant increase in area sown more than once (4.28 percent per annum). Despite having limited availability of irrigation facility, area cultivated more than once increased from about 5 per cent of gross cropped area in 1960-61 to nearly 23 per cent in 2007-08. In fact, it has increased nearly four times between 1970-71 to 1997-98. Thane, Nashik, Pune, Solapur, Satara, Beed, Buldhana, Wardha, Nagpur, Bhandara, Chandrapur and Gadchiroli districts recorded negative growth in gross cropped area, which resulted in decline in cropping intensity of these districts. The cropping intensity at the state level has hardly increased by 13.4 point period during TE 1992-93 and TE 2004-05. Irrigation is the limiting factor in most of district in bringing land as sown more than once.

Irrigation:

Water is a leading input in agriculture and therefore irrigation has been seen as an engine of agricultural growth. The new technology of production has resulted in bringing about agricultural growth in areas where, irrigation facilities are available. Acharya (1973), while discussing the scope for Green Revolution in Maharashtra observed that water supply is a critical factor in the “*Green Revolution*” particularly in Maharashtra, where improved management of water resources is (badly) needed to obtain higher yields over a wider area. The districtwise growth in irrigated area during 1990-91 to 2004-05 and their CV and irrigation intensity at two points periods (TE 1992-93 and TE 2004-05) is presented in Table 4.26. It can be seen from the table that net irrigated and gross irrigated area has increased significantly at the rate of 2.29 and 1.89 percent per annum during the period 1990-91 to 2004-05. Though net irrigated area decreased in Aurangabad, Jalna and Osmanabad district, gross irrigated area recorded increase in these districts. It is surprisingly to note that growth in gross irrigated area of Sindhudurg, Dhule and Jalgaon districts was negative. Irrigation intensity of the state was 122 percent in TE 1992-93, decreased to 118 percent in TE 2004-05. The decrease in irrigation intensity is due to low space growth in gross irrigated area (due to low growth in area irrigated more than once) as compared to net irrigated area during period under study.

Table 4.25: Districtwise Growth Rate of Land use and their CV and Cropping Intensity in Maharashtra (per cent per annum)

District /Divisions	NCA		ASMO		GCA		Cropping Intensity (%)	
	1990-91 to 2004-05	CV	1990-91 to 2004-05	CV	1990-91 to 2004-05	CV	TE 92-93	TE 2004-05
Thane	-2.68 ^a	14.53	2.42	59.66	-2.41 ^b	15.25	102.5	103.8
Raigad	-0.24	3.82	5.38 ^a	25.49	0.30	4.65	108.2	114.3
Ratnagiri	1.06 ^a	6.86	12.32 ^b	84.33	1.54 ^b	10.73	102.7	104.3
Sindhudurg	0.65 ^c	5.96	-0.52	53.13	0.73 ^b	5.29	108.0	113.3
Kokan Div	-0.63	6.11	5.72	36.64	-0.24	6.98	104.5	108.0
Nashik	-0.23	4.85	0.55	21.11	-0.11	3.37	110.3	109.2
Dhule	-0.28	7.59	4.01 ^c	33.38	0.22	4.75	109.5	112.1
Jalgaon	-0.13	3.32	8.08 ^b	72.56	2.19 ^b	19.71	121.7	176.6
Nashik Div	-0.21	4.66	5.53^a	31.19	0.71	6.95	114.0	128.0
Ahmednagar	-0.04	3.81	0.96	30.6	0.25	4.71	117.2	127.9
Pune	-0.53 ^a	3.27	-2.61 ^c	25.38	-0.93 ^a	6.4	125.3	119.9
Solapur	-0.16	5.69	-1.47	33.21	-0.22	6.27	107.3	109.1
Pune Division	-0.23	2.95	-0.79	23.52	-0.28	4.28	116.6	119.3
Satara	-0.81 ^a	4.55	1.61	21.73	-0.38	4.86	118.1	120.2
Sangli	0.11	3.40	3.37 ^c	29.36	0.59	6.04	113.2	116.1
Kolhapur	-0.25	2.99	17.51 ^a	83.16	3.61 ^a	19.26	110.2	186.1
Kolhapur Div	-1.25^b	8.48	9.72^a	51.42	1.20^a	5.75	114.2	153.0
Aurangabad	-0.37 ^c	3.27	5.5 ^b	43.39	0.92	9.28	120.2	149.4
Jalna	-0.41 ^c	3.57	3.1	20.04	0.14	4.23	116.7	128.2
Beed	-0.38	4.84	0.52	21.89	-0.34	4.21	115.2	118.9
Aurangabad Div	-0.39^c	3.37	3.39	25.8	0.23	4.43	117.3	131.4
Latur	-0.03	5.67	2.62	28.6	0.59 ^c	4.75	121.6	138.1
Osmanabad	-1.13 ^b	7.86	7.15 ^a	30.34	0.67 ^c	6.04	118.1	153.3
Nanded	-0.2	3.76	4.48 ^a	20.81	0.32	3.88	110.7	116.6
Parbhani	-0.60 ^a	3.89	4.41 ^a	27.39	0.93 ^b	7.26	135.3	166.0
Latur Div	-0.48^b	3.70	4.67^a	24.84	0.67^a	3.96	122.4	144.1
Buldhana	-0.42	5.15	1.29	17.35	-0.16	4.99	119.7	124.4
Akola	-0.58	3.41	5.99 ^a	27.89	0.67 ^a	4.61	116.8	136.1
Amravati	-0.23 ^c	2.03	9.10 ^a	40.43	1.45 ^a	7.47	114.0	141.0
Yavatmal	-0.13	2.31	5.74 ^a	28.3	0.52 ^a	2.71	109.3	115.1
Amravati Div	-0.34	2.76	5.51^a	23.19	0.64^a	3.88	114.7	129.0
Wardha	-0.56 ^a	2.88	1.62	56.53	-0.19	5.16	106.3	105.4
Nagpur	-0.08	3.73	-1.68	39.09	-0.19	5.96	113.1	108.9
Bhandara	-0.38	7.97	-3.83 ^b	27.18	-1.11 ^a	6.27	129.7	118.8
Chandrapur	-0.80 ^a	4.94	0.84	14.11	-0.55 ^b	4.4	115.9	119.0
Gadchiroli	-1.20 ^a	7.79	-3.18	45.6	-1.16 ^a	6.23	115.1	106.6
Nagpur Div	-0.51^b	4.04	-1.29	27.47	-0.55^b	4.09	115.8	112.3
Maharashtra	-0.35^a	1.79	4.28^a	21.6	0.45^b	3.18	116.0	129.4

Notes: NCA Net Cropped Area, ASMO-Area Sown More than Once, GCA-Gross Cropped Area, CV Coefficient of Variation; a, b and c are significant at 1, 5 and 10 percent significance level, respectively.

Source: Computed from Season and Crop Report of Maharashtra (various issues) and GOM (2009).

Table 4.26: Districtwise Growth Rate of Irrigated Area and their CV and Irrigation Intensity in Maharashtra (per cent per annum)

District /Divisions	NIA		GIA		Irrigation Intensity (%)		% GIA to GCA TE 2001-02
	1990-91 to 2001-02	CV	1990-91 to 2001-02	CV	TE 92-93	TE 2001-02	
Thane	10.98 ^a	33.13	10.50 ^a	31.73	114.89	110.49	5.33
Raigad	3.20 ^b	17.39	3.45 ^a	16.59	114.94	117.51	7.03
Ratnagiri	10.84 ^b	68.53	9.33 ^b	59.03	124.27	111.72	3.12
Sindhudurg	-0.56	24.14	-0.61	20.49	115.27	114.50	16.87
Kokan Div	4.31^a	16.31	4.04^a	14.98	115.81	113.58	6.67
Nashik	1.24 ^b	7.26	1.71 ^b	8.31	115.06	120.17	25.68
Dhule	1.72	13.12	-0.85	8.22	139.84	114.05	13.04
Jalgaon	0.01	5.71	-0.96 ^c	6.06	121.30	111.95	16.61
Nashik Div	0.90	6.78	0.25	5.42	121.88	116.19	18.83
Ahmednagar	2.18 ^a	9.51	1.18 ^b	6.19	118.63	109.35	28.83
Pune	1.98 ^a	8.18	1.93 ^a	7.64	118.09	118.22	27.66
Solapur	3.24 ^a	13.69	2.81 ^a	11.75	119.29	115.61	26.34
Pune Division	2.40^a	9.37	1.87^a	7.38	118.62	113.92	27.70
Satara	1.38 ^b	7.24	2.29 ^a	9.22	120.86	130.93	31.59
Sangli	4.52 ^a	16.09	3.29 ^a	12.17	121.30	110.46	21.18
Kolhapur	5.34 ^a	18.78	4.65 ^a	17.00	110.71	104.99	24.20
Kolhapur Div	3.41^a	12.38	3.17^a	11.50	118.50	116.66	25.64
Aurangabad	-0.14	13.60	0.13	11.51	116.49	119.04	18.03
Jalna	-0.55	13.20	0.84	9.75	136.88	152.22	13.38
Beed	1.86 ^c	11.74	2.08 ^c	12.50	116.83	119.63	24.45
Aurangabad Div	0.70	7.94	1.14	8.24	120.26	124.88	19.10
Latur	4.05	34.40	0.97	30.58	136.48	108.32	9.53
Osmanabad	-0.32	6.64	0.12	8.15	119.66	123.70	16.70
Nanded	2.45 ^a	10.10	2.65 ^b	13.00	134.66	134.68	10.40
Parbhani	3.31 ^c	20.38	2.12 ^c	12.94	151.78	141.74	11.99
Latur Div	1.84	13.49	1.34	12.24	133.95	128.44	12.17
Buldhana	1.96 ^b	10.91	1.24	9.08	124.42	118.67	5.79
Akola	9.06 ^a	32.48	7.31 ^a	26.54	145.79	125.58	5.07
Amravati	9.62 ^a	31.00	5.79 ^a	20.56	165.50	120.44	9.66
Yavatmal	6.90 ^a	26.17	2.94 ^b	15.92	157.33	115.86	6.10
Amravati Div	6.96^a	23.98	4.33^a	16.20	148.36	120.00	6.67
Wardha	4.16 ^a	17.55	4.08 ^a	14.94	132.62	132.31	9.11
Nagpur	5.84 ^a	22.70	4.57 ^a	18.55	132.28	121.72	22.07
Bhandara	0.97	6.91	1.35 ^a	6.31	113.66	117.93	49.77
Chandrapur	1.93 ^a	8.07	2.00 ^a	8.30	109.00	110.87	21.33
Gadchiroli	2.15 ^a	8.21	1.86 ^a	7.41	110.08	107.65	30.70
Nagpur Div	2.43^a	9.88	2.39^a	9.18	116.69	117.02	25.73
Maharashtra	2.29^a	8.68	1.89^a	7.29	121.92	118.29	17.90

Notes: NIA Net Irrigated Area, GIA-Gross Irrigated Area, CV Coefficient of Variation; : a, b and c are significant at 1, 5 and 10 percent significance level, respectively.

Source: Computed from Season and Crop Report of Maharashtra (various issues) and GOM (2009).

Table 4.27: Districtwise Growth rate of area under HYVs and their CV in Maharashtra (per cent per annum)

District /Divisions	High Yielding Variety seeds	
	1990-91 to 2004-05	CV
Thane	0.29 ^a	4.62
Raigad	-1.23 ^a	7.14
Ratnagiri	0.29 ^a	5.27
Sindhudurg	1.98 ^a	10.66
Konkan Division	0.05^a	4.64
Nashik	-1.75 ^a	24.53
Dhule	-3.76 ^a	18.9
Jalgaon	-6.24 ^a	27.07
Nashik Division	-3.52^a	19.29
Ahmednagar	-7.26 ^b	46.72
Pune	-6.44 ^a	39.34
Solapur	-22.04 ^a	75.55
Pune Division	-9.23^a	51.21
Satara	-3.81 ^c	31.93
Sangli	-5.67 ^b	29.6
Kolhapur	-3.34 ^a	14.74
Kolhapur Division	-4.39^a	25.8
Aurangabad	-7.32 ^a	35.15
Jalna	-10.54 ^a	43.9
Beed	-5.97 ^a	28.37
Aurangabad Division	-7.47^a	34.2
Latur	-2.35 ^a	13.38
Osmanabad	-8.44 ^a	37.87
Nanded	-3.47 ^a	16.32
Parbhani	-4.93 ^a	25.53
Latur Division	-4.71^a	22.51
Buldhana	-6.38 ^a	26.89
Akola	-5.64 ^a	24.48
Amravati	-5.05 ^a	24.54
Yavatmal	-5.03 ^a	21.92
Amravati Division	-5.54^a	24.02
Wardha	-9.56 ^a	37.57
Nagpur	-6.13 ^a	27.53
Bhandara	0.45 ^a	6.07
Chandrapur	-4.63 ^a	24.66
Gadchiroli	0.17 ^a	4.14
Nagpur Division	-2.61^a	13.28
Maharashtra	-4.89^a	24.63

Notes: CV Coefficient of Variation; a, b and c are significant at 1, 5 and 10 percent significance level, respectively. Source: Computed from Season and Crop Report of Maharashtra (various issues) and GOM (2009).

HYVs:

High yielding variety seeds and fertilisers are the linchpins of the new technologies (Bhalla, 2007). Increase in area under high yielding varieties indicates the level of agricultural development of a region. It can be seen from the Table 4.27 that area under hybrid/high yielding varieties has declined during the period from 1990-91 to 2004-05. Also most of the district have recorded decline in area under HYV seed except Ratnagiri, Sindhudurg, Bhandara and Gadchiroli districts. The high yielding variety seed is available in case cereal crops only, viz. Paddy, Wheat, Jowar, Bajra and Maize and for fibre crop, i.e. Cotton. As major expansion of HYV area under cereal crops occurred during 1970s, i.e. from 12.01 percent in TE 1972-73 to 41.25 percent in TE 1982-83. But thereafter actual rate of expansion slowed down and coverage moved up to only about 70.62 percent in TE 1992-93 though the scope existed for further increase. Further the area under HYVs increased to 89.38 percent in TE 2000-01 and then declined marginally to 88.32 per cent in TE 2004-05. Thus set back to further progress in HYV coverage under cereals may be due to decline in area under cereals crops since 1990-91, from 10.57 mha in TE 1992-93 to 9.00 mha in TE 2004-05, as seen earlier.

Agricultural Credit:

Credit availability is of crucial importance for agriculture development of any region. The agricultural sector needs credit both for working capital and for investment. The sources of borrowing can be divided into institutional (banks) and non-institutional (such as money lenders, relatives and friends. In India a multi-agency approach comprising co-operative banks, scheduled commercial banks and RRBs has been followed for purveying credit to agricultural sector. There has been some improvement in institutional credit to agriculture during past few years. But because of high instability in income, increased input costs and less profit margin, the debt burden on the farmers of the state has been increasing. This is because most of the marginal and small farmers try to experiment and take risks, but they are not able to visualize that a bad monsoon leading to a crop failure or a glut in the market, which pushes them into indebtedness. The recent farmer suicides in Vidarbha and Marathawada have once again highlighted the disturbing reality of widening regional disparity in Maharashtra. Further evidence of the worsening situation of farming households due to indebtedness can be seen from the results

of the 59th Round of NSS under '*Situation Assessment Survey of Farmers*'. The data shows that 54.8 percent of the farmers' households in Maharashtra are in debt. However, the comparable figure for all India level is only 48.6 percent. The average debt burden in Maharashtra is Rs. 16973/-, however, at all India level, debt burden is little less of Rs. 12585/-. More than 62 percent of those in debt are small and marginal farmers. Informal sources still accounts for over 16 percent of the total debt. The districtwise growth rate of credit disbursement by Primary Agricultural Cooperative Credit Societies² and their CV in Maharashtra is presented in Table 4.28. There is significant increase in credit disbursement to agriculture and allied sector in all district as well as state level. However, variability is very high among all the districts of the state indicates high year to year fluctuations in credit disbursement. Out of total loan disbursement during 2008-09, only 43 percent of total loan was disbursed to small and marginal farmers (GOM, 2009). Thus, despite impressive growth in credit disbursement to state agriculture sector, question arise that are the existing formal institutions sufficient for full filling the demand of credit required for agriculture sector or should we have separate institutions for promoting credit expansion. On the demand side, some of the contrasting factors for credit in rural and urban areas are low productivity and high risk and vulnerability of small and marginal farmers, low skill and poor market linkages for rural non-farm and urban workers, and low finance literacy. Therefore, the credit expansion programme will be successful only if the productivity of the small and marginal farmers improve. Credit expansion should be taken into account the risk element of farmers while framing policies. As suggested by Jadhav (2008) while studying farmers suicide and loan waiver in Maharashtra that flexibility should be brought in granting loan to agriculture sector and instead of prevailing cropping pattern, average cropping pattern could be used and limit should be set accordingly. With a view to alleviating the distress of the farmers in the six districts of Vidarbha region (Wardha, Yavatmal, Amravati, Akola, Buldhana and Washim), the Hon'ble Prime minister has announced a Relief package involving, in addition to other measures, rescheduling of old loans, waiver of overdue interest, sanction of fresh credit to keep the agriculture credit cycle moving.

² The districtwise data on credit disbursement to agriculture and allied sector was available only on Primary Agricultural Cooperative Societies (PACS). Data was collected from District Socio-Economic Review of each district of Maharashtra since 1981. However, we observed gaps and up/ down in reported data. To get growth rates of same, gaps were filled up by taking average.

Table 4.28: Districtwise Growth rate of Credit Disbursed by Primary Agricultural Cooperative Credit Societies and their CV in Maharashtra (per cent per annum)

District /Divisions	Credit to Agricultural Sector	
	1990-91 to 2004-05	CV (%)
Thane	20.17 ^a	106.7
Raigad	1.46	53.7
Ratnagiri	21.55 ^a	88.3
Sindhudurg	13.01 ^a	58.6
Kokan Division	16.7^a	75.3
Nashik	17.71 ^a	96.5
Dhule	5.12 ^b	38.6
Jalgaon	16.16 ^a	52.5
Nashik Division	15.48^a	66.0
Ahmednagar	2.89 ^b	17.1
Pune	18.28 ^a	71.1
Solapur	22.51 ^a	78.1
Pune Division	15.59^a	59.6
Satara	13.19 ^a	62.7
Sangli	14.71 ^a	70.0
Kolhapur	9.06 ^c	64.8
Kolhapur Division	12.83^a	61.5
Aurangabad	17.2 ^a	81.7
Jalna	5.54 ^a	50.0
Beed	13.1 ^a	67.0
Aurangabad Division	14.62^a	72.3
Latur	19.99 ^a	66.5
Osmanabad	16.89 ^a	76.0
Nanded	12.72 ^a	57.5
Parbhani	12.62 ^a	64.4
Latur Division	16.19^a	60.1
Buldhana	11.89 ^a	58.3
Akola	4.99 ^b	33.2
Amravati	9.09 ^b	46.9
Yavatmal	7.51 ^a	41.4
Amravati Division	8.37^a	37.8
Wardha	12.4 ^a	46.5
Nagpur	7.03 ^a	39.7
Bhandara	12.52 ^a	59.0
Chandrapur	17.35 ^a	62.5
Gadchiroli	6.14 ^a	29.5
Nagpur Division	11.56^a	43.9
Maharashtra	14.46^a	55.3

Notes and Sources: Same as in Table 4.26.

Use of Plant Protection Equipments and Four Wheeled Tractors:

The number of plant protection equipments and four wheeled tractor also one of the indicator of agricultural development. The districtwise annual growth in use of plant protection equipments and four wheeled tractors in Maharashtra is presented in Table 4.29. The number of plant protection equipments is increased at the rate of 2.29 percent per annum at state level. However, negative growth has been recorded in Sindhudurg, Buldhana, Amravati, Wardha, Nagpur and Bhandara districts. The number four wheeled tractor in the state also increased at the rate of 7.71 percent per annum. Except Sindhudurg, all districts have recorded increase in use of four wheeled tractors.

Electricity Use in Agriculture:

Electricity is one of the key drivers of the economy. Nearly a decade and half ago, the availability of electricity in the Maharashtra state was in surplus. However, in the post-liberalization era the public sector investments in the power sector reduced considerably. Consequently, there was no addition in the installed capacity. Hence the gap between demand and supply of the electricity in the State is ever widening and is a cause of concern. The consumption of electricity in agriculture sector as proportion to total electricity has gone up to around 31.6 in 1998-99 from 12.58 in 1980-81 and thereafter after it dropped to 15.7 percent in 2006-07. The same trend observed at national level, where it dropped from 31.38 percent to 21.73 percent in corresponding years. The Government has realized the seriousness of the problem and has taken number of steps for capacity addition and modernization of existing infrastructure for transmission and distribution (GOM 2008). The aggregate consumption of electricity in the State during 2006-07 was 62,085 million KWH, in which industrial sector was the largest consumer of the electricity (42.7 per cent) followed by domestic (23 per cent) and agriculture sector (15.7 per cent). The districtwise average annual growth rate of electricity use in agriculture and their CV is presented in Table 4.30. It can be seen from the table that despite limited availability of electricity for agriculture sector, electricity consumption in agriculture of the state has increased significantly at the rate of 13.18 per cent per annum. However, share of electricity use in agriculture has declined from 21.46 percent in 1990-91 to 18.15 percent in 2007-08. The increase in electricity use in agriculture recorded in all the districts of the state.

Use of Diesel and Electric Pumpsets:

It can be seen from the Table 4.31 that both diesel and electric pumpsets increased during the period 1990-91 to 2001-02. The growth was substantial and significant in case of electric pumpsets, which were increased at the rate of 11.76 percent per annum. The significant and unbelievable increase in electric pumpsets was noticed in 1998-99 onwards, which may be due to state government support for digging wells. There are divisional variations in number of pumpsets availability in the state.

Table 4.29: Districtwise Annual Growth Rate (ACGR) of Plant Protection Equipments and Four Wheeled Tractors in Maharashtra (1992 & 2003)

District /Divisions	Annual Compound Growth Rate (ACGR)	
	Plant Protection Equipments	Four Wheeled Tractors
Thane	0.97	9.38
Raigad	0.43	14.47
Ratnagiri	1.97	3.00
Sindhudurg	-1.70	-4.18
Konkan Div.	0.24	8.98
Nasik	9.79	7.72
Dhule	6.38	2.27
Jalgaon	1.17	5.70
Nasik Div.	5.68	6.21
Ahmednagar	4.23	9.68
Pune	5.94	11.91
Solapur	1.74	9.20
Pune Div.	4.09	10.38
Satara	2.35	6.68
Sangli	5.30	4.76
Kolhapur	4.40	3.43
Kolhapur Div.	3.87	4.92
Aurangabad	4.54	7.84
Jalna	1.31	6.44
Beed	6.76	7.37
Aurangabad Div.	4.12	7.35
Latur	11.19	3.67
Osmanabad	8.41	17.51
Nanded	2.85	11.98
Parbhani	0.57	6.25
Latur Div.	4.20	9.65
Buldhana	-0.24	8.18
Akola	1.09	11.26
Amravati	-0.14	9.20
Yavatmal	1.11	11.02
Amravati Div.	0.58	9.83
Wardha	-0.56	3.43
Nagpur	-0.59	5.31
Bhandara	-7.03	6.32
Chandrapur	1.04	7.96
Gadchiroli	8.41	5.99
Nagpur Div.	-1.46	6.05
State Total	2.29	7.71

Note: ACGR-Annual Compound Growth rate -two period points 1992 and 2003 (Livestock Census).

Table 4.30: District-wise Average Annual Growth Rates of Electricity Use and their CV in Maharashtra

District /Divisions	Electricity Use in Agriculture		
	% to total use	CGR- 1990-91 to 1997-98	C.V.
Thane	3.0	13.38 ^a	30.2
Raigad	6.0	20.72 ^a	40.5
Ratnagiri	24.7	22.02 ^a	43.9
Konkan Division	5.8	18.22^a	37.6
Nashik	46.5	10.35 ^c	31.6
Dhule	58.4	6.57	27.8
Jalgaon	57.4	10.44	44.9
Nashik Division	51.9	9.98^b	29.3
Ahmednagar	77.4	15.37 ^a	39.7
Pune	26.0	19.89 ^a	43.0
Solapur	67.7	15.79 ^c	48.0
Pune Division	48.0	16.77^a	41.7
Satara	69.8	22.03 ^a	48.0
Sangli	69.1	19.76 ^a	46.3
Kolhapur	39.5	15.64 ^a	42.7
Kolhapur Division	58.7	19.58^a	44.4
Aurangabad	45.8	7.45	25.7
Jalna	61.5	6.66	30.3
Beed	80.0	9.19 ^a	22.2
Aurangabad Division	57.5	7.94^a	18.2
Latur	81.8	12.33 ^a	26.3
Osmanabad	69.5	8.69 ^a	18.9
Nanded	72.2	14.62 ^a	31.2
Parbhani	72.7	16.92 ^a	36.2
Latur Division	73.7	13.25^a	28.2
Buldhana	62.9	5.48 ^b	16.9
Akola	53.2	10.54 ^a	22.5
Amravati	54.5	2.67	17.1
Yavatmal	54.5	6.82 ^c	22.9
Amravati Division	56.4	6.02^b	17.1
Wardha	25.5	5.88 ^b	17.6
Nagpur	12.4	1.14	31.6
Bhandara	31.6	18.18 ^a	39.7
Chandrapur	17.3	36.6 ^a	63.3
Nagpur Division	18.9	11.33^a	27.3
Maharashtra	31.5	13.18^a	28.4

Notes: CV Coefficient of Variation; a, b and c are significant at 1, 5 and 10 percent significance level, respectively.

Source: Computed from Statistical Abstract of Maharashtra State (various issues), GOM.

Table 4.31: Districtwise Growth Rate of Pumpsets Use and their CV Maharashtra

District /Divisions	Diesel Engines			Electric Pumps		
	Total Number 2001-02	CGR-1990-91 to 2001-02	CV	Total Number 2001-02	CGR-1990-91 to 2001-02	CV
Thane	654	-3.70 ^c	29.33	20533	12.77 ^a	40.75
Raigad	672	1.23 ^a	5.52	10676	17.64 ^a	87.45
Ratnagiri	636	10.65 ^a	34.13	10951	18.2 ^a	61.92
Sindhudurg	893	4.92 ^a	16.22	12776	18.45 ^a	86.69
Konkan Division	2855	2.01^b	10.09	54936	15.06^a	59.26
Nashik	9668	-2.11 ^a	10.58	203228	12.34 ^a	52.42
Dhule	2085	-10.97 ^a	46.74	97875	17.72 ^a	81.43
Jalgaon	2736	8.38 ^b	63.14	142876	12.49 ^a	58.90
Nashik Division	14489	-3.65^a	18.58	443979	13.34^a	59.86
Ahmednagar	6414	-1.78 ^a	9.27	238348	10.3 ^a	45.59
Pune	12785	3.36 ^a	11.65	151459	13.99	55.26
Solapur	9598	6.17 ^a	27.09	172523	8.67	36.46
Pune Division	28797	2.70^a	10.72	562330	10.59^a	44.87
Satara	14046	-1.63 ^a	7.57	91669	18.9 ^a	83.76
Sangli	5672	-2.68 ^b	15.86	113779	13.56 ^a	68.58
Kolhapur	13740	4.39 ^a	18.47	73456	12.88 ^a	48.20
Kolhapur Division	33458	0.23	7.35	278904	14.84^a	66.19
Aurangabad	1396	4.57	95.92	122140	4.3 ^a	14.51
Jalna	1568	-1.49 ^b	8.24	68749	16.21 ^a	70.48
Beed	2482	-1.53	17.57	90946	14.92 ^a	50.12
Aurangabad Division	5446	-0.71	14.45	281835	9.02^a	31.59
Latur	818	13.10 ^a	40.12	64562	11.67 ^a	45.45
Osmanabad	1333	-5.93 ^b	35.24	70941	12.87 ^a	49.44
Nanded	1674	4.61 ^b	21	64187	12.8 ^a	61.22
Parbhani	1433	-5.17 ^c	39.62	76470	14.77 ^a	52.33
Latur Division	5258	-1.43	20.85	276160	12.9^a	51.32
Buldhana	985	-5.98	55.19	89324	9.61 ^a	32.13
Akola	1340	0.43	8.86	59184	10.93 ^a	51.10
Amravati	1032	10.35 ^a	37.87	86036	5.65 ^a	20.33
Yavatmal	2082	3.44	42.02	54926	15.25 ^a	56.35
Amravati Division	5439	0.89	23.22	289470	11.01^a	54.53
Wardha	1559	12.34 ^a	31.63	47563	12.01 ^a	46.43
Nagpur	2980	5.19 ^a	19.54	74062	9.81 ^a	37.90
Bhandara	5940	8.30 ^a	26.79	32143	11.34 ^a	39.82
Chandrapur	6595	5.11 ^a	17.83	21230	15.39 ^a	62.66
Gadchiroli	3681	11.00 ^a	36.42	6500	21.21 ^a	81.10
Nagpur Division	20755	7.18^a	23.73	181498	11.42^a	43.75
Maharashtra	116497	1.20	9.75	2369112	11.44^a	46.63

Notes: CV Coefficient of Variation; a, b and c are significant at 1, 5 and 10 percent significance level, respectively. Source: Computed from Season and Crop Report of Maharashtra (various issues) and GOM (2009).

Fertilizer Use:

Fertilizer is an important input in crop production. It is one of the important components of the new production technology. Fertiliser use in Maharashtra was considerably lower than the All India average. This likely affected productivity levels in the state. In 2007-08, the fertiliser use rate in Maharashtra was 103.1 kg per hectare, which was more than 10 percent below the all India average and about half of fertiliser use rates in Punjab and Andhra Pradesh in 2007-08. The uncertain rainfall and limited irrigation facilities may be influencing fertiliser use in the state, fertiliser is supplementary to water use in agriculture. It could be seen from Table 4.32 that despite having poor irrigation facility, the state exhibited positive and significant growth in total fertilizer consumption (2.59 percent per annum) during the period 1990-91 to 2004-05. Increase in the total fertilizer consumption can also take place due to the expansion of area under cultivation (i.e. area sown more than once). A similar pattern was observed for per hectare usage, which is increased at the rate of 2.90 percent per annum. Raigad, Sangali, Kolhapur, Amravati district recorded negative growth in total fertilizer consumption, however, Jalgaon, Sangali and Kolhapur recorded negative growth in per hectare fertilizer consumption.

The use of fertilisers is found to be very low in divisions like Konkan, Latur and Amravati as compared to the state's average. Poor irrigation facility coupled with the cultivation of low value crops are the main reasons for the low use of yield increasing inputs like fertilisers. Besides low use of fertilisers, improper application of fertilisers (N P K ratio)³ also affects the productivity of crops and thereby the growth of agriculture. While making efforts to improve the use of yield increasing inputs through increased irrigation facility and moisture availability, proper use (mix) of fertilisers should be promoted through quality extension network.

³ The ideal nitrogen-phosphorous- potassium (NPK) application ration aggregated for the whole country is 4:2:1 (World Bank, 2004). In case of Maharashtra, the ration was 4.14:1.92:1 in 2000-01, which highly varies across the divisions (for details please see Narayanamoorthy and Kalamkar, 2005).

Table 4.32: Districtwise Growth rate of area Total Fertilizer and Per hectare Fertilizer Use and their CV and in Maharashtra

District /Divisions	Total Fertilizer			Per ha Fertilizer		
	Total in tons (TE 2004-05)	CGR- 1990-91 to 2004-05	CV	Fertilizer (kg/ha)	CGR- 1990-91 to 2004-05	CV
Thane	18659	3.22 ^a	15.73	88.9	8.46 ^a	40.17
Raigad	13406	-0.62	21.85	76.6	0.38	19.62
Ratnagiri	8203	1.01 ^c	10.02	58.2	3.54	34.98
Sindhudurg	6579	0.90 ^c	9.18	61.0	2.11	25.12
Konkan Division	46848	1.18	12.16	71.20	3.35^a	24.20
Nashik	108289	4.82 ^a	22.53	130.0	5.66 ^a	27.55
Dhule	71246	3.18	17.53	94.2	2.97 ^a	17.34
Jalgaon	129167	0.91	10.35	126.6	-0.16	17.84
Nashik Division	308702	2.63^a	14.49	116.9	2.17^a	15.05
Ahmednagar	104136	1.07	15.90	85.8	1.27	17.66
Pune	96932	2.69 ^a	14.87	115.6	5.51 ^a	36.00
Solapur	74917	1.65	21.68	81.3	2.79	28.80
Pune Division	275985	1.79^c	16.11	94.2	3.25^b	25.85
Satara	52477	-0.59	13.11	90.4	0.56	16.96
Sangli	68140	-0.86	14.19	105.4	-0.73	14.53
Kolhapur	85024	-1.27 ^c	10.59	179.2	-2.57 ^c	21.12
Kolhapur Division	205641	-0.51	52.86	125.0	-1.29	15.29
Aurangabad	73449	6.32 ^a	30.11	87.8	5.88 ^a	33.10
Jalna	57023	6.02 ^a	27.85	79.4	6.32 ^a	29.57
Beed	51273	6.67 ^a	29.92	57.1	7.59 ^a	32.88
Aurangabad Division	181745	6.31^a	28.28	74.8	6.48^a	29.66
Latur	37402	2.06	22.85	75.3	3.74 ^a	24.44
Osmanabad	17036	3.74	31.54	23.3	3.73 ^c	38.37
Nanded	87223	3.21 ^b	22.91	108.8	2.74 ^b	19.42
Parbhani	66412	5.79 ^a	27.13	51.5	4.82 ^a	23.88
Latur Division	208073	3.75^a	22.24	64.7	3.13^a	20.39
Buldhana	64256	4.32 ^a	21.07	77.7	4.41 ^a	23.17
Akola	55932	3.25 ^b	23.28	52.9	2.56 ^c	21.70
Amravati	39558	-0.58	15.15	78.2	0.85	46.72
Yavatmal	57213	4.03 ^a	19.11	61.3	3.65 ^a	17.10
Amravati Division	216959	2.86^a	16.52	67.5	2.89^a	19.30
Wardha	23550	-0.19	13.95	56.5	0.18	22.20
Nagpur	50565	2.99 ^a	18.20	88.1	3.50 ^a	21.55
Bhandara	42436	4.91 ^a	22.09	106.9	7.15 ^a	30.08
Chandrapur	36940	6.98 ^a	28.38	77.5	8.28 ^a	34.89
Gadchiroli	11731	7.41 ^a	38.66	66.0	8.65 ^a	38.94
Nagpur Division	165222	3.83^a	17.31	79.0	5.58^a	24.38
Maharashtra	1609053	2.59^a	14.53	82.3	2.90^a	16.63

Notes: CV Coefficient of Variation; a, b and c are significant at 1, 5 and 10 percent significance level, respectively.
Source: Computed from Fertilizer Statistics (various issues), FAI.

4.4: Conclusions

The foregoing discussion reveals that during overall period, production and productivity of Jowar crop has declined in almost all the districts of the state. Jowar which is staple food crop of the farmers and accounts for more than 20 percent of gross cropped area during TE 2004-05 and mostly grown under rainfed conditions, deceleration in production and productivity of this crops calls for urgent attention by the policy makers and administrators. Except in few districts, same negative trend has been observed in case of Bajra and ragi crops. However, the growth in productivity of Maize crop was positive during overall period. Among the pulse crops, production of tur crop increased significantly during overall period at the rate of 3.75 percent per annum. The increase in production was mainly due to significant increase in productivity (3.37 percent per annum) followed by increase in area (0.37 percent per annum). Among the divisions, Amravati, Latur and Aurangabad accounts major share in area under tur crop. In all these major divisions and their districts, increase in production and productivity of tur crop was recorded. The area, production and productivity of mung crop decreased during 1990 to 2005, however, urad crop recorded increase. Buldhana district recorded increase in area, production and productivity of urad crop, however, production and productivity declined in Latur and Jalgaon district. Other districts recorded higher positive growth in area and production in urad crop due to low base/less area during base year. Except Nashik, Jalgaon and Aurangabad, all other major gram growing districts have recorded increase in area and production. However, productivity deceleration is recorded in some districts such as Ahmednagar, Pune, Solapur, Aurangabad, Buldhana, Osmanabad and Parbhani. Among oilseed crops, Soybean crop accounts highest share in area followed by groundnut, sunflower, safflower and sesamum. Except Soybean, all other oilseeds have recorded decline in production and productivity in almost all the districts. Soybean crop is mostly grown in Vidarbha region (i.e. Amravati and Nagpur divisions) and Latur division. The production and productivity of soybean crop increased significantly at the rate of 18.01 and 2.19 percent per annum respectively during the period 1990-91 to 2004-05. Except Bhandara district, all other major soybean districts have recorded substantial increase in area and production of soybean crop during the period under study. In case of cotton, though area was almost stable during the period

1990-91 to 2004-05, production and productivity level has increased significantly at the rate of 3.55 percent and 2.80 percent per annum. Sugarcane, which has been cultivated repeatedly in Western Maharashtra (mostly in Pune and Kolhapur divisions), area under this crop has decreased at the rate of 1.06 percent per annum, also the production by 0.29 percent per annum. The sugarcane productivity is almost stagnant during last one and half decade. This is because of sugarcane mono-cropping. Wide variation in productivity of different crops across districts is another feature of Maharashtra's agriculture. More importantly, the growth rate of productivity of almost all major crops either decelerated or declined during the second part of green revolution. Except sugarcane and some horticulture crops, productivity of all other crops is very low in Maharashtra as compared to the national average.

Among the inputs, the net cropped area in the state has decreased marginally at the rate of 0.35 percent per annum during the period 1990-91 to 2004-05. Except Ratnagiri, Sindhudurg and Sangali districts, net sown area has decreased in all other districts. Thane, Osmanabad, Bhandara and Dhule districts recorded highest variations during the period. Despite decline in area sown, gross cropped area significantly increased at the rate of 0.45 percent per annum, which is obvious due to significant increase in area sown more than once (4.28 percent per annum). Thane, Nashik, Pune, Solapur, Satara, Beed, Buldhana, Wardha, Nagpur, Bhandara, Chandrapur and Gadchiroli districts recorded negative growth in gross cropped area, which resulted in decline in cropping intensity of these districts. The net irrigated and gross irrigated area has also increased significantly at the rate of 2.29 and 1.89 percent per annum during the overall period. Though net irrigated area decreased in Aurangabad, Jalna and Osmanabad district, gross irrigated area recorded increase in these districts. It is surprisingly to note that growth in gross irrigated area of Sindhudurg and Jalgaon districts was negative. Irrigation intensity of the state was 122 percent in TE 1992-93, decreased to 118 percent in TE 2004-05. The decrease in irrigation intensity is due to low space growth in gross irrigated area (due to low growth in area irrigated more than once) as compared to net irrigated area during period under study. Also most of the district have recorded decline in area under HYV seed except Ratnagiri, Sindhudurg, Bhandara and Gadchiroli districts. There is significant increase in credit disbursement to agriculture and allied sector in all district as well as state level. The number of plant

protection equipments is increased at the rate of 2.29 percent per annum at state level. However, negative growth has been recorded in Sindhudurg, Buldhana, Amravati, Wardha, Nagpur and Bhandara districts. The number four wheeled tractor in the state also increased at the rate of 7.71 percent per annum. Except Sindhudurg, all districts have recorded increase in use of four wheeled tractors. Despite limited availability of electricity for agriculture sector, electricity consumption in agriculture of the state has increased significantly at the rate of 13.18 per cent per annum. However, share of electricity use in agriculture has declined from 21.46 percent in 1990-91 to 18.15 percent in 2007-08. The increase in electricity use in agriculture recorded in all the districts of the state. The growth was substantial and significant in case of electric pumpsets; however, there are divisional variations in number of pumpsets availability in the state. The state exhibited positive and significant growth in total fertilizer consumption (2.59 percent per annum) during the period 1990-91 to 2004-05. A similar pattern was observed for per hectare usage, which is increased at the rate of 2.90 percent per annum. Raigad, Sangali, Kolhapur, Amravati district recorded negative growth in total fertilizer consumption, however, Jalgaon, Sangali and Kolhapur recorded negative growth in per hectare fertilizer consumption. The use of fertilisers is found to be very low in divisions like Konkan, Latur and Amravati as compared to the state's average. Poor irrigation facility coupled with the cultivation of low value crops are the main reasons for the low use of yield increasing inputs like fertilisers.

Determinants of Productivity Stagnation of Major Agricultural Crops in Maharashtra

5.1 Introduction:

As mentioned in the earlier chapters, being one of the richer states, Maharashtra earns the bulk of its income from the secondary and the tertiary sectors as agricultural sector accounts for only about 12 percent of its SDP as against the sector accounting for about 22 percent of GDP at the national level during 2008-09. Though average agricultural growth rate turned out slightly higher (2.9 percent) than the population growth (2.26 percent) during last four decades, its agricultural performance is not very appreciable as compared to other states as well as country level. Infact total foodgrains production growth rate was less than one percent (0.67 percent) during 1961 to 2001. Having accounted for around 12 percent of India's gross cropped area (in 2001-02), the contribution of state's agriculture in the agricultural GDP of the country was only about 7.30 percent in 2001-02, mainly due to predominant cultivation of crops under rainfed condition. The productivity of important crops in the state is relatively low as compared to the productivity in other parts of the country. In addition to this, most of the crops have recorded stagnant growth in productivity during last decade. Therefore, there is a need to examine the changes in total factor productivity over the time for principal crops at the state level. It is in this context, in this chapter, we analyzed the total factor productivity index by using Tornqvist-Theil index for principal crops in the state.

5.2 Determinants of Stagnation in Productivity of major Crops:

As mentioned earlier, the increased use of inputs, to a certain extent, allows the agricultural sector to move along the production surface. The use of modern inputs may also induce an upward shift in the production function to the extent that a technological change is embodied within. However, it has long been recognized that partial productivity measures, such as output per unit of individual inputs, are of

limited use of indicators of real productivity change as defined by a shift in the production function. The Total factor Productivity (TFP) concept, which implies as index of output per unit of total factor inputs, measure these shifts in output properly, holding all inputs constant. Thus, TFP measures the amount of increase in total output that is not accounted for by increases in total inputs. The rate of growth in input index, output index and total factor productivity of important crops¹ in Maharashtra state is presented in Table 5.1. Also the trends in total factor productivity indices of major crops can be seen from Figure 5.1 to 5.8.

It can be seen from the Table 5.1 that during the overall period, among the crops, the input index has risen at the highest rate of 12.25 percent in case of sunflower followed by 11.82 percent in bajra, whereas it was 7.39 percent in groundnut, 6.97 percent in safflower, 6.42 percent in cotton, 4.6 percent in moong, 4.4 percent in urad, 0.76 percent in sugarcane and as low as 0.11 percent in case jowar crop. With increase in inputs and technological change the total output increased by more than 4 percent per annum in case of sunflower, between 2 to 3 percent per annum in case of jowar, moong and safflower, between 1 to 2 percent per annum in case of bajra, groundnut, cotton and sunflower and as low as less than 1 percent in case of urad crop. Except bajara, groundnut and cotton crop, the TFP index has risen by more than 8 percent in case of urad, 5.14 percent per annum in moong, almost 4 percent in case of sunflower, about 3 percent in Jowar, 1.53 percent in safflower and 0.59 percent in sugarcane crop. The negative TFP growth was observed in case of bajara (2.85 percent), groundnut (1.68 percent) and cotton (2.94 percent). Infact during all sub periods of these crops, share of TFP in output growth was negative. The higher growth rate in input indices than output indices resulted in negative growth in TFP. Thus, it appears that production is input based and the role of technology is not visible. There are wide fluctuations in TFP indices during the sub-periods. The wide fluctuations in TFP indices may be due to fluctuations in production due to weather.

¹ Data on per hectare quantity, price and values of various inputs used and output (i.e. cost of cultivation) for the major crops grown in Maharashtra is collected from the CACP reports. However, due to non-availability of time series data for some crops, we could not to estimate TFP (such as tur, gram, soybean and some other crops).

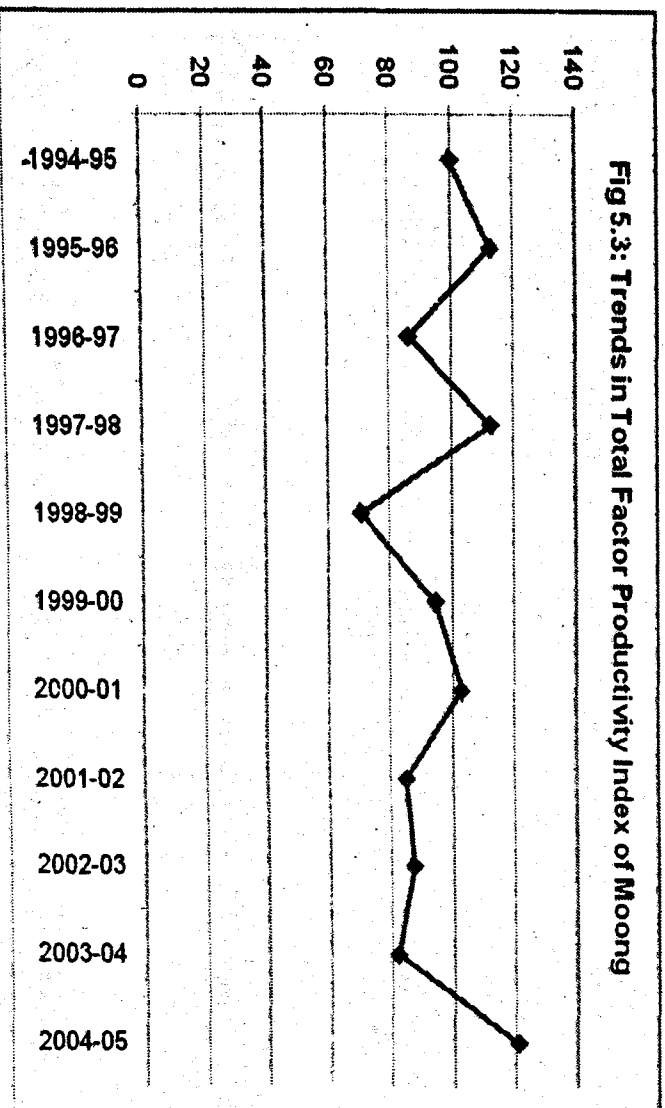
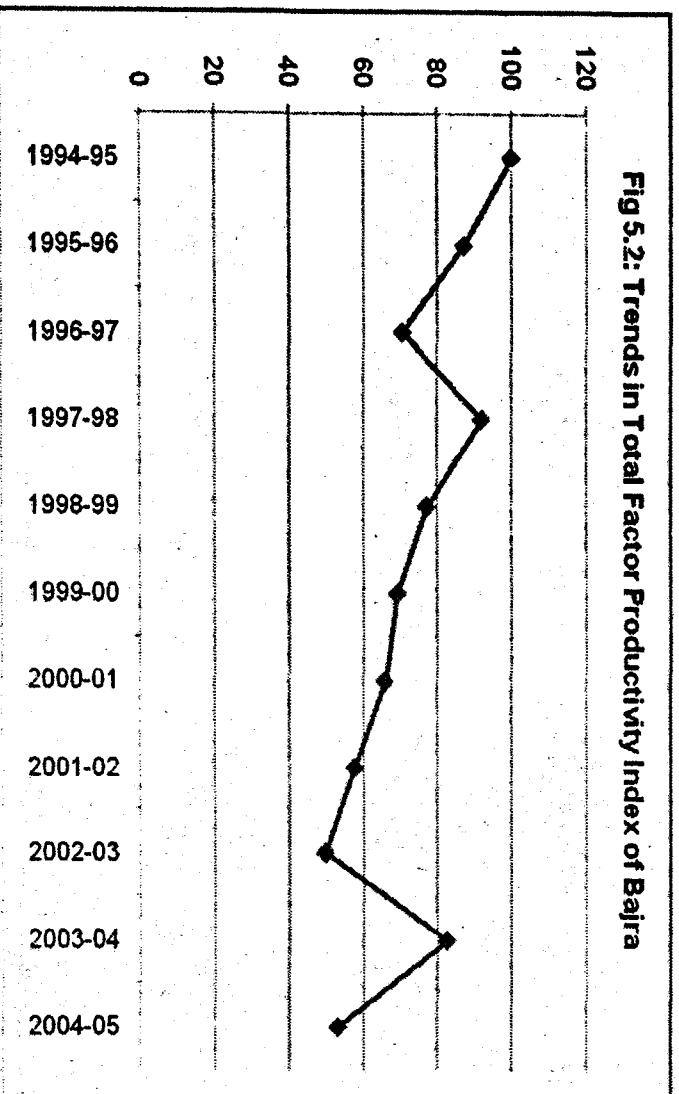
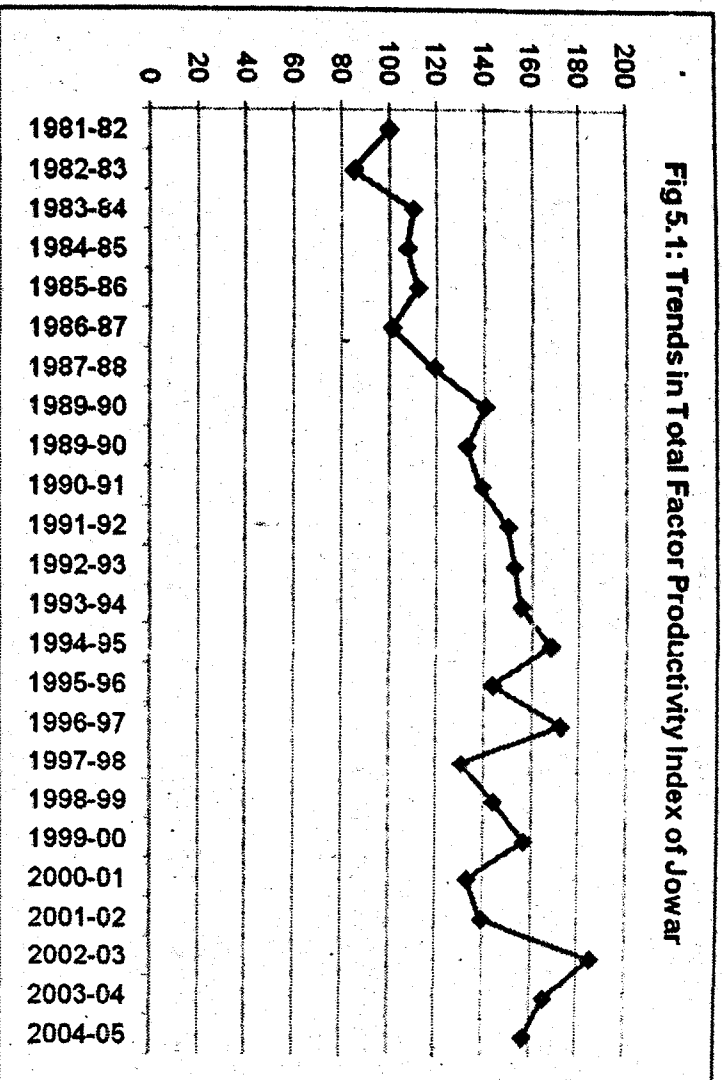
Table 5.1: Rate of Growth in Total Factor Productivity of Major Crops in Maharashtra

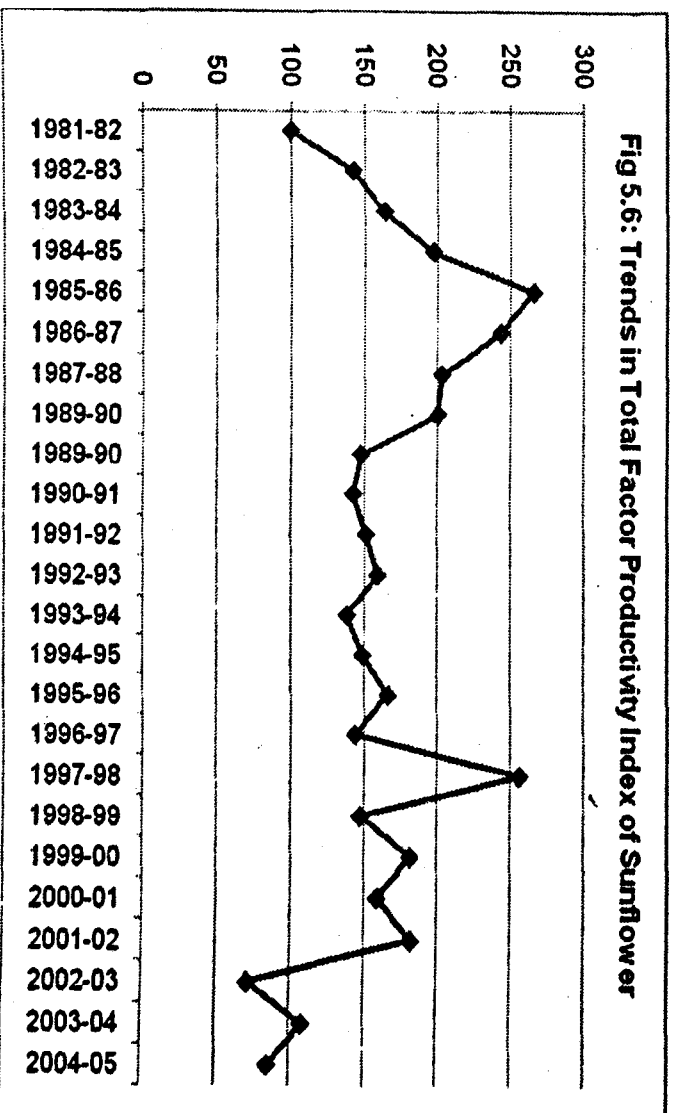
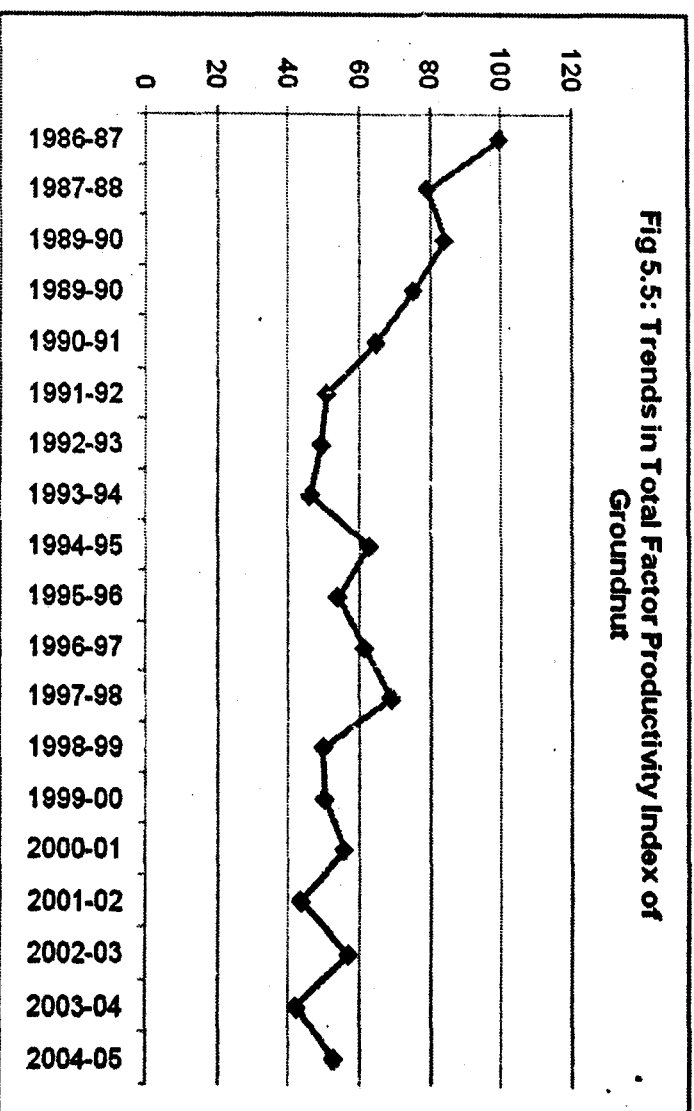
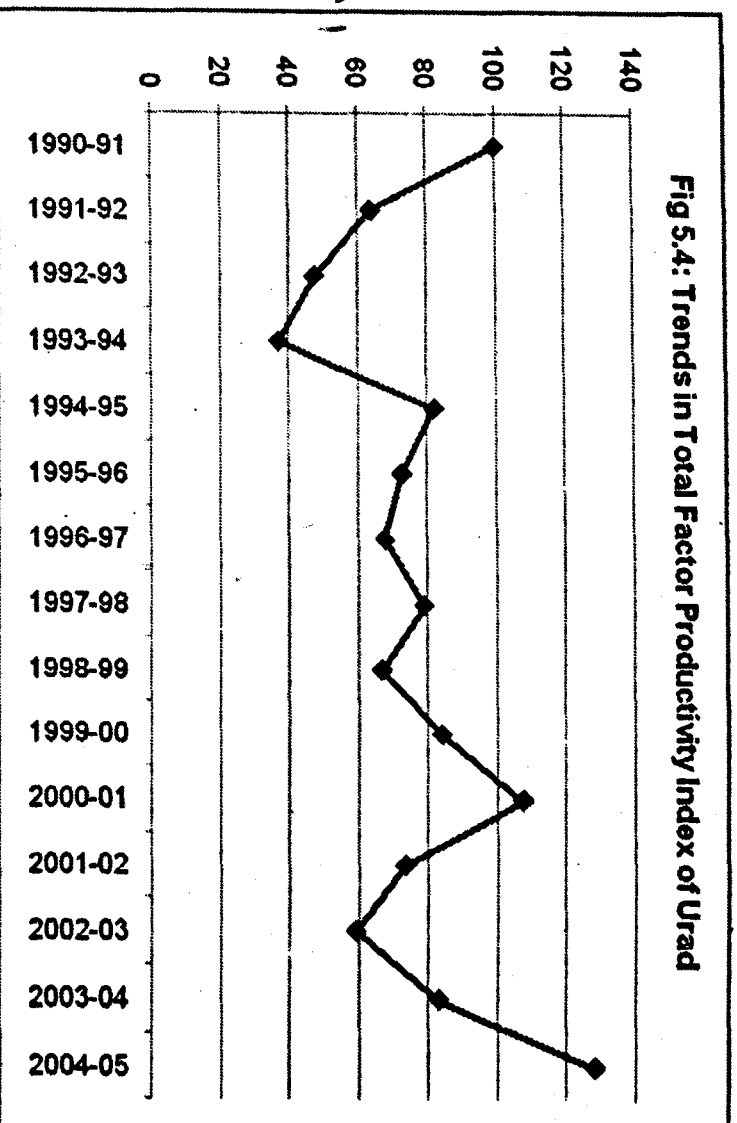
Crops/Periods	Input	Output	TFP	Share of TFP in output growth
Jowar				
1981-82 to 1989-90	2.75	6.60	4.61	69.92
1990-91 to 1999-00	0.99	3.48	2.26	64.86
2000-01 to 2004-05	-5.55	-4.99	1.36	Negative
1981-82 to 2004-05 (OP)	0.11	2.75	2.99	108.57
Bajra				
1994-95 to 1999-00	13.71	4.05	-5.58	Negative
2000-01 to 2004-05	9.92	-0.93	-0.12	Negative
1994-95 to 2004-05 (OP)	11.82	1.56	-2.85	Negative
Moong				
1994-95 to 1999-00	12.96	5.98	3.25	54.29
2000-01 to 2004-05	-3.37	-0.59	7.03	Negative
1994-95 to 2004-05 (OP)	4.80	2.69	5.14	190.73
Urad				
1990-91 to 1999-00	9.73	1.87	5.10	272.36
2000-01 to 2004-05	-5.19	-1.94	14.25	Negative
1990-91 to 2004-05 (OP)	4.40	0.51	8.37	1640.02
Groundnut				
1986-87 to 1989-90	14.90	4.28	-8.27	Negative
1990-91 to 1999-00	7.78	1.59	-2.41	Negative
2000-01 to 2004-05	2.12	-2.11	3.72	Negative
1986-87 to 2004-05 (OP)	7.39	1.01	-1.68	Negative
Sunflower				
1981-82 to 1989-90	10.52	14.13	7.52	53.23
1990-91 to 1999-00	1.86	-0.55	5.90	Negative
2000-01 to 2004-05	35.78	-1.88	-5.63	Negative
1981-82 to 2004-05 (OP)	12.25	4.27	3.96	92.75
Safflower				
1986-87 to 1989-90	10.27	10.20	0.89	8.77
1990-91 to 1999-00	4.65	-1.32	0.22	Negative
2000-01 to 2004-05	9.63	4.34	4.54	104.67
1986-87 to 2004-05 (OP)	6.97	2.17	1.53	70.52
Cotton				
1986-87 to 1989-90	17.71	4.36	-9.30	Negative
1990-91 to 1999-00	3.39	1.62	-0.79	Negative
2000-01 to 2004-05	5.70	-0.39	-3.43	Negative
1986-87 to 2004-05 (OP)	6.42	1.52	-2.94	Negative
Sugarcane				
1981-82 to 1989-90	1.37	1.55	0.48	31.20
1990-91 to 1999-00	0.99	-0.31	-0.98	Negative
2000-01 to 2004-05	-0.69	3.04	3.92	128.97
1981-82 to 2004-05 (OP)	0.76	1.06	0.59	55.68

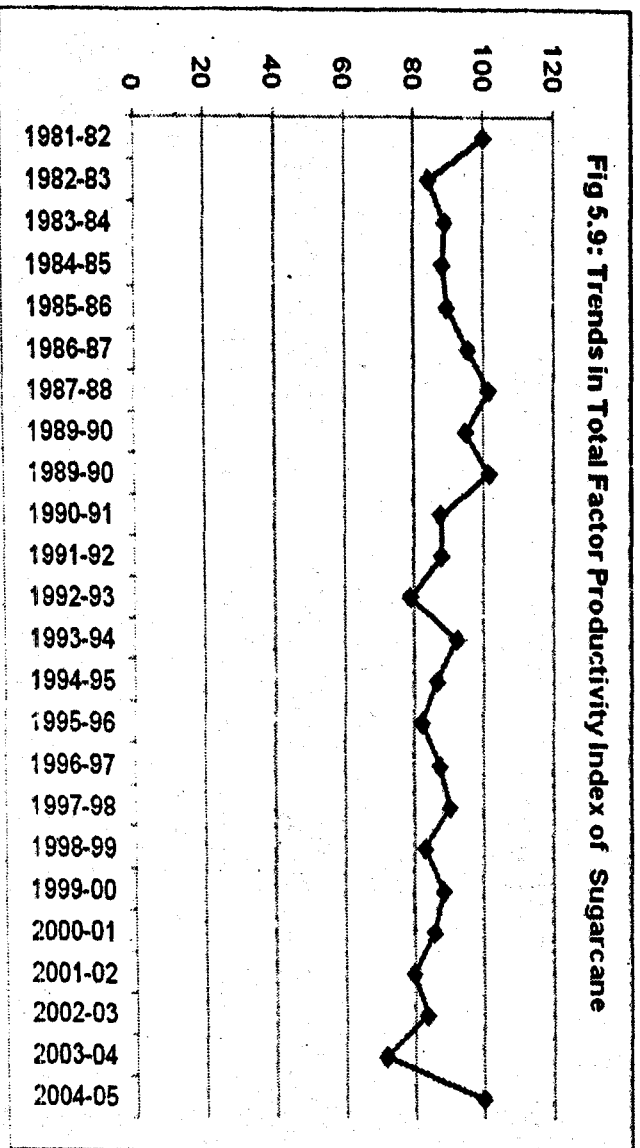
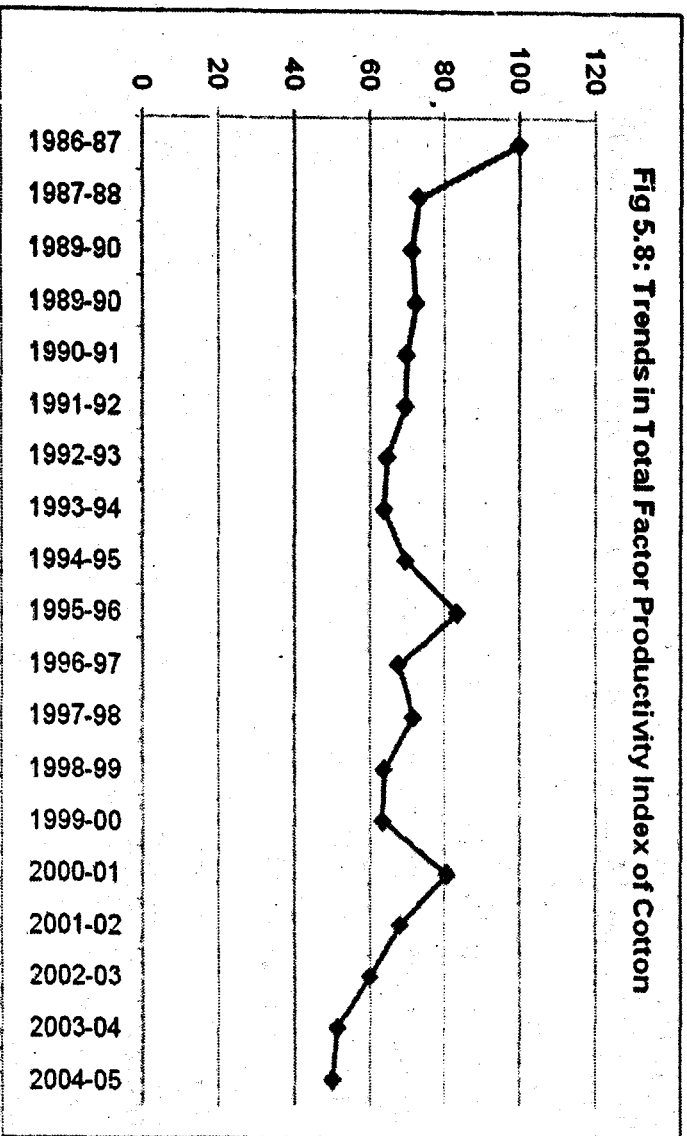
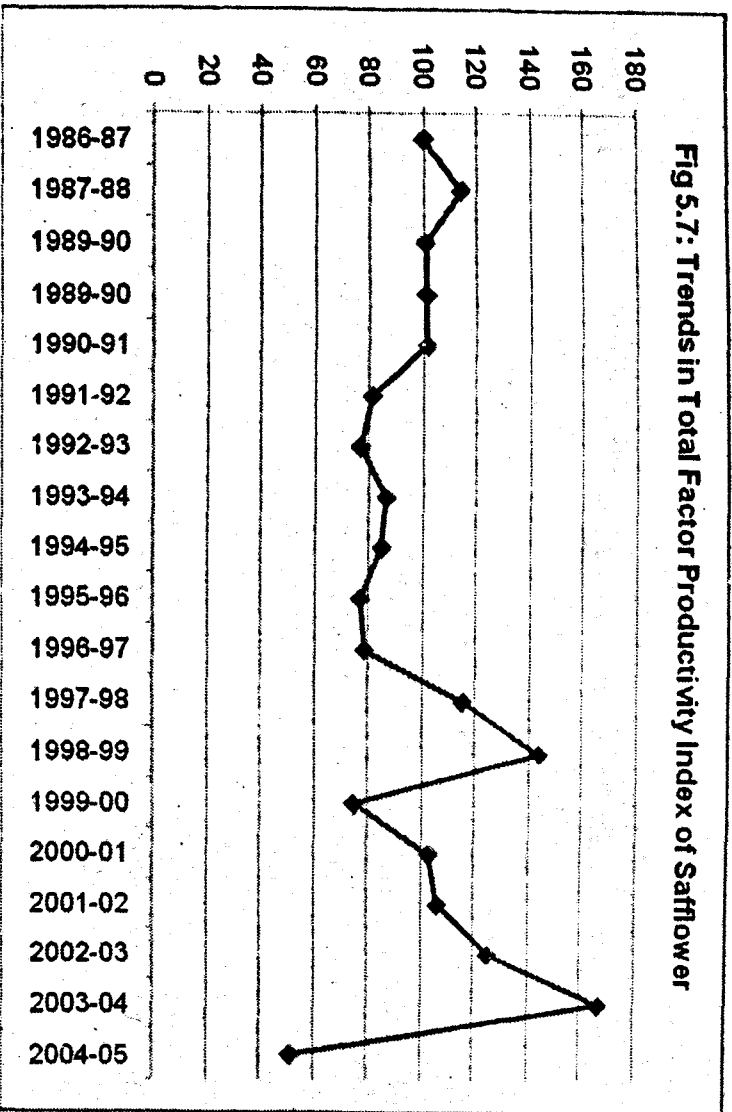
Notes: Average annual growth rate- per cent per annum, OP-Overall Period.

Productivity growth or technological change was responsible for more than 1640 percent in case of urad, 190.73 percent in moong, 108.57 percent in Jowar, 92.75 percent in sunflower, 70.52 percent in safflower and 55.68 percent in sugarcane. The negative share of TFP in output growth during recent period (2000-01 to 2004-05) for almost all crops except safflower and sugarcane is major concern. The results on TFP growth analysis shows mix results in case of two important commercial crops of the state, viz. cotton and sugarcane. The negative growth in TFP was recorded for cotton crop during overall (1986-87 to 2004-05) as well as during sub-periods. The growth in input indices was much higher than the output growth, which resulted in negative TFP growth for cotton. In case of sugarcane, during overall period (1981-82 to 2004-05), TFP growth rate was found positive due to higher positive growth of output index and lower input index growth.

Thus, TFP indices growth rate was positive during overall period in case of Jowar, moong, urad, sunflower, safflower and sugarcane, whereas growth was negative in case of bajara, groundnut and cotton. The negative TFP growth in these crops discouraged crop diversification towards these crops. The significant deceleration in total factor productivity growth during the later period in respect of major crops has serious implications for the agricultural development of Maharashtra. The productivity growth or technological change was responsible for significant growth in total output growth for jowar and urad during overall period. It implies that past higher growth rate of output and TFP observed in these crops may not be sustained without substantial technological improvements in future. If this stagnant and negative growth in TFP continues, already food deficit state will see further increase in shortage of foodcrops, especially pulses and oilseeds if not jowar. There is an urgent need to increase TFP growth in all the major crops especially pulses, oilseeds and cotton to make their cultivation profitable and to increase crop diversification and optimal use of land and other resources.







5.3 Determinants of Total Factor Productivity²:

Total Factor Productivity (TFP) is the portion of output not explained by the amount of inputs used in production. As such, its level is determined by how efficiently and intensely the inputs are utilized in production. The method used to measure TFP does not by itself suggest what determines changes in TFP. Nor does it suggest an underlying TFP production process that might make it possible to derive functional form restrictions that can be used in statistical specifications. TFP growth in its simplest sense is a residual. That is, it is difference between an actual change in production and a change in production predicted by weighted factor changes (Evenson, *et al.*, 1999). Past literature shows that technical change in agriculture is determined by non-price factors like government expenditure on research and development, infrastructure, etc. The TFP growth is shown to be the product of technological change and change in technical efficiency. Agricultural research, infrastructure, agricultural extension and improvements in efficiency were found to be the major sources of the TFP growth in agriculture. Therefore, it is important to assess the contribution made by the several sources to the growth of TFP.

The independent variables utilized in the analysis for the state includes the Capital Outlay on Agricultural Research and Education (COARE), number of regulated markets (MKTS), proportion of Rural Literate (LITERACY), Rainfall June to August (JUAURAIN), Annual Rainfall (YEARRAIN), Year which is linear trend variable (YEAR). Dependent variable is the log of the TFP index. All variable specified in logarithms, except those variables defined in percentage terms, which enter linearly (LITERACY).

The estimated parameters of TFP decomposition equations for the state is presented in Table 5.2. It can be seen from the table that number of regulated markets and total annual rainfall are the most important sources of growth in Total Factor Productivity of agriculture in the state. Total rainfall during the year is crucial importance for growth of productivity. This may be because of the fact that as of

² Due to non-availability of districtwise data on input use and related parameters, TFP indices as well as districtwise determinants for changes in productivity and stagnation of important crops could not estimated.

As most of independent variables are sector specific (cropwise data for independent variables was not available) and therefore weighted TFP index for the State as whole was constructed (by taking cropwise area share as weights) and then the factors affecting TFP was analyzed.

today more than 82 percent gross cropped area is rainfed and productivity of the crops heavily depends on rainfall pattern. The estimated effect of research, literacy and rainfall during June and August in TFP was found negative. The negative effect of June-Aug rainfall may be due to variations in rainfall and widening gap in rain during this period. The estimated effect of literacy on TFP was found negative, which may be due to the fact that because of non profitable agriculture business, rural educated youth are moving away to non-agriculture and therefore, literacy has not contributed to TFP growth. While negative contribution of research in total factor productivity growth of major crops in the state is major concern, as it has positive and significant contribution at national level. It is may be due to very minimal capital expenditure on agricultural research and education in the state. Therefore there is a need to target public investment in research.

Table 5.2: Determinants of Total Factor Productivity Growth in Maharashtra

Variable	All Crops	
	Parameter estimates	Standard Error
Intercept (Constant)	-0.199	2.095
COARE	-0.032	0.026
MKTS	1.234	0.903
LITERACY	-0.017 ^a	0.005
JUAURAIN	-0.006	0.125
YEARRAIN	0.056	0.112
YEAR	0.018 ^a	0.006
R2	0.471	
Degrees of freedom	23	

Notes: Dependent Variable is TFP. All variables specified in logarithms, except those variables defined in percentage terms, which enter linearly (LITERACY) and Year; a- significant at 1 percent significance level.

5.4 Conclusions

The foregoing discussion indicate that during overall period, TFP indices growth rate was positive during overall period in case of Jowar, moong, urad, sunflower, safflower and sugarcane, whereas TFP index growth rate was negative in case of bajara, groundnut and cotton. The negative TFP growth in these crops

discouraged crop diversification towards these crops. The significant deceleration in total factor productivity growth during the later period in respect of major crops has serious implications for the agricultural development of Maharashtra. The productivity growth or technological change was responsible for significant growth in total output growth for jowar and urad during overall period. It implies that past higher growth rate of output and TFP observed in these crops may not be sustained without substantial technological improvements in future. If this stagnant and negative growth in TFP continues, already food deficit state will see further increase in shortage of foodcrops, especially pulses and oilseeds if not jowar. There is an urgent need to increase TFP growth in all the major crops especially pulses, oilseeds and cotton to make their cultivation profitable and to increase crop diversification and optimal use of land and other resources.

The determinants analysis of total factor productivity growth of agriculture in Maharashtra shows that number of regulated markets and annual rainfall are the most important sources of growth in Total Factor Productivity of agriculture in the state. Total rainfall during the year is crucial importance for growth of productivity. This may be because of the fact that as of today more than 82 percent gross cropped area is rainfed and productivity of the crops heavily depends on rainfall pattern. The estimated effect of research, literacy and rainfall during June and August in TFP was found negative. The negative effect of June-Aug rainfall may be due to variations in rainfall and widening gap in rain during this period. The estimated effect of literacy on TFP was found negative, which may be due to the fact that because of non profitable agriculture business, rural educated youth are moving away to non-agriculture and therefore, literacy has not contributed to TFP growth. While negative contribution of research in total factor productivity growth of major crops in the state is major concern, as it has positive and significant contribution at national level. It is may be due to very minimal capital expenditure on agricultural research and education in the state. Therefore there is a need to target public investment in research.

Chapter VI

Summary and Conclusions

6.1 Introduction:

India is still an agricultural economy in the beginning of 21st century and according to 2001 census, near about 73 per cent of people live in the rural area, primarily depending on agriculture for their livelihood. Agriculture is the main stay of Indian economy because of its high share in employment and livelihood creation notwithstanding its reduced contribution to the nation's Gross Domestic Product (GDP). The share of agriculture in GDP has registered a steady decline from 36.4 percent in 1982-83 to 17.8 percent in 2007-08. Yet this sector continues to support more than half a billion people providing employment to 52 percent of the workforce. Agricultural sector also contributed 12.2 percent of national exports in 2007-08. In spite of rapid urbanization during last few decades, India's rural population still accounts for about three fourths of the total population. It is observed that growth in agriculture contributed to poverty alleviation and employment generation in the rural areas and achievements of higher rates of economic growth and therefore, prosperity of the rural economy is closely linked to agriculture and allied activities.

India has made lot of progress in agriculture after mid sixties in terms of growth in output, yields and area under many crops. The main source of long-run growth was technological augmentation of yields per unit of cropped area. However, Indian agriculture suffers from a mismatch between food crops and cash crops, low yields per hectare except for wheat, volatility in production and wide disparities of productivity over regions and crops. Agricultural growth in India during the late 1970s and early 1980s was propelled by the green revolution technologies. But, the productivity gains from green revolution technologies in India have essentially ended. The decade of nineties showed mixed performance for the agricultural sector. Initially, the agricultural sector showed positive signs of growth but soon under the pressure of inter-sectoral growth pulls the investment trends in the agricultural sector showed signs of deceleration. The situation was further impacted by signing of the WTO agreement on agriculture and that placed additional factor in front of the policy planners. A clear picture of intensifying stress

in the agriculture sector was emerging and that took very ugly culmination in a few regions. The Mid Term Appraisal for the Tenth Five Year Plan had drawn attention to the loss of dynamism in agriculture and allied sectors after the mid 1990s. In the last decade, there has been a sharp deceleration in Indian agriculture with the growth rate of agricultural GDP slipping from 3.62 percent during 1984-85 to 1995-96 to less than 2 percent in the period from 1995-96 to 2004-05. Further, state-wise trends indicate that the largest slumps occurred predominantly in rainfed area. This deceleration, although most marked in rainfed areas, occurred in almost all states and covered all major sub-sectors. The growth in productivity of all crops was showing declining trend across the regions by the end of 2004-05. Wheat, an important constituent of National Food Security, showed a declining trend in productivity, while rice and *ragi* seem to have reached yield plateau after 1992-93. These results clearly show the signs of acute distress and stagnation in productivity in the sector. Low farm incomes due to inadequate productivity growth have often combined with low prices of output and with lack of credit at reasonable rates, to push many farmers into crippling debt. This seems to be a matter of serious concern, especially in view of a growth strategy from globalization and trade angles. It calls for an examination of the issues related to the trends in agricultural productivity, particularly with reference to individual crops in the recent years and the determinants of stagnation in productivity of important crops.

Maharashtra is an important state of India so far as its contribution to the agriculture development of the country is concerned. During the last four decades, the agricultural sector of Maharashtra has undergone lot of changes. Though the new seed fertilizer technology was introduced in Maharashtra in mid-sixties, it has arrived in full swing in the early part of seventies. Though agricultural performance improved during the last forty years, its progress was not sustained and showed wide fluctuations. Infact, the important characteristics of Maharashtra agriculture is the instability in crop production and significant regional variations in the performance of agriculture in the state (Dev, 1996). The recent farmer suicides in Vidarbha and Marathawada have once again highlighted regional disparity in Maharashtra. The agrarian crisis in Vidarbha has spun almost out of control. There are a number of factors which limit the growth of agriculture over the years in the state. It is, therefore, necessary to look into the factors affecting agricultural growth. Hence the present study tries to examine the district-wise growth and the

stagnation in the important agricultural crops of state of Maharashtra. The broad objectives of the study are:

6.2 Objectives:

The specific objectives of the study are:

1. To analyse the growth pattern of production and productivity of important crops across the district and State.
2. To study the regional variations in productivity of important crops (specially bringing out the districts with differentiated growth behaviour) and to map out the regions with acute stagnation
3. To trace the determinants for changes in productivity and stagnation of important crops
4. To suggest district level interventions to overcome the problems of stagnation

6.3 Methodology:

This study has been carried out for Maharashtra state, mainly using available secondary level information. The time period for the study was from 1960-61 to 2004-05. Data for this study have been mainly compiled from various published sources, viz., Season and Crop Report of Maharashtra State (various issues), Districtwise Agricultural Statistical Information of Maharashtra State, Economic Survey of Maharashtra and India, Districtwise Agricultural Database for Maharashtra: 1960-61 to 1997-98 (published by EPWRF, Mumbai), various documents published by the Ministry of Agriculture, Government of India, New Delhi, various committee and commission reports, related websites such as <http://agricoop.nic.in>, <http://agri.mah.nic.in>, <http://www.censusindia.net>, etc. Recent data on Maharashtra's agricultural development have been directly compiled from the Office of the Commissionerate of Agriculture, Government of Maharashtra, Pune. For the data analysis, the simple statistical tools like average, percentages, exponential /annual growth rates and regression etc. calculated. The study concentrates on districtwise analysis of major crops in Maharashtra. In order to know the importance of crops in the economy of the farmers and its importance in inter-regional and across crops, Crop Concentration Ratio (CCR) is computed. In order to know the determinants of stagnation in productivity of important crops in

the state, Total Factor Productivity was calculated. For the estimation of Total Factor Productivity, a widely used Tornqvist-Theil Index was used.

6.4: Major Findings of the Study:

6.4.1 Recent Development in Maharashtra Agriculture:

Maharashtra is one of largest states in India, both in terms of gross cropped area (GCA) and population. While accounting both for 9.4 percent of India's population and geographical area, the state accounts for about 12 percent in India's gross cropped area in 2005-06. The state contributes about 13 per cent of the national income and per capita state income is higher than the national income and ranks after Haryana among all the Indian states in the year 2007-08 (GOM, 2009). The sectoral composition of the State Income has undergone considerable changes during 1960-61 to 2007-08. Over these 47 years, the share of agriculture and allied activities has declined steadily from 31.1 per cent to 15.2 per cent; the share of industry sector has remained between 23.2 and 25.0 per cent, while the share of services sector has increased from 45.7 per cent to 59.8 per cent. Though Maharashtra is one of the industrialized states in the country, agriculture and allied activities are still predominant in the state and continue to be the major source of income for most of the population.

Maharashtra is economically among the most developed states in the country, but it is not counted among the advanced states in India in terms of agricultural production, though most of the state's workforce still depends on agriculture. As per the population census 2001, 55.41 per cent population is dependent on agriculture for livelihood. Indeed, the share of state's rural labour force employed in agriculture was as high as 80.08 per cent even in 2001, near about half (38.39 per cent) of the agricultural workers being labourers. Thus, the crucial dependence of its rural labour force on agriculture is quite evident and it is unlikely to diminish drastically in the future (Sawant, *et al*, 1999). It can be noted that despite the high income and industrial dominance, magnitude of poverty in Maharashtra (30.7 per cent) is higher by 3.20 percent than the national level average (27.5 per cent) in 2004-05 and as regards the population below poverty line in absolute number, the State stands third amongst major states in the country after Uttar Pradesh and Bihar (GOM, 2009). Most of the poor in the state live in

rural areas and agriculture is the major source of income for them. As agricultural productivity growth has a positive impact on reducing poverty (Bhattarai and Narayanamoorthy, 2002), and therefore improvement in growth performance of the agriculture and allied sectors would be the most important factor for reducing rural poverty, increasing farmers' income in Maharashtra. The slow crop output growth is also due to low productivity of different crops in the state as compared to the national average (except sugarcane). Apart from reducing farmers' income, low productivity of crops pulls down the overall growth rate of agriculture production in the state.

Keeping in view the importance of agriculture, the government of Maharashtra introduced various programmes in different plan periods since third five year plan and the draft agriculture policy prepared by the state government has also highlighted the thrust areas to be focused in the future. As a result of initiatives taken by the government, the agricultural sector of Maharashtra has undergone lot of changes. However, as compared to other states, agricultural performance of the state is not very appreciable. Having accounted for about 12 percent of India's gross cropped area (in 2005-06), the contribution of state's agriculture in the agricultural GDP of the country is only about 10.48 percent in 2007-08, mainly due to predominant cultivation of crops under rainfed condition. Though Maharashtra state occupies relatively better position in terms of contribution to the total production of different commodities at all India level, but still it is lagging behind in many parameters as compared to the national average. The productivity gains achieved by the crops during seventies and eighties have not sustained over time and agricultural sector of the state has been facing a number of different problems. The low irrigation facility has been one of the serious problems of the state. About 83 percent of cultivated area is under rainfed condition as of today. Due to low irrigation facility, not only low value crops are cultivated predominantly in the state but the productivity of most of the crops is also very low as compared to the national average. Cultivation of low value crops coupled with the low productivity of crops reduce the income of the farmers, which adversely affect the standard of living of both farming and non-farming (landless agricultural labourers) rural communities. Since rainfed crops are generally affected by varied rainfall (moisture stress), productivity of different crops is very low in the state as compared to the all India average. Mono-cropping pattern (example, sugarcane) followed in certain

regions of the state has also affected the productivity of crops, which is important issue of Maharashtra's agriculture. Though significant development has taken place in horticultural sector during the last decade, it has not made any significant impact on the growth rate of agriculture. The slow growth of agriculture is a serious issue from the point of view of rural employment and poverty, both of which are heavily dependent on agricultural growth.

6.4.1.1 Rainfall:

Monsoon rain plays a critical role in the agricultural development of the state, as about 83 percent of cropped area is cultivated under rainfed condition as of today. Though the average rainfall of the state is relatively higher as compared to many states in India, its timeliness and spread across months as well as across different regions are not very much favourable (Narayanamoorthy and Kalamkar, 2004). Nearly one third of area of the state falls under rain-shadow region where the rains are scanty and erratic. In these areas, only dry land cultivation is undertaken (GOM, 2008). While the normal rainfall of the Konkan division (about 2900 mm) is about 135 percent higher than the average normal rainfall of the state (1254 mm), the same is less by about 40 percent in Aurangabad division. Moreover, except 10 districts of the total 34 districts in the state, the normal rainfall of all other districts is less than the state's average normal rainfall (Narayanamoorthy and Kalamkar, 2004). Due to large year to year fluctuations in receipt of amount of rainfall, district are shifting from one group to another, i.e. high-medium and to low rainfall group and vice versa. Out of 26 districts, during the period 1960-61 to 1964-65, 4 districts were in high rainfall group, 10 district falls in medium rainfall group and remaining 12 district fall in low rainfall group. The corresponding numbers for the period during 2001-2005 were 6, 10 and 17 (out of 33 reported districts). The most of the districts from Pune, Latur and Amravati divisions fall under low rainfall group. This wide variation in rainfall across regions/across the year acts as one of the major constraints in state's agriculture. An analysis shows that the productivity of agricultural commodities goes down sharply whenever there is a reduction in rainfall (Narayanamoorthy and Kalamkar, 2004). This is because of the fact that foodgrains and other crops are cultivated predominantly in those districts which receive relatively less-normal rainfall. Apart from variation in the normal rainfall across districts, it also widely varies across

talukas within a district/region. This not only discourages the farmers to adopt the required quantity of various yield increasing inputs but ultimately results in lower productivity most of the time. In view of the limited water potential as well as increasing demand for water from different sectors, the only option available before the policy makers is to implement sustainable rain water harvesting systems at a rapid pace through watershed development programme.

The drought proneness of the state is a critical additional stress factor that adversely affects productivity, livelihood, and the rural economy and ironically the cultivated areas lie in drought affected districts. About a quarter of India's drought prone districts are in Maharashtra, with 73 per cent of its geographic area classified as semi-arid (World Bank, 2008) and CWC identified total 45 talukas from nine districts of the state as drought prone.

6.4.1.2 Irrigation Status:

Irrigation is the most important element in the steady growth of the agricultural sector. It not only increases agricultural production but also minimizes the uncertainty due to unpredictable rainfall. Limited availability of irrigation is one of the main constraints that affect the growth of agriculture in Maharashtra. Though irrigation sector of Maharashtra is one of the largest in the country, both in terms of the number of large dams and the live storage capacity, irrigation sector has been facing multifarious problems. While the water availability for the future use of irrigation has been reducing at a fast rate, the demand for water for irrigation purposes has been alarmingly increasing due to agricultural expansion and intensification (Narayanamoorthy and Kalamkar, 2007). Considering the predominant nature of rainfed cultivation and wide variation in the rate of rainfall across regions, a significant emphasis has been given for the development of irrigation in the state by the policy makers since independence. Despite huge spending on the irrigation projects, the proportion of gross area irrigated to gross cropped area in the state is around 18 percent as against about 43 percent at the national level during the year 2006-07. In fact, the percentage of irrigation is less than 15 percent in 18 out of 33 districts in 2002-03, as per latest data available. This kind of situation is seldom seen in any of the states in India. The low level of irrigation as well as the erratic rainfall pattern often discourages the farmers to take up intensive cultivation in many regions in the state. Besides the problem of low

development of irrigation, the created irrigation potential is also not equally distributed across regions in the state. Data show that four divisions namely Pune, Kolhapur, Aurangabad and Nagpur together accounted for about 74.23 percent (0.780 mha) of total surface irrigated area of the state during TE 2001-02. However, the distribution of area under well irrigation across divisions is relatively better than surface source of irrigation. Except Konkan, Amravati and Latur divisions, the share of well irrigated area to total (net) well irrigated area is varied from about 12 percent to 25 percent in other divisions. Interestingly, the share of surface irrigated area is found to be higher in those areas where the share of well irrigated area is also higher, except Nashik and Nagpur divisions. As irrigation is one of the important factors which determine the income generating capacity of the rural population and also involves a large amount of public investment, the allocation of resources for irrigation development needs to be linked with the percentage of utilisation of irrigation potential across regions in the future.

As mentioned earlier, Maharashtra state stands on the upper side of the ladder in terms of investment on irrigation. As a result of large investment on irrigation, Maharashtra state accounts for about 37 percent (1651 dams) of the total number of large dams constructed in the country, as per the latest information available from CWC (2004). Despite having largest number of dams and also storage (second highest in the country) capacity of 22.10 cubic km from the completed projects, in terms of achievements, the proportion of cultivated area under irrigation is only about 18 percent of gross cropped area (GCA) as of today, which is one of the lowest among the states in the country. One of the important reasons for the less proportion of irrigated area is that two-third of water available in the state is used only for sugarcane, which accounts for less than three percent of gross irrigated area in the state. Thus, it is clear that irrigation water is not used judiciously in the state. One of the significant developments in Maharashtra's irrigation is the impressive growth in micro-irrigation (drip and sprinkler). Maharashtra is the leading state in adoption of micro irrigation, contributing almost half of the country's micro irrigated area. Micro irrigation is adopted for thirty types of fruit trees, vegetables, flowers, and other crops like sugarcane, cotton, and agro-forestry.

6.4.1.3 Land Use Pattern:

Land use statistics shows that pattern of land use in the state has been fairly stable since 1961, with marginal downward change in the share of forest area or simply upward movement in the proportion of area under non agricultural use (see, Kalamkar, 2003). Since crops are cultivated predominantly under rainfed condition in Maharashtra, net sown area (NSA) has marginally declined between TE 1962-63 and TE 2004-05 (by 1.55 percent points), which is somewhat different from the trend emerging at the national level. Despite having limited availability of irrigation facility, area cultivated more than once increased from 3.18 percent of total geographical area in TE 1962-63 to 15.65 percent in TE 2004-05. In fact, area cultivated more than once increased nearly three times between TE 1982-83 and TE 2004-05. Intensive cultivation of annual crops such as sugarcane, horticulture crops, etc., could be the main reasons for this sharp increase. While there is no significant change in area under fallow, lands under cultivable waste as well as permanent pastures and grazing land, land used for non-agricultural purpose and barren and unculturable land, which has increased from about 72.77 lakh hectares in TE 1962-63 to 80.44 lakh hectares in TE 2004-05, an increase of about 10.5 percent over base period. The increase in land put to non-agricultural uses is due to the fact that more and more land is brought under construction of buildings, roads, industries and other development purposes. Out of the total arable land available in the state, 85 per cent land is already used for agricultural production. Thus, on the extensive front, agriculture in the state has extremely limited scope to bring additional land under cultivation (Dandge and Pawar, 2004). However, altogether about 49.33 lakh hectares of lands are available in the form of cultivable waste, permanent pastures, land under tree crops and grooves, current as well as other follows. With a proper wasteland development programme, these lands can be brought under productive use, which may help to reduce the rural poverty in the state.

6.4.1.4 Changing Structure of Landholdings:

Land holding pattern of the state is somewhat different from the all-India level. Though the proportion of marginal and small holdings has been increasing both at the state and the national level, the share of these groups in the total number of holdings is relatively lower in Maharashtra as compared to all-India level. As per Agricultural Census 2000-01, the total number of land holdings in the state

were 1.21 crore with 2.01 lakh ha area of operational holdings. The marginal and small holdings accounted for about 73.4 percent of the total holdings in Maharashtra, whereas the same group accounted for only 38.7 percent of area. Whereas, total 7.8 percent of medium and large farmers had 31.0 percent of area of operational holdings. There is a sharp reduction in the number of large holdings in Maharashtra (from 10.4 percent in 1970-71 to 0.7 percent in 2000-01). Because of relatively lower number of marginal and small holdings in Maharashtra, the average size of operational holdings is found to be higher in the state (1.66 ha) as compared to the same at the all-India level (1.33 ha). The average size of the operational holdings in Maharashtra has declined to 1.66 ha in the year 2001, from 2.21 ha in 1990-91. The same kind of trend has also been recorded in all the districts of the state. Out of total number of operational holdings in 2001, the highest numbers of marginal land holdings were recorded in Kolhapur (67.7 percent) and Konkan division (60.9 per cent) and lowest in Amravati (23.3 percent) and Latur divisions (32.6 percent). Among the districts, the average size of operational holdings was lowest in Kolhapur district (0.79 ha) and the highest was in Yavatmal (2.70 ha). The corresponding average size of holdings during 1990-91 was 1.11 ha for Kolhapur, 3.29 ha for Yavatmal district and state average was 2.21 ha. The remaining districts average size of holdings ranges/varies from 0.99 ha to 2.43 ha in 2000-01. As compared to the year 1990-91, the average size of holdings has decreased in all the districts in the year 2000-01. About 92 percent of land holding of Kolhapur district was categorized as marginal and small, however they accounted for only 63.4 percent of total land area in 2000-01. The highest increase in number and area under operational holdings of small and marginal group of farmers was recorded in Nashik district, by 15.4 and 17.5 percent points respectively during 1991 and 2001. It is clear from the table that the average size of land holding is higher in suicide prone districts of Vidarbha (Amravati, Yavatmal, Buldhana, Akola, Washim and Wardha districts) than state average. However, it is very low in Kolhapur division and at par in Pune division. Thus, despite having higher average land holding size in Vidarbha region, the crop cultivation has become uneconomical due to rainfed farming and vagaries of monsoon.

6.4.1.5 Changes in Cropping Pattern:

The cropping pattern of the state has changed considerably over the last 40 years. Due to limited availability of irrigation, rainfed crops have been predominantly cultivated in Maharashtra. The area under cereal crops declined by nearly 12 percent points between TE 1962-63 (55.60 percent) and TE 2004-05 (39.74 percent) mainly because of substantial reduction in area under Jowar, which is the important foodgrain crop of Maharashtra. Though the productivity of pulse crops has been lower in the state, the total area under pulse crops has increased from 12.60 percent in TE 1962-63 to 15.26 percent in TE 2004-05. As the alternative crops suitable to rainfed condition are not available, farmers continue to cultivate pulse crops predominantly in the state. Oilseed crops such as Soybean, Sunflower, Sesamum, Groundnut, etc., have also been cultivated predominantly in the state. Despite a significant reduction in area under groundnut, area under the total oilseed crops increased marginally (increased from 10.11 percent to 12.62 percent) between TE 1962-63 and TE 2004-05. This is mainly because of impressive increase in area under soybean crop since early 1990s. Since both pulses and oilseeds are mainly cultivated under rainfed condition and also the state has enormous potential for cultivating these crops, the policy makers should give top priority for promoting the cultivation of these crops. Cotton is another important crop predominantly cultivated under rainfed condition in the state. In spite of facing problems such as severe pest attack, increased cost of cultivation, low productivity and profitability, area under cotton increased between TE 1962-63 and TE 2000-01 (2.6 mha to 3.2 mha) and then recorded decline in TE 2004-05 (2.8 mha). One interesting observation is that despite significant increase in productivity of cotton in recent years (due to introduction of Bt cotton varieties in 2002), area under cotton was almost stable. Measures such as introduction of pest resistance varieties (Bt cotton), improved cultivation practices, quality extension network and proper marketing network may help to improve the cultivation of cotton crop in the state.

It is important to note that despite severe water scarcity in the state, area under sugarcane in the state has increased nearly four times between TE 1962-63 (1.48 lakh ha) and TE 2000-01 (6.52 lakh ha) and then recorded marginal decline in TE 2004-05 (4.48 lakh ha). The share of sugarcane area in GCA has also increased from just 0.78 percent in TE 1962-63 to 3.00 percent in TE 2000-01 and then drastically declined to 1.98 percent in TE 2004-05. Though net returns per unit

of water generated by sugarcane is very low when compared to most of the foodgrain crops (Rath and Mitra, 1989), estimates show that this crop alone consumes nearly two-third of irrigation water available in the state (World Bank, 2002). Continued support of the sugar industries (through state government) encourages the farmers to cultivate this water intensive crop. Keeping in view the water balance of the state, strict rules need to be enacted to discourage the cultivation of sugarcane under flood or conventional method of irrigation. Crop Concentration analysis shows that crop diversification prevails in Amravati, Latur and Nashik division. As land holding size was large in these areas and therefore farmers are diversifying towards soybean, and other commercial crops. However, the areas with crop specialization has low size of land holdings and probably the economic viability at the lower size of holding and assurance of income flow due to presence of commercial crops make it possible (Deshpande, *et al.*, 2004).

6.4.1.6 Growth in Area, Production and Productivity of Major Crops:

The data on area, production and productivity of major crops in Maharashtra shows that production of various crops has increased many folds in the state over the last forty years. But the productivity of different crops is relatively lower in the state. as compared to the all-India average, which is the major problem of Maharashtra's agriculture. It is observed that there is low coverage of irrigation in different crops in the state as compared to the national level average. Crops such as Jowar, groundnut and sugarcane have higher coverage of irrigation in Maharashtra and therefore, the productivity of these crops is relatively higher/at par with national average. Productivity of important crops such as gram and cotton is very low in the state as compared to national average mainly due to poor irrigation availability (GOI, 2002). Unless the productivity of crops is increased significantly, farmers' income cannot be increased.

The results shows that during pre-green revolution period (period I 1960-61 to 1966-67), the production of almost all the crops in the state decreased significantly due to decrease in productivity. The positive growth in area under cereals and pulses (except Jowar, Wheat and Gram crop) could not substitute the decrease in productivity of these crops, resulted in decline in production. One reason behind decrease in production and productivity of crops was severe drought experienced by the nation during 1965-66 and 1966-67. There was significant

growth in production and productivity of all the major crops in the state during 1970s. The foodgrains production in the state increased at the rate of 4.97 per cent per annum, despite low growth in area (0.88 percent per annum) during Period II: 1967-68 to 1979-80. Thus, productivity growth was instrumental in increase in production of foodgrains and oilseeds. However, production of groundnut crop declined at the rate of 0.43 per cent per annum, which was due to drastic decline in area under these crops. During post green revolution period (period III 1980-81 to 1989-90), except rice, wheat and sugarcane, all other crops recorded increase in production. The decrease in production of wheat and sugarcane was due decrease in area and however, in case of rice crop, it was due to decline in productivity. During this period, the production of oilseed and pulses crops increased significantly, which may be due to implementation of Technology Mission in the country during 1986-87. As discussed earlier, during post reform period, i.e. 1990-91 to 2004-05, all most all the crops production has declined due to decline in area and productivity. The decrease in production was due to either declined or stagnant productivity of these crops. For example, all the major cereals crops recorded decrease in production due to stagnant productivity and reduction in area or both. Except soybean, all other oilseed crop production has also decelerated due to negative productivity growth. The increase in production of soybean was heavily contributed by increase in area followed by productivity growth. As soybean is coming up an alternative crop in rainfed areas and therefore area under cereals and cotton is switching over to soybean crop in recent years.

6.4.1.7 Changes in Input use:

Improvement in yield which is a key to long term growth depends on a host of factors that includes technology, use of quality seeds, fertilizers and pesticides and micronutrients, not the least irrigation. Each of these plays an important role in determining the yield level and in then the augmentation in the level of production (GOI, 2009). Seed is the most cost efficient means of increasing agricultural production and productivity. Though the use of HYVs is positively correlated with the availability of irrigation, farmers have been using the same even under rainfed condition because of the government's subsidy programmes. While HYVs have been used for different crops including non-foodgrain crops, data on the coverage of HYVs for non-foodgrains are seldom available even at the micro level. This does

not allow us to find out the extent of adoption of HYVs in various crops, especially in non-foodgrain crops. Despite having low irrigation facility and wide variation in rainfall across different regions in Maharashtra, coverage of HYVs is significantly increased from 1.08 lakh hectares in 1966-67 to 82.32 lakh hectares in 2003. This shows that farmers in the state are fully aware of the importance of HYVs in crop cultivation. However, relatively higher coverage of HYVs in cereal crops does not reflect in the productivity of the crops, which is a major concern of the agricultural sector of Maharashtra. This is mainly because of predominant cultivation of HYVs under rainfed condition, where moisture stress often affects the yield of crops substantially. By introducing drought resistant cum high yielding varieties in different crops, productivity of crops can be increased to a larger extent.

Credit availability is of crucial importance for agricultural development of any region. Some of the studies concluded that farmer indebtedness has been singled out as the foremost cause for farmer suicides in Vidarbha region of Maharashtra (Planning Commission, GOI, 2006) and a few states (Deshpande and Nagesh, 2005). It is observed that the ground level credit flow to agriculture sector in the state increased significantly from Rs. 859 crore in 1980-81 to Rs. 1283 crore in 1990-91, Rs. 4576 crore in 2000-01 and Rs. 12113 crore in 2007-08. During 2007-08, the amount of loans advanced to the cultivators by the PACS was Rs. 5,828 crore of which 43 per cent were given to small and marginal farmers (GOM, 2009). During last three years, favorable monsoon conditions enabled robust growth in the demand for credit. Also, announcement of various schemes under the programme of doubling of agriculture credit by the Government of India, provision of crop loans at rates of interest not exceeding 7 percent (6 percent in the state of Maharashtra) and buoyancy in the economy in general, appear to have facilitated the growth in credit flow (NABARD, 2008).

The farm harvest price index has also increased significantly during last four decades. The number of plant protection equipments such as sprayer and dusters has increased from 0.46 lakh in 1972 to 7.59 lakh in 2003, almost 17 times in thirty years. This increase may be due to high incidence of pest and disease attack on major crops, such as cotton, sugarcane, grape during 1990s. The use of four wheel tractors in state agriculture has increased significantly, as number of tractors increased to 1.05 lakh in 2003 from just 0.01 lakh in 1961. As per the Livestock Census reports, the number of electric pumpsets have increased at very high rate

as compared to the use of diesel oil pumps. During 1961, only 7100 electric pumpsets and 63747 diesel oil pumpsets were in the state, which increased to 1005437 and 168228 in 2003, respectively. Despite low level of irrigation and interrupted and less power supply, the number of electric pump in the state has increased at higher rate. The government should provide adequate and continues electric supply to the agriculture sector. Though there is significant increase in number of pumpsets in the state, there is wide variation among the regions. Vidarbha and Marathawada regions are having backlog of 55.33 per cent and 28.06 per cent of total backlog in the state of pumpsets in 2005 respectively. The Western Maharashtra accounts for more than 54 percent of total pumpsets in the state during 2005 and consumed 66 percent of total electricity used for pump and same pattern is observed in case of four wheeled tractors. Thus, there is a huge disparity among the regions in case of level of agriculture mechanization as well.

It is observed that despite having poor irrigation facility and less area under paddy and wheat, the consumption of fertilisers in the state is not very low as compared to the national level average. While the consumption of fertilizers in the state increased from 1.62 kg/ha in 1960-61 to 103.1kg/ha in 2007-08, the same has increased from 1.93 kg/ha to 117.1kg/ha at all India level during the same period. The consumption of fertilizers in the state is not very low as compared to the national average because of two reasons, i) sugarcane is intensively cultivated in the state, which consumes higher amount of fertilisers than many other crops; ii) high value horticultural crops such as grapes, banana, vegetables, etc, are also cultivated intensively in the state, which also require higher amount of fertilizers. However, due to less awareness as well as resource constraints, farmers are not able to apply fertilizers in time with proper mix (of NPK). Uncertainties associated with rainfall and the limited access to irrigation were likely influencing fertilizer use in the state, as water is critical to efficient utilisation by plants of supplementary nutrient applications (World Bank, 2003). With the proper institutional credit support along with quality extension network, these constraints can be removed (Narayanamoorthy and Kalamkar, 2004).

As mentioned earlier, in spite of limited availability of irrigation, the available irrigation water is not distributed properly across different crops, which is another important issue of Maharashtra's irrigation sector. Out of the total irrigated area of 3.86 million hectares available during TE 2000-01, foodgrain crops such as paddy,

wheat, Jowar and bajra together accounted for only 38.05 percent, while sugarcane alone accounted for 16.87 percent. Pulses and oilseeds are the important crops in Maharashtra accounting about 28.74 percent of GCA in TE 2000-01, but these two crops together accounted for only about 14.0 percent of irrigated area during the same period. Irrigated sugarcane area accounted for over 16 percent of GIA in the state, which is very high when compared to the national average of about 5 percent during 2001-02. The area under sugarcane in the state has increased at the rate of 2.1 percent per annum during the period from 1990-91 to 2000-01. Keeping in view the water balance of the state, strict rules need to be enacted to discourage the cultivation of sugarcane under flood or conventional method of irrigation. Cotton is one of the important crops, which has been traditionally cultivated under rainfed condition in the state (2.76 percent during TE 2004-05). In spite of facing problems such as severe pest attack, increased cost of cultivation, low productivity and profitability, area under cotton has marginally increased between TE 1962-63 and TE 2000-01.

6.4.1.8 Changing Cost Structure of Principle Crops in Maharashtra

Some of the studies noted that deceleration in agricultural output in the state was due to stagnating or declining profitability per hectare of some important crops. This is mainly due to an increase in fixed costs, over capitalization of farm operations, an increase in the rent per acre and decrease in subsidies (Kalamkar, 2003). The annual growth rate of cost of cotton, sugarcane and Jowar was 8.45, 7.09 and 9.57 per cent respectively, whereas the growth rate of price of these crops was 7.83, 9.28 and 7.38 per cent respectively during 1995-98 over 1981-84. The growth rate of cost and price was very low during 1980's. There has, however, been a significant increase in the growth rate of both the cost (Rs/qt) and the price (Rs/qt) in the 1990's. But the growth rate of cost is higher than price, which made the farming non-economical/non-profitable. In case of Cotton and Jowar, there was huge loss to the farmers (Kalamkar, 2003). This may be one of the probable reasons for suicidal death of the cotton growers in Maharashtra. Because of high instability in income, increased input costs and less profit margin, the debt burden on the farmers of the state has been increasing. This is because most of the marginal and small farmers try to experiment and take risks, but they are not able to visualize that a bad monsoon leading to a crop failure or a glut in the market, which

pushes them into indebtedness. The recent farmer suicides in Vidarbha and Marathawada have once again highlighted the disturbing reality of widening regional disparity in Maharashtra. As per the results of the 59th Round of NSS under '*Situation Assessment Survey of Farmers*', the annual income (includes wages, cultivation, farming of animals and non-farm business income) of the farmers household of Maharashtra state was Rs. 29556, which was higher than all India average (Rs. 25380/-). The income from the cultivation accounts for 51.28 percent in the state income, while corresponding figure was 45.82 at all India level. Though the annual net cultivation income was higher than cultivation expenditure at state as well as national level, but the consumption expenditure was higher than total income, indicates that income from all sources are not adequate to meet the expenses of the households. Then question arises that how do farmers manage other expenditure when the income is not enough to meet their consumption need? That means farmers must be possibly taking loan from various sources so as to meet the consumption as well as productive expenditure of the households (Narayanamoorthy, 2006). The results of analysis of trends in cost of cultivation of major crops in the state during last three decades shows that the cost of cultivation of all the important crops has increased substantially during last three and half decades. The increase in machine labour was major input cost followed by human and bullock labour, seed and land cost in total cost of cultivation of crops. The manure cost share in total cost of cultivation per hectare has declined and in some cases it has become nil, which may be due to increased use of fertilizers in state agriculture.

6.4.1.9 Trend in Agricultural Prices in Maharashtra

It is well known that agricultural prices have a tendency to display wider inter and intra-year fluctuations. Given the functions of agricultural prices, the implication of wider fluctuations remains that the income of producers would fluctuate more than the fluctuation in output. As a result, not only the producer's price will be depressed in the short run but also the producers' enthusiasm to invest in agriculture to enhance the future production will be dampened. On the other hand, the unrestrained rise in agricultural price would affect the levels of living of the population in the country. It is for these reasons those governments' intervention for price stabilization become necessary. The average annual growth rates of

Wholesale Prices Index (WPI), Farm Harvest Prices (FHP) and Minimum Support Prices (MSP) of major crops shows that during the period 1980-81 to 1989-90, the growth rate of MSP of all the crops was higher than the FHP (in case of rice, growth is almost at same rate). However, growth rate of WPI of the crops is higher than MSP and FHP, except in case of bajra, maize, wheat, groundnut and cotton. During 1990-91 to 2004-05, except wheat (WPI) and cotton (WPI and FHP), all other crops have recorded higher growth in MSP as compared to WPI and FHP. Thus, during 1990-91 to 2004-05, there was significant increase in Minimum Support Prices of agricultural commodities as compared to earlier period. Most of the increase in MSP was noticed during last five years. Because of which, the farm harvest prices and wholesale prices of agricultural commodities has increased. However, in addition to Farm Harvest Prices, productivity of the crops have grater bearing on the income of the farmers.

6.4.1.10 Capital Formation in Agriculture:

Investment in agriculture is essential for increasing as well as sustaining the overall growth of agriculture. Development planning in Maharashtra began with the third five year plan in 1961. The objectives of the various plans followed by the state since then has aimed at employment generation, containment of population, development of infrastructure, agriculture, industry, poverty alleviation and reducing disparities. The economy of the state has made commendable progress in various sectors during the plan periods. Plan expenditures from three heads namely (i) agriculture and allied activities, (ii) rural development, (iii) irrigation development and flood control altogether from third plan to tenth plan period, about Rs. 65575 crore (in current prices) have been spent on the above mentioned three heads. Though these three heads altogether accounted for about 44 percent in the total plan expenditure from third plan to tenth plan period, the share of agriculture and allied services has sharply declined from 30.87 percent in third plan to 3.47 percent in tenth plan in Maharashtra. Unlike the agriculture and allied services, the plan expenditure in irrigation and flood control has sharply increased from 14.87 percent in third plan to nearly 37 percent in ninth plan and then decreased to about 28 percent in tenth plan in Maharashtra. This is in contrast to the national level picture, where the same share has declined from 7.8 percent to around 6.5 percent during this period. Considering the vast rainfed cultivated areas and also the importance of

irrigation in agricultural growth, the state government has been giving top priority to exploit the available irrigation potential. This naturally requires more investment and therefore, investment in irrigation and flood control has increased substantially over the plan periods in Maharashtra. One needs to study how far this investment in irrigation has translated into irrigated area in the state.

The nexus between capital formation and agricultural growth, and agricultural growth and poverty alleviation are very well articulated in literature. The decline in the share of agricultural sector's capital formation in GDP from 2.2 percent in the late 1990s to 1.7 percent in 2004-05 at national level is a matter of concern. This declining share was mainly due to stagnation or fall in public investments in irrigation, particularly since the mid-1990s. The estimates of gross fixed capital formation at current prices in Maharashtra agriculture shows that the Gross Fixed Capital Formation as a percent of agriculture gross state domestic product has declined from 7.4 percent in 1980-81 to 4.3 percent in 2006-07. At national level, the gross capital formation in agriculture as a proportion to the total GDP has shown a decline from 2.9 percent in 2001-02 to 2.5 percent in 2007-08. However, despite increase in the share of public sector, the share of agriculture and allied sector in total Gross Capital formation has declined to 7.0 percent in 2006-07 from 11.7 percent in 2001-02 at national level (GOI, 2009). The capital expenditure on agriculture and allied heads has increased in absolute terms over the period of time. The capital expenditure on agriculture and allied heads per net sown area has increased at current prices from Rs. 37.59 in 1980-81 to Rs. 44.22 in 1990-91, Rs. 235.35 in 2000-01 and Rs. 466.82 in 2007-08. However, the share of budget expenditure on agriculture has declined from 14.22 percent to 11.97 percent, 5.45 percent and 4.22 in corresponding years. The increase in capital expenditure per hectare of net sown area may be due to stagnant/decline net sown during last two decades. The net sown area in the state has declined marginally by 2.92 percent in 2006-07 over the base year 1980-81, from 18 million ha in 1980-81 to 17.48 million hectares in 2006-07. In order to achieve positive agricultural growth, capital formation in agriculture should be enhanced through strengthening market infrastructure, more focus on micro irrigation, micro finance, micro insurance and rural credit. Also there is a need to introduce national scheme for the repair, renovation and restoration of water bodies and set up knowledge centre in every village to reduce gap between technology transfers from lab to field.

6.4.1.11 Terms of Trade in Agriculture:

As per World Bank (2003) report, Terms of Trade in recent years have moved slightly against agriculture in Maharashtra. The index of output prices have risen by 50 percent during 1993-94 to 1999-2000 (as indicated by the state agricultural income implicit deflator), while the index of prices of all inputs taken together have risen by 56 percent during the same period.

6.5 Trends and Patterns in Production and Productivity: District Level analysis

Though the cropping pattern has been shifting in favour of high value crops in the state in the recent years as compared to seventies and eighties, this shift is not very impressive as compared to the same at the national level. For instance, coarse cereals (which are mainly low value crops) accounted for only about 15 percent of GCA at all India level during TE 2004-05, but the same accounted for over 30 percent in Maharashtra. Similarly, the share of area under pulses in GCA has declined about 1.31 percent points at all India level between TE 1970-71 and TE 2004-05, but the same has increased by about 2.31 percent points in Maharashtra during the same period. Area under oilseeds and cotton¹ is also higher in Maharashtra (a total of 17.98 percent of GCA in TE 2004-05) as compared to all India average (15.41 percent). The limited availability of irrigation is the main reason for the predominant cultivation of low value crops in state.

6.5.1 Cereals:

Maharashtra state rank first in area and production of coarse cereals in India, accounts for 23.89 percent and 18.10 percent share respectively in total during the year 2006-07. The state of Maharashtra has about 6.9 million hectares area under coarse cereals and production of about 6.14 million tones. Jowar and Bajra are the two major coarse cereals grown in Maharashtra.

The area under Jowar crop was 6.20 mha in TE 1962-63, which decreased 4.7 mha in TE 2004-05, resulted in falling share in gross cropped area from 32.71 to 20.61 percent in corresponding years. During overall period, area, production and productivity of Jowar crop declined substantially. The decline in production of Jowar was due to decline in yield as well as reduction in area under this crop. Most

¹ The oilseeds and cotton are generally treated as high value commercial crops. However, since these crops are cultivated predominantly under rainfed condition and also the productivity of these crops are very low in Maharashtra, we have considered them as low value crops for the purpose of analysis.

of decline in area was noticed during the period 1990-91 to 1999-2000; however yield growth rate was almost stagnant, which resulted in decline in production at the rate of 1.86 percent per annum. During the period 2001-2005, production of Jowar declined at the rate of 4.86 per cent per annum, which is due to decrease in area under this crop and decline in productivity as well. The yield of Jowar remained stagnant at around 900 kg/ha during last one and half decade. Districtwise analysis shows that during overall period, area, production and productivity of Jowar crop has declined in almost all the districts of the state. Jowar which is staple food crop of the farmers and accounts for more than 20 percent of gross cropped area during TE 2004-05 and mostly grown under rainfed conditions, deceleration in production and productivity of this crops calls for urgent attention by the policy makers and administrators.

Bajra is another important coarse cereals crop mostly grown in Nashik, Pune and Aurangabad divisions. It is noticed that growth in productivity of Bajra crop was positive during overall period; however area under crop has declined substantially at the rate of 2.12 percent per annum, which result in declined in production. During first (1990-91 to 1999-2000) and second (200-01 to 2004-05) periods, growth in area was negative; however, productivity growth rate during second period was positive and much higher. Bajra crop is grown in Nashik, Dhule, Ahmednagar, Aurangabad, Beed districts. Except beed districts, in all other major bajra growing district, area and production has declined during overall period.

Unlike other coarse cereals crops, area, production and productivity of maize has increased significantly during overall period, at the rate of 9.44 percent, 12.09 percent and 2.42 percent, respectively. As like bajra crop, area under maize is mostly concentrated in Nashik, Pune, Aurangabad and Kolhapur divisions and Buldhana district of Amravati division. In all the major maize growing districts, area and production of maize crop has increased, however productivity growth was negative in case of Ahmednagar and Solapur district of Pune division. In Pune and Nashik division, most of the poultry farms are located around the metropolitan cities like Pune, Nashik and maize is the main feed source for poultry, which account for about 70 percent in total production cost of broiler. Therefore, increase in area is mostly due to ready demand for this crop in those areas. The increase in productivity was due to readily availability of new seed and inputs at the market.

Ragi is another coarse cereal crops mostly grown in the districts of Konkan, Nashik and Kolhapur divisions of the state. As like other coarse cereals crops, area under ragi crop has been decelerated during the period under study. The production of ragi crop has declined significantly at the rate of 1.47 percent per annum during overall period; however, growth in productivity was positive. Thus declined in production was mainly accounted by decline in area under this crops (2.06 percent per annum). In all the major ragi growing districts, particularly in the districts of Konkan region, production has decreased significantly due to significant decline in area under this crop. Except Thane and Pune district, productivity was increased or was almost stagnant all other district. During sub-periods also, same kind of picture was noticed.

Wheat crop production and productivity has increased during overall period, but area has declined marginally. The most of the decline in area, production and productivity of this crop was noticed during second period. Except Konkan division, wheat crop is grown on small area. Ahmednagar district accounts for highest area under wheat crop followed by Pune and Nashik. These three districts have recorded decline in area under wheat crop during overall period.

6.5.2 Pulses:

Maharashtra is the second largest producer of pulses after Madhya Pradesh. The area under Pulses in the state has gone up from 2.39 mha in TE 1962-63 to 3.46 mha in TE 2004-05. Among the various pulses grown in the state, kharif pulses occupy a major share both in terms of area and production and they are also grown as mixed as well as pure crops. Tur (*C. cajan*), Mung (*V. radiata*) and Udid (*V. mungo*) are among the major kharif pulses of Maharashtra. In rabi season, Gram (*C. arietinum*) forms the major rabi pulse. Tur and gram are the two important pulse crops grown in most of the districts of the state. Due to different agro-climatic conditions in the state, the changes in area, production and productivity are not uniform in all the districts in Maharashtra. The per cent contribution of pulses in total foodgrains production in Maharashtra has increased during the last three decades by 4.65 per cent in 2000 over 1960. Cereals pulses ratio decreased from 7:1 to 5:1, however, percentage contribution of pulses in foodgrains increased from 12.78 per cent in 1960-61 to 16.15 per cent in 1999-2000.

Among the pulse crops, Tur is the major crop grown in all the districts in the state. Tur generally grown as intercrop with cotton, Jowar, soybean and other crops. It is very rarely taken as sole crop, mostly on inferior land. Thus cultivation of tur crop is not major activity; rather it is complementary with other crop production. Despite these aspects, tur crop accounts more than 5 percent gross cropped area of the state and about 15 percent in national total tur production. The production of tur crop increased significantly during overall period at the rate of 3.75 percent per annum. The increase in production was mainly due to significant increase in productivity (3.37 percent per annum) followed by increase in area (0.37 percent per annum). Among the divisions, Amravati, Latur and Aurangabad accounts major share in area under tur crop. In all these major divisions and their districts, increase in production and productivity of tur crop is recorded. Mung is another important pulse crop grown in Amravati, Latur, Aurangabad and Nashik divisions of the state. The area, production and productivity of mung crop decreased during 1990 to 2005. Mung is short duration crop, generally grown in kharif season as intercrop with cotton or sole crop under rainfed conditions. Also the availability of improved and hybrid varieties are limited. Also due to increasing area under Soybean crops, area under mung crop is declining. Same as in Mung, Udid is another pulse crop grown in the Kharif season, mostly in the districts of Amravati, Nagpur and Nashik divisions, particularly Buldhana, Latur, Jalgaon and Osmanabad districts. The area, production and productivity of udid crop increased during overall period. Buldhana district recorded increase in area, production and productivity of udid crop, however, production and productivity declined in Latur and Jalgaon district. Other districts recorded higher positive growth in area and production in udid crop due to low base/less area in base year. Udid crop is also grown in kharif season as intercrop with cotton and other crops under rainfed conditions. Non availability of improved and hybrid seed is also one of the constraints in cultivation of this crop.

In case of gram, except Nashik, Jalgaon and Aurangabad, all other major districts have recorded increase in area and production. However, productivity deceleration is recorded in some districts such as Ahmednagar, Pune, Solapur, Aurangabad, Buldhana, Osmanabad and Parbhani. Gram crop generally grown in Rabi season and mostly on depend on soil moisture as far as water is concern. Therefore gram productivity keeps fluctuating heavily from year to year. Despite low

level of irrigation, growth in production and productivity of gram crop was positive during overall period. Though there is significant growth in area under total pulses, area under foodgrains has declined significantly at the rate of 2.91 percent per annum, which may be due decrease in area under coarse cereal crops. Same the case of production and productivity of total pulses and foodgrains. The production and productivity of total pulses has increased, however, same has declined in case of foodgrains. The cropping pattern of the state has been dominated by foodgrains crops, however, during last few years, cropping patterns is diversifying from coarse cereals towards commercial and horticultural crops. Therefore, area under foodgrains crops is declined. However declined in productivity of foodgrains which is attributed to decline in productivity of coarse cereal crops need to be address immediately. In order to increase the production of pulses, particularly yield per hectare, it would be essential to develop some new high yield varieties suitable to agro-climatic regions. Also biotechnology and gene transfer technology can be adopted to enhance pulse crop productivity.

6.5.3 Oilseed Crops:

Oilseed crops accounts for about more than 12 percent of state gross cropped area in Maharashtra state during TE 2004-05. The main oilseed crops grown in the state are Soybean, Groundnut, Safflower, Sunflower and Sesamum. Among oilseed crops, Soybean crop accounts highest share in area, accounting about 58 percent during the period TE 2004-05, followed by groundnut (14.2 percent), sunflower (10.3 per cent), safflower (8.9 percent) and Sesamum (4.0 percent). The area under groundnut crop has declined at the rate of 4.89 percent per annum and productivity was almost stagnant, which results in substantial decline of production of groundnut crop (4.27 percent per annum). Groundnut was major oilseed crop till 1990s, but thereafter availability of substitute in the form of Soybean crop, has brought decline in groundnut area. Satara, Kolhapur, Pune, Nashik, Dhule and Sangli are major groundnut growing districts. All the major growing districts have recorded decline in area, production and productivity (except in case on area in Pune district). Despite drastic decline in area under groundnut crop at the district levels as well as state level, which resulted in reduction in production, growth in productivity of groundnut was positive during the overall period. During period I, productivity growth was positive but very low as compared

to decline in area, which could not offset decline in negative effect on production. However, during period II, despite very high growth in productivity, production declined at the rate of 1.68 percent per annum due to drastic decline in area under this crop (4.58 per cent per annum). Safflower is another important oilseed crop grown in mainly the district of Latur, Aurangabad and Nashik divisions. As like groundnut crop, there was decline in area, production and productivity of safflower crop during the period 1990-91 to 2004-05. All the major safflower growing districts have recorded decline in production and productivity of safflower.

Sunflower, another important oilseed crop is mostly concentrated in Latur, Aurangabad and Pune divisions. The negative growth in area, production and productivity was also observed in case of sunflower crop. Almost all the districts have recorded declined in area, production and productivity of sunflower crop, The same kind of picture is noticed in case of Sesamum crop also. There was substantial reduction in area under Sesamum (7.76 percent per annum), resulted in reduction in production at same rate due to positive but stagnant productivity level. All the district have recorded declined in area under Sesamum, however, except Nashik and Aurangabad divisions, all the divisions recorded marginal increase in productivity, which could not substitute the decline in area.

Maharashtra is the second largest Soybean growing state in the country, accounts for about 25 percent area and 33 percent of production of national basket in the year 2996-07. In Maharashtra, area under soybean crop was around 26 lakh hectares in 2007-08. Soybean crop is mostly grown in Vidarbha region (i.e. Amravati and Nagpur divisions) and Latur division. Vidarbha region contributes 66 percent area under soybean of the state and it becoming popular day by day. It can be seen from the Table 4.17 that area, production and productivity of soybean crop increased significantly at the rate of 15.48, 18.01 and 2.19 percent per annum respectively during the period 1990-91 to 2004-05. Except Bhandara district, all other major soybean districts have recorded substantial increase in area and production of soybean crop during the period under study. It is observed that farmers in Vidarbha region are gradually switching over to soybean from cotton, Jowar, tur and other traditional crops. One of the most important economic factors which act as an incentive to the farmer for shifting area from cotton, Jowar, tur, groundnut to its substitute (Soybean) crop, due to higher yield and remunerative price for soybean crop. Due to substantial increase in area and production of

soybean crop in all the districts of the state, the total oilseed production in the state increased at the rate of 3.85 per cent per annum during 1990-91 to 2004-05. It is very surprise to note that productivity of total oilseed has increased significantly at the rate of 3.4 percent per annum. It is welcome shift of area from coarse cereals, cotton to soybean crop, which give some ray of hopes to farmers of rainfed area.

6.5.4 Cotton:

Cotton is one of the important crops, which has been traditionally cultivated in Maharashtra. During TE 2004-05, Maharashtra State alone accounted for about 35 percent of India's cotton area, which was about 8.02 million hectares (mha). The area under cotton crop in the state has increased from 2.62 million hectares (mha) in TE 1962-63 to 2.8 mha in TE 2004-05. Favourable rain and climate condition that exists in certain parts of the state helps the farmers to cultivate the crop extensively. Unlike other commercial crops, at the national level, about 64 percent of area under cotton was cultivated under rainfed condition as late as during 2005-06, however, only 4.8 percent cotton area is irrigated in Maharashtra (GOI, 2008). The districtwise growth in area, production and productivity of cotton crop shows that though area under cotton crop is almost stable during the period 1990-91 to 2004-05, production and productivity level has increased significantly at the rate of 3.55 percent and 2.80 percent per annum. Farmers cultivating cotton crop have been encountering many problems, some of which are totally different from other crops. While predominant cultivation of cotton under rainfed condition increases the uncertainty in getting expected yield, different kinds of pests attack significantly reduce the yield of crop. Controlling bollworms was major as well as a persistent problem standing before the farmers. Bt cotton varieties were released in Maharashtra during the agricultural season 2002-03, which leads to significant increase in productivity of cotton crop in the state. Studies shows that the expenditure towards control of bollworm has come down after introduction of Bt cotton, however, expenditure towards control of sucking pest has again increase cost of insecticide as well as cost of cultivation of cotton. Cotton crop is heavily grown in Amravati, Akola, Yavatmal, Buldhana, Jalna, Aurangabad and Jalgaon districts. Except Jalna, Aurangabad and Jalgaon, area and production of cotton has decreased in all other major cotton growing districts. Despite increase in productivity and production of cotton, one disconcerting factor which is a subject of

major concern and can hardly be overlooked is the reports of agrarian distress in the Vidarbha region associated with cotton farming. The cause and effect relationships are drawn from the vulnerability of cotton crop to the vagaries of nature and pest infestation, particularly in the low productivity region. As most of cotton grown under rainfed condition, irrigation potential should be increased by completing ongoing projects besides taking up lift irrigation through wells and creating water reservoirs. Also drought tolerant varieties should be developed.

6.5.5 Sugarcane:

Sugarcane is another important crop of state agriculture as far as its contribution to total national production is concern. Maharashtra state accounts for about 22 percent of total national production in the year 2006-07. Sugarcane has been cultivated repeatedly in Western Maharashtra over the last four decades. Pune and Kolhapur divisions' together account for nearly 62 percent of sugarcane area in TE 2004-05. Despite severe water scarcity in the state, area under sugarcane has increased nearly four times between TE 1962-63 (1.48 lakh ha) and TE 2001-02 (5.87 lakh ha) in the state. The share of sugarcane area in GCA has also increased from just 0.78 percent to 2.63 percent during this period. The area under sugar crop has decreased at the rate of 1.06 percent per annum, also the sugarcane production by 0.29 percent per annum during overall period. The sugarcane productivity is almost stagnant during last one and half decade. This is because of sugarcane mono-cropping. Due to which, not only the soil fertility has deteriorated over the years but the productivity has also stagnated or declined due to certain pests and diseases associated with mono-cropping pattern. The strict rules need to be enacted to discourage the cultivation of sugarcane under flood or conventional method of irrigation. By introducing volumetric pricing for canal water, cultivation of sugarcane may be discouraged in those areas where the productivity is stagnating or has started declining.

6.5.6 Horticultural Crops:

One of the significant changes that have taken place in the cropping pattern of the state especially in recent years is development in horticultural crops. Area under fruit and vegetable crops has increased by about 6.04 times (from 1.47 lakh in 1960-61 ha to 8.66 lakh ha in 2001-02) over the last 40 years. That is, area under fruits and vegetables accounted for only about 0.80 percent in TE 1962-63,

but the same increased to nearly 7.82 percent in TE 2004-05. Within the group of fruits and vegetables, some significant changes have taken place over the years. While the share of area under grapes, mango and cashewnut has increased, the share of orange and guava has declined. Similar kind of changes is noticed in vegetable crops as well. The districtwise growth in area under total fruit and vegetable crops shows that area under total fruits and vegetables increased significantly at the rate of 7.24 percent and 2.48 percent per annum respectively. However, area under chillies crop as well as condiments and spices has declined at the rate of 1.62 and 1.74 percent per annum during 1990-91 to 2001-02.

Though significant growth has taken place in area under horticultural crops in the state between 1980-81 and 2001-02, the horticulture sector is not free from problems. The major problems that are expected to limit the growth of horticultural sector in Maharashtra are, less diversification of crops in non-traditional regions; deceleration in area and productivity of certain crops and poor post harvesting infrastructure facilities. Despite significant potential for horticulture crops in different regions in Maharashtra, the growth in area under horticulture crops in non-traditional districts is not very impressive as of today. For instance, horticulture crops have been traditionally and also predominantly cultivated in districts like Ratnagiri, Nasik, Jalgaon, Ahmednagar, Pune, Solapur, Satara, Amravati and Nagpur. These nine districts accounted for over 68 percent of the total area under horticulture crops in the state during TE 1966-67 and in fact these same districts have also accounted for about 61 percent in TE 2001-02 as well. Importantly, the share of area under horticulture crops to state total has marginally declined between TE 1966-67 and TE 2001-02 (from 39.5 percent to 28.7 percent points) in Western Maharashtra, where water is heavily used for cultivating sugarcane. As mentioned earlier, since the limited availability of irrigation water is the main constraint for agricultural growth in the state, required steps need to be taken to increase the area under horticulture crops in those areas where sugarcane is cultivated predominantly so that the surplus water arising due to the cultivation of horticulture crops can be transferred to other regions/ for other crops.

Though lot of euphoria has been created in the state quoting that linking of EGS with horticulture development programme has made significant improvement in the growth of area under horticulture crops, our growth analysis does not completely support this. While the growth rate of area under grapes and banana

either declined or decelerated during the period 1992-93 to 2001-02 as compared to eighties (1982-83 to 1992-93), the same is found to be decelerated in almost all vegetable crops during the nineties as compared to the growth realized during the eighties. As future growth of agriculture in the state is heavily dependent on the performance of horticultural sector because of its natural advantages, it is essential to examine why the growth rate of area under certain horticultural crops decelerated during the nineties. Another important problem associated with horticulture sector is declining productivity of horticulture crops. Productivity of important horticulture crops namely orange and mango has declined between 1990-91 and 2001-02. This is not an encouraging sign as far as the horticultural sector of the state is concerned. Reduction in productivity would not only affect the growth of the horticultural sector but would also affect the overall performance of agricultural growth in the state. Therefore, it is essential to examine the causes for declining productivity of major horticulture crops in those regions where productivity started declining.

6.5.7 Wide Variation in Productivity of Crop across Districts:

Wide variation in productivity of different crops across districts is also another feature of Maharashtra's agriculture (Table 8). More importantly, the growth rate of productivity of almost all major crops either decelerated or declined during the second part of green revolution. Except sugarcane and some horticulture crops, productivity of all other crops is very low in Maharashtra as compared to the national average. Apart from reducing farmers' income, the low productivity of crops pulls down the overall growth rate of state's agriculture. Since low irrigation facility and variation in rainfall are considered to be the important factors responsible for low and varied productivity level, major initiatives need to be taken to increase irrigation facility wherever possible. Introduction of drought resistance cum high yielding varieties, promoting balanced use of fertilisers (appropriate ratio of N:PK) and well designed location specific policies/programmes can help to increase the productivity of crops appreciably.

6.6. Rate and Growth of Inputs Used: District Level analysis

6.6.1 Cropped and Irrigated Land:

As mentioned earlier, pattern of land use has been fairly stable at the state level since 1961, with marginal downward change in the share of forest area or

simply upward movement in the proportion of area under non agricultural use. The net sown area has marginally declined between 1960-61 and 2007-08 (by 1.03 percent over base year), which is somewhat different from the trend emerging at the national level. As indicated above, unlike in other states, the net cropped area in the Maharashtra state has decreased marginally at the rate of 0.35 percent per annum during the period 1990-91 to 2004-05. Except Ratnagiri, Sindhudurg and Sangali district, net sown area decreased in all the districts. Thane, Osmanabad, Bhandara and Dhule districts recorded highest variations during the period. Despite decline in area sown, gross cropped area significantly increased at the rate of 0.45 percent per annum, which is obvious due to significant increase in area sown more than once (4.28 percent per annum). Despite having limited availability of irrigation facility, area cultivated more than once increased significantly. Thane, Nashik, Pune, Solapur, Satara, Beed, Buldhana, Wardha, Nagpur, Bhandara, Chandrapur and Gadchiroli districts recorded negative growth in gross cropped area, which resulted in decline in cropping intensity of these districts. The cropping intensity at the state level has hardly increased by 13.4 point period during TE 1992-93 and TE 2004-05. Irrigation is the limiting factor in most of district in bringing land as sown more than once. The net irrigated and gross irrigated area in the state has increased significantly at the rate of 2.29 and 1.89 percent per annum during the period 1990-91 to 2004-05. Though net irrigated area decreased in Aurangabad, Jalna and Osmanabad district, gross irrigated area recorded increase in these districts. It is surprisingly to note that growth in gross irrigated area of Sindhudurg and Jalgaon districts was negative. Irrigation intensity of the state was 122 percent in TE 1992-93, decreased to 118 percent in TE 2004-05. The decrease in irrigation intensity is due to low space growth in gross irrigated area (i.e. due to low growth in area irrigated more than once) as compared to net irrigated area during period under study.

6.6.2 Area under High Yielding Variety Seeds:

It is observed that area under hybrid/high yielding varieties in the state has declined during the period from 1990-91 to 2004-05. Also most of the district have recorded decline in area under HYV seed except Ratnagiri, Sindhudurg, Bhandara and Gadchiroli districts. The high yielding variety seed is available in case cereals crops only, viz. Paddy, Wheat, Jowar, Bajra and Maize and for fibre crop, i.e.

Cotton. As major expansion of HYV area under cereal cops occurred during 1970s, i.e. from 12.01 percent in TE 1972-73 to 41.25 percent in TE 1982-83. But thereafter actual rate of expansion slowed down and coverage moved up to only about 70.62 percent in TE 1992-93 though the scope existed for further increase. Further the area under HYVs increased to 89.38 percent in TE 2000-01 and then declined marginally to 88.32 per cent in TE 2004-05. Thus set back to further progress in HYV coverage under cereals may be due to decline in area under cereals crops since 1990-91, from 10.57 mha in TE 1992-93 to 9.00 mha in TE 2004-05, as seen earlier.

6.6.3 Agricultural Credit:

The districtwise growth rate of credit disbursement by Primary Agricultural Cooperative Credit Societies indicated that there was significant increase in credit disbursement to agriculture and allied sector in all district as well as at the state level. However, high variability indicates high year to year fluctuations in credit disbursement. Out of total loan disbursement during 2008-09, only 43 percent of total loan was disbursed to small and marginal farmers (GOM, 2009). Thus, despite impressive growth in credit disbursement to state agriculture sector, question arise that are the existing formal institutions sufficient for full filling the demand of credit required for agriculture sector or should we have separate institutions for promoting credit expansion. Therefore, the credit expansion programme will be successful only if the productivity of the small and marginal farmers improve. With a view to alleviating the distress of the farmers in the six districts of Vidarbha region (Wardha, Yavatmal, Amravati, Akola, Buldhana and Washim), the Hon'ble Prime minister has announced a Relief package involving, in addition to other measures, reschedulement of old loans, waiver of overdue interest, sanction of fresh credit to keep the agriculture credit cycle moving. Credit expansion should be taken into account the risk element of farmers while framing policies. As suggested by Jadhav (2008), flexibility should be brought in granting loan to agriculture sector and instead of prevailing cropping pattern, average cropping pattern could be used and limit should be set accordingly.

6.6.4 Plant Protection Equipments and Four Wheeled Tractors:

The number of plant protection equipments is increased at the rate of 2.29 percent per annum at state level. However, negative growth has been recorded in

Sindhudurg, Buldhana, Amravati, Wardha, Nagpur and Bhandara districts. The number four wheeled tractor in the state also increased at the rate of 7.71 percent per annum. Except Sindhudurg, all districts have recorded increase in use of four wheeled tractors.

6.6.5 Electricity Use in Agriculture:

Electricity is one of the key drivers of the economy. Nearly a decade and half ago, the availability of electricity in the Maharashtra state was in surplus. However, in the post-liberalization era, the public sector investments in the power sector reduced considerably. Consequently, there was no addition in the installed capacity. Hence the gap between demand and supply of the electricity in the State is ever widening and is a cause of concern. The consumption of electricity in agriculture sector as proportion to total electricity has gone up to around 31.6 in 1998-99 from 12.58 in 1980-81 and thereafter after it dropped to 15.7 percent in 2006-07. The same trend observed at national level, where it dropped from 31.38 percent to 21.73 percent in corresponding years. The districtwise average annual growth rate of electricity use in agriculture shows that despite limited availability of electricity for agriculture sector, electricity consumption in agriculture of the state has increased significantly at the rate of 13.18 per cent per annum. However, share of electricity use in agriculture has declined from 21.46 percent in 1990-91 to 18.15 percent in 2007-08. The increase in electricity use in agriculture recorded in all the regions and districts of the state. The growth was substantial and significant in case of electric pumpsets use in agriculture, which were increased at the rate of 11.76 percent per annum. The significant increase in electric pumpsets was noticed in 1998-99 onwards, which may be due to state government support for digging wells. There are divisional variations in number of pumpsets availability in the state.

6.6.6 Fertiliser Use:

It is observed that fertiliser use in Maharashtra was considerably lower than the all India average. This likely affected productivity levels in the state. In 2007-08, the fertiliser use rate in Maharashtra was 103.1 kg per hectare, which was more than 10 percent below the all India average and about half of fertiliser use rates in Punjab and Andhra Pradesh in 2007-08. Despite having poor irrigation facility, the state exhibited positive and significant growth in total fertilizer consumption (2.59 percent per annum) during the period 1990-91 to 2004-05. Increase in the total

fertilizer consumption can also take place due to the expansion of area under cultivation (i.e. area sown more than once). A similar pattern was observed for per hectare usage, which is increased at the rate of 2.90 percent per annum. Raigad, Sangali, Kolhapur, Amravati district recorded negative growth in total fertilizer consumption, however, Jalgaon, Sangali and Kolhapur recorded negative growth in per hectare fertilizer consumption. The use of fertilisers is found to be very low in divisions like Konkan, Latur and Amravati as compared to the state's average. Poor irrigation facility coupled with the cultivation of low value crops are the main reasons for the low use of yield increasing inputs like fertilisers. Besides low use of fertilisers, improper application of fertilisers (N P K ratio) also affects the productivity of crops and thereby the growth of agriculture. While making efforts to improve the use of yield increasing inputs through increased irrigation facility and moisture availability, proper use (mix) of fertilisers should be promoted through quality extension network.

6.7 Determinants of Stagnation in Productivity of Major Crops:

TFP indices growth rate was positive during overall period in case of jowar, moong, urad, sunflower, safflower and sugarcane, whereas growth rate was negative in case of bajara, groundnut and cotton. The negative TFP growth in these crops discouraged crop diversification towards these crops. The significant deceleration in total factor productivity growth during the later period in respect of major crops has serious implications for the agricultural development of Maharashtra. The productivity growth or technological change was responsible for significant growth in total output growth for jowar and urad during overall period. It implies that past higher growth rate of output and TFP observed in these crops may not be sustained without substantial technological improvements in future. If this stagnant and negative growth in TFP continues, already food deficit state will see further increase in shortage of foodcrops, especially pulses and oilseeds if not jowar. There is an urgent need to increase TFP growth in all the major crops especially pulses, oilseeds and cotton to make their cultivation profitable and to increase crop diversification and optimal use of land and other resources.

The determinants analysis of total factor productivity growth of agriculture in Maharashtra shows that number of regulated markets and annual rainfall are the most important sources of growth in Total Factor Productivity of agriculture in the

state. Total rainfall during the year is crucial importance for growth of productivity. This may be because of the fact that as of today more than 82 percent gross cropped area is rainfed and productivity of the crops heavily depends on rainfall pattern. The estimated effect of research, literacy and rainfall during June and August in TFP was found negative. The negative effect of June-Aug rainfall may be due to variations in rainfall and widening gap in rain during this period. The estimated effect of literacy on TFP was found negative, which may be due to the fact that because of non profitable agriculture business, rural educated youth are moving away to non-agriculture and therefore, literacy has not contributed to TFP growth. While negative contribution of research in total factor productivity growth of major crops in the state is major concern, as it has positive and significant contribution at national level. It may be due to very minimal capital expenditure on agricultural research and education in the state. Therefore there is a need to target public investment in research.

6.8 Policy Implications:

- Since low irrigation facility and variation in rainfall are considered to be important factors responsible for low and varied productivity level, major initiatives need to be taken to increase irrigation facility wherever possible. In those areas where irrigation potential is low, watershed development programmes should be promoted.
- Irrigation facility needs to be increased by exploiting unutilized potential. Public investment on irrigation should be increased to complete all the on-going projects. Also no new projects should be sanctioned till the completion of all the on-going projects. Projected crop pattern in each command area should be strictly followed.
- It is noted that there is a sharp reduction in plan expenditure in agriculture and allied activities since the third plan period. Therefore, plan expenditure on agriculture and allied activities needs to be increased substantially keeping in view the share of population relying on agriculture. Also the private investment in research and development activities concerning agriculture should be encouraged and promoted.
- Instability in crop production is one of the characteristics of Maharashtra agriculture. Also there are considerable divisional/inter-district disparities in the

growth rates and level for different crops. Therefore, there is urgent need to ensure adequate and timely supply of quality inputs. Thus, state government must strengthen the systems for timely supply of these inputs and check quality of inputs since there are evidences that sales of spurious seed, fertiliser, and farm chemicals is on the rise.

- Introduction of drought resistance cum high yielding varieties, promoting balanced use of fertilisers (appropriate ratio of NPK) and well designed location specific policies/programmes can help to increase the productivity of crops appreciably.
- Large proportion of area of different crops already is being covered by HYV. Need of the hour, therefore, is to stabilize the yield of the crops. Research efforts of the State Agricultural Universities should therefore be directed to stabilize the yield of various crops.
- The crop pattern change and dry farming technology development played a significant role in promoting productivity and output growth in Maharashtra. Research efforts, therefore, need to be intensified further to develop high yielding varieties of the crops suitable to agro-climatic conditions of the region. Also drought tolerant and pest resistant varieties should be developed. Low-water-intensive cum high value commercial crops should be promoted.
- Resource poor farmers in the rainfed ecosystems practice less intensive agriculture and therefore to help them, efforts must be increased to disseminate the available dryland technologies and to generate new ones. It will be also necessary to remove pro-irrigation biases in the public investment and expenditure, as well as credit flow for technology based agricultural growth.
- Productivity of most of the crops in the state is low as compared to all India average. Also there are wide variations in productivity of crops across districts. Therefore inter-district variation in productivity of crops should be reduced. On-going irrigation projects should be completed within a specific period and watershed development programme and rainwater harvesting system should be promoted in a big way to increase productivity. Since yield gaps vary considerably from crop to crop, district to district and division to divisions, the strategy should be to develop specific plans for each crop and for each agro-

climatic region. SAUs also need to be made more accountable, and strengthened to develop, refine, and promote location-specific technologies.

- Over exploitation of groundwater should be restricted through legal, technological and institutional options. Cultivation of crops using surface method of irrigation should not be allowed and micro-irrigation (drip and sprinkler) should be made compulsory in all those areas. Digging new wells should not be allowed in the areas that are classified as “dark” block. Same time volumetric pricing of water should be introduced and appropriate output price for different crops should be announced keeping in view the water availability.
- Due to several hours of load (electric supply) shedding in rural areas, the use of ground irrigation is affected. Hence, electricity supply to agriculture should be regulated.
- There is low and wide variation in the use of fertilisers and therefore ideal ratio of NPK (4:2:1) fertilisers must be achieved to sustain the soil fertility. Fertilisers should be made available in time. Importance of P and K nutrients should be disseminated to farmers through quality extension network. Proper pricing of N, P and K nutrients should be introduced with a view to reduce the imbalance in NPK ratio.
- There is predominant cultivation of low value crops in the state. Therefore, cultivation of high value crops should be promoted using available resources (water and other inputs) and area under rainfed cultivation should be brought down. Horticulture crops should be promoted in those regions where coarse cereals are cultivated predominantly. Also mono-cropping (sugarcane) should be discouraged to sustain soil fertility and avoid other associated problems. Adequate post-harvesting infrastructure facilities should be created to sustain the growth of horticulture sector.
- Through rain water harvesting system and watershed development programmes considerable area can be brought under cultivation. Also proper distribution of water among different crops would help to reduce area under rainfed cultivation. Crop rotation should be advocated through quality extension network.
- More area should be brought under the cultivation of horticulture crops in Western Maharashtra to reduce water stress. Adequate post-harvesting

infrastructure facilities should be created to sustain the growth of horticulture sector.

- Institutional credit facility should be made available to farmers at right time. Flexibility should be brought in granting loan to agriculture sector and instead of prevailing cropping pattern, average cropping pattern could be used and limit should be set accordingly.
- Crop Insurance based upon weather should be expanded to cover all districts under distress. All commercial banks, RRBs, and the cooperative banks should make crop insurance mandatory for all agricultural loanees.
- Short duration cum high yielding varieties of pulse crops should be made available to improve the cultivation of these crops. Government should give top priority to bring technological improvement particularly on varietal development by allocating more resources for research activities on pulses.
- Considering that the frontiers of expansion of cultivated area are almost closed in the state, the future increase in crop production must come from increase in yield. Therefore, there is a need to strengthen adaptive research and technology assessment, refinement and transfer capabilities so that existing wide gap in technology transfer can be bridged. An appropriate network of extension services will have to be created to stimulate and encourage both top-down and bottom-up flows of information among farmers, extension workers, and research scientists to promote the generation, adoption, and evaluation of location specific farm technologies.
- The agro-economic and soil research in the state needs to be intensified to address the location-specific problems as factor productivity growth is decelerating.
- Watershed development for increasing productivity of rainfed crops can be an option along with seed revolution for pulses, oilseeds and fruits and vegetables. Therefore high priority should be given to Watershed development programme in rainfed areas.
- There is a huge disparity among the regions in case of level of agriculture mechanization as well. Therefore, steps needs to be taken to remove the physical backlog in this area.

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 Directorate of Economics and Statistics, Government of Maharashtra, Mumbai
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 Maharashtra Electricity Regulatory Commission, World Trade Centre, Colaba, Mumbai
 Maharashtra State Agricultural Marketing Board (MSAMB), Market Yard, Pune
 Maharashtra State Electricity Distribution Company Limited, Prakashgad, Mumbai
 National Bank for Agriculture and Rural Development (NABARD), Regional Office, Pune

Annexure I

Schemes/ Programmes implemented during different Plan Periods in Maharashtra State

Plan Period	Schemes/Programmes
Third Five Year Plan	<p>A. Agricultural Production Schemes</p> <ul style="list-style-type: none"> • Expansion of Research on Rice • Intensification and Co-ordination of Research on Wheat • Expansion of Research on Millets and Pulses • Expansion of Research on Cotton • Expansion of Research on Sugarcane • Expansion of Research on Oilseeds • Research on Horticultural Crops • Expansion of Research on Soils • Expansion of Research on Agricultural Entomology • Expansion of Research on Plant Pathology • Expansion of Research on Agricultural Economics • Establishment of Research Sub-sections at the Extension Wings in the Colleges of Agriculture at Poona and Nagpur • Strengthening and upgrading of the Agricultural Statistical Section • Model Agronomic Experiments on rice, irrigated wheat and cotton. • Schemes for experiments in sprinkler irrigation at the Agricultural College, Poona • Establishment of a Research cum testing centre for Bullock driven and manually operated agricultural implements • Research on Vegetables, Turmeric and Betelvine • Trial cum Demonstration Farms • Simple manurial trials in cultivators' field • Expansion of Agricultural Colleges • Training of departmental Officers • Extension Training of Gramsevaks and Gramsevikas • Propagation of Improved Agricultural Implements • Co-ordination Cotton Extension Scheme • Development of Sugarcane • Integrated Oilseeds Development Scheme • Development of Tobacco Cultivation • Horticultural Development in the Konkan Region of Maharashtra • Pilot Scheme for Land Development-cum-Cashewnut plantation for Ratnagiri District. • General Horticultural Development in Maharashtra State (except Konkan) • Development of Local Manurial Resources • Scheme for expansion of Plant protection services in Maharashtra State • Scheme for Intensive Cultivation of Foodcrops in selected areas • Propagation of Improved Agronomic Practices • Establishment of Taluka Seed Multiplication Farms • Strengthening of the Administrative Staff of the Department of Agriculture • Intensive Agricultural District Programme <p>B. Land Development Schemes</p> <ul style="list-style-type: none"> • Consolidation of Holdings • Land development with the help of bulldozer • Tractor Ploughing • Maintenance of Divisional Workshops <p>C. Soil Conservation Schemes</p> <ul style="list-style-type: none"> • Scheme for Contour bunding, Nala bunding and Contour trenching • Pilot Scheme for contour bunding with loan assistance from LDB • Scheme for Terracing of Lands • Scheme for conservation of heavy soils into double cropped area. • Expansion of Dry farming methods • Training in Soil Conservation • Reclamation of Khar and Khajan Lands

D. Minor Irrigation Schemes

- Construction of Irrigation Wells
- Installation of Pumping sets
- Financial assistance to Land Development Banks towards interest subsidy
- Improvement of irrigation wells by boring
- Air Compressor drilling and blasting operations
- Co-operative Lift Irrigation
- Minor Irrigation Works

E. Warehousing and Marketing

- Development of Agricultural Marketing
- Marketing Survey and Research
- Co-ordinated market News Service
- State Warehousing Corporation
- Development of grading

F. Irrigation Projects - (80 Projects)

- Spillover works - 49 Projects
- New Schemes- 27 Projects
- Common Schemes - 4 Projects

Fourth Five Year Plan

All schemes related to production of foodgrains, oilseed, cotton and sugarcane were allowed to continue. In this plan,

- Major and minor irrigation works
- Community well
- Construction of new wells
- Renovation of new wells
- Pumpsets on wells and rivers
- Cooperative lift irrigation
- Soil Conservation and Terracing
- Khar and Khajan lands
- Chemical Fertiliser and Local manurial resources
- Dry farming development programme
- Intensive Agricultural Development Programme
- Plant Protection Programme
- Intensive Cultivation of Foodcrops
- Oilseed Development Programme
- Cotton Development Programme
- Sugarcane Development Programme
- Land development Scheme for Small Holders
- Horticultural Development Programme
- Settlement of Landless labours
- Agricultural Research and Education
- Reclamation of permanent fallow
- Reclamation of ravine lands
- Reclamation of saline and alkaline lands

Fifth Five Year Plan

- Agricultural Education and Research
- Land reforms
- Multiplication and Distribution of seeds
- Development of Taluka Seed Development Farms
- Manures and Fertilisers
- Plant Protection Programme
- Intensive Cultivation Blocks
- Soil Testing Services
- Soil Conservation and Ayacut Development
- Resettlement of Landless Agricultural Workers on Forest Lands
- Development of Horticulture
- Cotton Development Programme
- Sugarcane Development Programme
- Oilseeds Development Programme
- Extension and Farmers training
- Agricultural Engineering Programme
- Soil and Water Conservation
- Special Area Programme for Rural Development
- Community Development Programme

Sixth Five Year Plan	<ul style="list-style-type: none"> • Special Programme for increasing production of pulses • Special Programme for increasing production of oilseeds • Horticultural Development Programme • Cotton development Programme • Sugarcane Development Programme • Agricultural Research and Education • Agricultural Information and publicity • Soil and Water Conservation, Soil Survey and Testing • Creation of Multi-disciplinary Cell in the Directorate of Agriculture for Planning and implementation of Integrated programme for watershed development • Pasture Seed Programme • Land Development through Soil Conservation • Afforestation for Soil Conservation • Development of Khar and Khajan Lands • Development of Land under Ayacut Development • Dry land Development Projects • Land reforms • Regulation of Markets Agricultural Produce Market Committees
Seventh Five Year Plan	<ul style="list-style-type: none"> • Back up of Agriculture inputs and Services (Seed and Fertiliser) • Plant Protection Campaigns • Oilseeds and Pulses development Programme • Sugarcane Development Programme • Improved farm implements and appliances • Sprinkler and Drip Irrigation Development Programme • Crop Insurance Programme • Scheme to improve the economic condition of weaker sections • Scheme to assist tribal families to bring them above the poverty line including assistance for sugarcane plantation • Special Component Plan • Agricultural Research and Education • Soil and Water Conservation • Ayacut Development • Afforestation for Soil Conservation • Reclamation of Khar and Khajan Lands • Horticultural Development • Land reforms • Ware Housing and Marketing • Development of Agricultural Marketing
Ninth Five Year Plan	<ul style="list-style-type: none"> • Multiplication and Distribution of Seeds Expansion of Seed Testing Laboratories • Development of Agricultural Farms/Taluka Seed Farms • Intensive Cotton Development Programme • Cotton Development Programme in Vidarbha • National Oilseed Production Programme (CSP) • Special Programme for Oilseed Production • Special Programme for Oilseed Production in Marathawada region • Special Production Programme of Soyabean in Vidarbha • Scheme on sustainable development of Sugarcane based cropping system (SDBACS) • Special Production Programme of Sugarcane in Vidarbha • Plant Protection Insecticides testing laboratories • Agriculture Engineering Sprinkler and Drip Irrigation for Sugarcane • Comprehensive Crop Insurance Scheme • Small and Marginal Farmers Assistance to Tribal Farm Families • National Pulses Production/Development Programme • Special Programme of Pulses Production for Mararthawada • Special Foodgrains Production Programme (Rice) • Integrated Programme for Cereals Development (CSP) • Soil Survey Organisation • Technology Mission for Integrated Nutrient Management • Setting up of Agri-Polyclinic • Promotion of Agricultural Mechanization- Distribution of small tractors

	<ul style="list-style-type: none"> • World Agricultural Census • Women in Agriculture • Tribal Area Sub Plan • Special Component Plan • Soil and Water Conservation • Watershed Development Programmes • National Watershed Development Programme for Rainfed Areas • Khar Land Development • Afforestation for soil Conservation • Horticultural Development • Agriculture Education and Research
Tenth Five Year Plan	<ul style="list-style-type: none"> • Multiplication and Distribution of Seeds • Intensive Cotton Development Programme • National Oilseed Production Programme (CSP) • Special Programme for Oilseed Production • Scheme on sustainable development of Sugarcane based cropping system (CSP) • Special Production Programme of Sugarcane in Vidarbha (CSP) • Special Foodgrains Production Programme (Rice) • Integrated Programme for Cereals Development (CSP) • Accelerated Development of Maize (CSP) • Development of Cereals and Sugarcane • Sprinkler and Drip irrigation for Horticulture and other Crops (CSP) • Strengthening of Agriculture training institute (100% CSP) • Mobility for the Effective Implementation of the Extension Machinery (100% CSP) • Study Tours of Farmers (CSP) • Agricultural extension through agri. Exhibition • Strengthening of Soil Survey and Soil testing Laboratories • Strengthening of Agri-Polyclinic (CSP) • Use of information Technology in Agriculture (CSP) • Seed Production Programmes in selected Village (CSP) • Hybrid Paddy and Basmati Development Programmes • Strengthening of Taluka Seed Farms • Strengthening of Fertilisers and Insecticides Testing Laboratories • Production and Marketing of Bio-Pesticides • Production of Vermi-Culture • Opening of Agricultural Input Distribution Centres in Inaccessible Hilly and Tribal areas • Crop Insurance Scheme (NAIS) • Timely Reporting of Agricultural Intelligence Statistics and Improvement of Crop Statistics • Assistance to Tribal Farm Families • Assistance to Scheduled Caste/Nav Budhists Farm families • Soil Survey Organisation • Setting up of Agro-Polyclinics and Agri-clinics • Promotion for Agricultural Mechanization-Distribution of Small Tractors (CSP) • Horticultural Development Schemes • Soil and Water Conservation • Watershed Development Programmes • Khar Land development • Afforestation for soil conservation

Source: GOM (various five year plan documents) as mentioned in Narayanamoorthy and Kalamkar (2005).

Agro-Climatic Zones of Maharashtra

Sr. No.	Name of the Zone	Geographical location	Geographical spread of the zone/ Districts and tahsils included	Climatic conditions	Average annual rainfall	Soil type	Crop and cropping pattern
SOUTH KOKAN COASTAL ZONE							
I	Very high rainfall zone with laterite soils	15.30 to 18.50 N Latitude 72 45 to 74 50 E Longitude	Comprises mainly of Ratnagiri and Sindhudurg Districts Total area of the zone is 13.20 lakh ha.	Daily temperature above 20 C. throughout the year. May hottest above 33 C. Rainfall due to S-W monsoon from June to Sept.	3105 mm in 101 days	Laterite. PH 5.5-6.5 acidic, poor in phosphorous rich in nitrogen and Potassium	Rice is the major crop. Ragi is the second important crop. Vari is a minor hill millet grown on the slopes, pulses like horsegram grown on residual moisture. Oilseeds-Niger/ Sesamum, area under Summer Groundnut, Jowar and Tur is likely to increase with irrigation. Horticultural crops-Mango, Coconut, Arecanut, Cashewnut Jackfruit, Banana and Pineapple Spices like clove Nutmeg and Blackpepper.
NORTH KOKAN COASTAL ZONE							
II	Very high rainfall zone with non lateritic soils	17 52 to 20 20 latitude 70 70 to 73 48 E longitude	Comprises of Thane & Raigad districts. Total area 16.59 lakh ha	Avg. daily temp. 22 to 30 C. Minimum temp. 17 to 27 C. Humidity 98 per cent in rainy season & in winter-60 per cent.	2607 mm in 87 days. Max. rain received in July	Coarse & shallow. PH 5.5 to 6.5, acidic, rich in nitrogen, poor in phosphorus and potash.	Rice is major crop, Vari, Pulses-udid/ tur, Vegetables-brinjal, tomato, Oilseeds-sesamum, niger, Fruits-banana, sapota
WESTERN GHAT ZONE							
III	Western Ghat Zone /Ghat zone	Narrow strip extending from north to south along the crest of Sahyadri ranges	Hilly high lying terrains of Kolahapur, Satara, Pune, Ahmednagar & Nasik districts & small area of Sindhudurg district. Altitude varies from 1000- 1900mt	Maximum temp. ranges from 29-39 C. Minimum temp ranges from 13-20 C.	3000 to 6000 mm.	'Warkas' i.e. light laterite & reddish brown. Distinctly acidic, poor fertility low phosphorous & potash content.	25% area is under forest. Principal crops-rice/ragi/ kodra & other cereals. Rabi jowar, gram, groundnut, niger. Sugarcane. Well suited conditions for rainfed crops. Fruits-mango, cashew, jackfruit, jamun & karwanda/Karonda.

Sr. No.	Name of the Zone	Geographical location	Geographical spread of the zone/ Districts and tahsils included	Climatic conditions	Average annual rainfall	Soil type	Crop and cropping pattern
TRANSITION ZONE -1							
IV	Sub Montane Zone/ Transition Zone 1	Located on eastern slopes of Sahyadri ranges	Spreads over 19 tahsils of five districts viz, Nasik, Pune, Satara, Sangli & Kolhapur. The area of the zone measures 10,289 Sq km	Average maximum temperature is between 28-35 C and minimum 14-19 C	700-2500 mm. Rains received mostly from S-W monsoon.	Soils are reddish brown to black tending to lateritic. PH 6-7. Well supplied in nitrogen but low in phosphorous & potash	Mainly dominated by kharif cereals, groundnut & sugarcane. Rabi crops are taken where there are deep soils & moisture holding capacity. Vegetables- potato, onion, chillies, tomato & brinjal. Fruits- mango, banana, guava cashew & grapes.
TRANSITION ZONE-2							
V	Western Maharashtra Plain Zone /Transition-2	It is a wider strip running parallel to eastern side of Sub Montane Zone.	This zone includes tahsils of Dhule, Ahmednagar, Sangli & central tahsils of Nasik, Pune, Satara & Kolhapur districts. Geographical area 17.91 lakh ha.	Maximum temperature 40 C & minimum 5 C. Water availability ranges from 120-150 days.	Well distributed rainfall 700 to 1200 mm.	Topography is plain. Soils greyish black. Moderately alkaline 7.4- 8.4, lowest layer is 'Murum' strata. Fair in NPK content. Well drained & good for irrigation.	The zone is predominantly a kharif tract suitable for single rainfed crop. Principal crops grown -kharif & rabi jowar, bajra, groundnut, wheat, sugarcane, urid, tur gram & ragi.
SCARCITY ZONE							
VI	Western Maharashtra Scarcity Zone/ Scarcity Zone	-	This zone covers geographical area of 73.23 lakh ha.	Suffers from very low rainfall with uncertainty & ill-distribution. Occurrence of drought is noted once in three years. Dry spell varies from 2-10 weeks. Water availability 60-140 days, which is affected due to 1) delayed onset of monsoon 2) early cessation of monsoon. Maximum temperature 41 C minimum -14-15 C	Less than 750mm in 45 days.	General topography is having slope between 1-2%. Infiltration rate is 6-7 mm/hr. The soils are vertisol. Soils have Montmorillonite clay. Poor in nitrogen, low to medium in phosphate & well supplied in potash	Based on bimodal distribution of rainfall hence two cropping systems are noticed. During kharif shallow & poor moisture retentive soils are cultivated. Medium deep, moisture holding capacity soils are diverted to rabi cropping. Crops-bajra, jowar, groundnut, safflower, pulses etc. Productivity is rather low in both the seasons.

Sr. No.	Name of the Zone	Geographical location	Geographical spread of the zone/ Districts and tahsils included	Climatic conditions	Average annual rainfall	Soil type	Crop and cropping pattern
ASSURED RAINFALL ZONE							
VII	Central Maharashtra Plateau Zone /Assured Rainfall Zone	-	Parts of Aurangabad, Jalna, Osmanabad and Beed districts. Major parts of Parbhani & Nanded & Complete Latur, Buldhana & parts of Akola, Amravati, Yavatmal, Jalgaon, Dhule & Solapur. Forest accounts to 9.90 % of geographical area.	Maximum temperature 41 C Minimum temperature 21 C	700 to 900 mm 75 % rains received in all districts of the zone.	Soil colour ranges from black to red. Type- 1) vertisols 2) entisols & 3) inceptisols PH 7-7.5	Jowar is a predominant crop, cotton-, oilseeds, pulses. Kharif jowar /bajra followed by gram, safflower. Pulses- tur, mung, urid, gram & lentils. Oilseeds- groundnut, sesamum safflower & niger. Sugarcane & summer crops are taken on availability of irrigation.
MODERATE RAINFALL ZONE							
VIII	Central Vidarbha Zone /Zone of Moderate Rainfall	There are five sub- zones of central vidarbha zone based on climate soil & cropping pattern	Entire Wardha, major parts of Nagpur Yavatmal, 2 tahsils of Chandrapur & parts of Aurangabad, Jalna Parbhani & Nanded districts. Largest agro climatic zone (49.88 lakh ha.)	Maximum temperature 33-38 C Minimum temperature 16-26 C. Average daily humidity 72 % in rainy season, 53 % in winter & 35% in summer.	1130 mm.	Black soils derived from basalt rock. Medium to heavy in texture alkaline in reaction. Low lying areas are rich and fertile.	Cropping patterns Involves Cotton, Kharif Jowar, Tur, Wheat other Pulses & Oilseeds
EASTERN VIDARBHA ZONE							
IX	Eastern Vidarbha Zone/ High Rainfall Zone (There are four subzone based on climate, soils and crop pattern)	-	Includes entire Bhandara & Gadchiroli and parts of Chandrapur and Nagpur districts. Geographical area is 32.7 lakh/Ha. And with almost 50% under forest.	Mean Maximum temperature varies from 32 to 37 C. Minimum temperature 15 to 24 C. Daily humidity 73% for rainy season 62 winter & 35 summer	Western- 950 to 1250 mm, 1700 mm on extreme east side Rainy days 59.	Soils derive from parent rock granite, gneisses, and schists. Brown to Red in colour. PH 6 to 7 (Soils derived from parent material of different crops)	Paddy, Rabi Pulses- Gram, Lathyrus. Paddy is followed by Rabi Jowar, Pulses and Oilseed

Source: Commissionerate of Agriculture, Government of Maharashtra (<http://mahaagri.nic.in>).

Annexure III

Comments on the report received from Agricultural Development and Rural Transformation (ADRT) Centre, Institute for Social and Economic Change (ISEC), Bangalore.

1. Title of the draft report examined : Determinants of Stagnation in Productivity of Important Crops in Maharashtra
2. Date of receipt of the Draft report : December 28, 2009
3. Date of dispatch of the comments : March 23, 2010
4. Comments on the Objectives of the study : The study addresses all the objectives
5. Comments on the methodology : Standard methodology was followed as suggested by the coordinating unit
6. Comments on analysis, organization, presentation etc. : Overall, the report reads well. The report is organized and presented well under different sections. The study results are meaningful and will be useful for policy interventions. However, the following comments shall be considered for incorporation in the report.
 1. It seems that compound annual growth rates (CAGRs) have been computed for input, output and TFP index (Table 5.1, p.167). For better results and to even out inter-year differential in growth rates, it is suggested to compute average annual growth rates.
 2. Table 5.2, P. 173 presents regression results on determinants of TFP by major crops. As most of independent variables are sector specific, it is suggested to construct weighted TFP index for the State as whole and then analyse the factors affecting TFP. Area share can be used as weights.
7. Overall view on acceptability of report : The report can be accepted after incorporating the above comments.

Annexure IV

Action taken by author based on the comments received from the Coordinator of the study

All the comments made by the Coordinator of the study have been addressed at the appropriate places in the report.

S. S. Kalamkar
March 25, 2010